World Sleep 2019

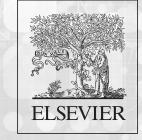SEPTEMBER 20-25, 2019 • VANCOUVER, CANADA

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OFFICIAL ABSTRACTS

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WORLD SLEEP 2019 POSTER ABSTRACTS

All accepted abstracts will be published in a *Sleep Medicine* journal supplement. Posters were accepted to World Sleep 2019 from various stages of research to provide an excellent opportunity for authors to discuss their methods and findings with other professionals.

POSTER ABSTRACT CATEGORIES

AG ....AGING AND DEVELOPMENTAL ISSUES
BCD ....BEHAVIOR, COGNILON AND DREAMING
BR ....BASIC RESEARCH
CD ....CHRONOBIOLOGY/CIRCADIAN DISORDERS
D .... DENTAL
EDS ....EXCESSIVE DAYLME SLEEPINESS (NOT NARCOLEPSY)
H ....HYPERSOMNIA
HE ....SLEEP HEALTH
I ....INSOMNIA
M .... MEMORY
MD ....MOVEMENT DISORDERS
NA .... NARCOLEPSY
NEU ....NEUROLOGICAL SLEEP DISORDERS AFFECLNG SLEEP
NP .... NEURAL PLASLCITY
O ....OTHER
P .... PEDIATRIC
PA .... PARASOMNIA
PH ....PHARMACOLOGY
PSY ....PSYCHIATRIC DISORDERS AFFECLNG SLEEP/WAKE
REM ....REM BEHAVIOR DISORDERS
RLS ....RESTLESS LEGS SYNDROME (RLS)
SBD ....SLEEP BREATHING DISORDERS
TEC ....TECHNOLOGY/TECHNICAL
W .... WOMEN

USING THE POSTER ABSTRACT LISTING

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CIRCADIAN BIOMARKERS IN ASYMPTOMATIC OFFSPRING OF PATIENTS WITH LATE-ONSET ALZHEIMER'S DISEASE AND THEIR RELATIONSHIP WITH COGNITIVE PERFORMANCE

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Introduction: Early neuropathological changes characteristic of late-onset Alzheimer's disease (LOAD) impact structures that regulate circadian rhythms and particularly sleep. Indeed, sleep pattern is emerging as a potential biomarker, mechanistic pathway and treatment target in LOAD. We hypothesized that circadian rhythm anomalies would already be present in asymptomatic, middle-aged offspring of patients with LOAD (O-LOAD) prior to cognitive decline.

Materials and methods: We tested 35 subjects with at least one parent with LOAD (O-LOAD) and 31 healthy individuals without family history of Alzheimer's disease (control subjects, CS) with a series of cognitive tests, as well as actigraphy measures of sleep-wake rhythm, cardiac autonomic function via heart rate variability (HRV), and bodily temperature.

Results: O-LOAD displayed subtle yet significant deficits in verbal episodic memory (RAVLT learning 48.32 ± 1.59 vs. 44.12 ± 1.21, p = 0.005; delayed recall 10.55 ± 0.38 vs. 8.68 ± 0.52, p = 0.005) and language (Vocabulary 50.5 ± 1.06 vs. 45.06 ± 1.48, p= 0.004) compared to CS. O-LOAD showed a more extended sleep duration (439.26 min ± 9.41 vs. 473.66 min ± 10.57, p = .018) and reduced sleep efficiency ($97.07\% \pm .41$ vs. $95.75\% \pm .48$, p = .042). No significant differences were found for body temperature or HRV variables. Correlations between increased sleep duration and poorer cognition were found in CS but not in O-LOAD. Improved cognitive performance was associated to indicators of greater sympathetic activity.

Conclusions: Our results support the hypothesis that sleep pattern disturbances are already present very early on in relatively young asymptomatic subjects. The unexpected reduced cognitive results found in O-LOAD suggest that cognitive decline could start earlier than anticipated in the form of subtle cognitive changes within the clinically normal range. It is widely accepted that sleep pattern disturbances would result in cognitive alterations. Taken these information together with the correlations between sleep duration and cognition present in CS but absent in O-LOAD suggest some impairment in the mechanisms underlying the sleep-cognitive relationship. Sleep pattern deserves further study as a potential biomarker in LOAD, even in healthy middle-aged individuals.

THE COMPOSITE SCALE OF MORNINGNESS FOR CHRONOTYPE ESTIMATION IN PORTUGUESE OLDER ADULTS - PSYCHOMETRIC PROPERTIES AND CUTOFF SCORES

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Introduction: Chronotype refers to the individual differences that exist in the timing of circadian rhythms (e.g., core body temperature, sleep-wake cycle). The Composite Scale of Morningness (CSM) is one of the most widely used measures to estimate chronotype. Despite the importance of accurate chronotype assessments, the psychometric properties of the CSM are not sufficiently explored in older adults. The aim of this study was to examine reliability and validity data of the Portuguese version of the CSM, and to obtain cut-off points (based on percentiles), with a sample of older adults.
Materials and Methods: The sample comprised 522 participants (55% women) with ages between 65 and 95 years ($M = 71.40$; $SD = 5.69$), and up to 19 years of formal education ($M = 7.10$; $SD = 4.56$). After providing informed consent, all participants completed the CSM. So as to obtain validity data, participants also completed the Basic Scale on Insomnia symptoms and Quality of Sleep (BaSIQS), and questions concerning sleep schedules, and based on the latter the formula of the Mean Sleep point on Free days - sleep corrected (MSFsc) was used to estimate chronotype.
Results: Regarding the scale's reliability, an alpha value of 0.81 was obtained. All items appeared to contribute to the scale's internal consistency, as removing items would reduce Cronbach's Alpha. The corrected item-total correlations assumed appropriate values (0.33 - 0.60). CSM scores showed a normal distribution, ranging from 19 to 54, $M=39.06$ ($SD = 6.18$). Concerning the scale's validity, a non-significant correlation ($r = -0.07$; $p = 0.25$) was observed between CSM scores and BaSIQS scores (discriminant validity). Significant correlations were obtained between CSM scores and sleep schedule variables (convergent validity), ranging between -0.34 and -0.79 (i.e., higher morningness scores were accompanied by earlier sleep-wake schedules), and between CSM scores and MSFsc, $r = -0.532$, $p < 0.001$. Cut-off points based on P10, P25, P75, and P90, were obtained.
Conclusions: The Portuguese version of the CSM seems to be a valid and reliable measure for chronotype assessment in older adults. Internal consistency analyses suggest that the CSM is a consistent and homogeneous scale in this age group. Validity analyses revealed that the CSM significantly correlates with measures of related constructs (sleep schedules and mid sleep point), whilst presenting a non-significant correlation with a measure of a less related construct (sleep quality). CSM mean scores and cut-off scores were higher than those generally reported for young adults in agreement with the advancing circadian system phase with age.

TRENDS IN SLEEP-WAKE PATTERNS OF PRIMARY SCHOOL-AGE CHILDREN: A COMPARISON BETWEEN 1996 AND 2016

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Introduction: In spite of the inconsistent evidence, it is often assumed that sleep duration has declined over recent decades and that sleep schedules have delayed as society modernizes. We aimed to explore sleep-wake patterns differences of primary school-age children between 1996 and 2016.

Materials and Methods: Data from two different studies using the same questionnaire (Children's Sleep-Wake Questionnaire - cf. Ferreira AM et al. Pediatrics. 2000 Nov;106(5):E64) were combined for 666 Portuguese children attending 3rd and 4th grades of basic education.

Results: There were no statistically significant differences between the two time points regarding average sleep duration. However, the number of children sleeping the recommended number of hours decreased since 1996. Wake-times on free-days as children got older became earlier on 2016. Difficulties on settling to sleep alone and returning back to sleep, as well as fearing the dark and needing lights on or parents' presence in order to fall asleep increased in 2016 when compared to 1996.

Conclusions: In the participants considered in the present study, sleep timing and duration did not change on average between the two times points, albeit more children were sleeping less in 2016 when compared to 1996. Sleep onset-related disturbances increased from 1996 to 2016, most likely due to changes in parental practices that prevent children from learning to fall asleep independently.

LINKING SLEEP QUALITY TO BRAIN CONNECTIVITY: A MULTIMODAL MRI APPROACH IN NORMATIVE AGEING

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Introduction: Sleep is a ubiquitous and multidimensional phenomenon, important for the organism homeostasis and overall well-being. Across the lifespan, alterations in sleep habits, routines and architecture occur. Often, within the ageing process, sleep quality gets compromised and an increase in sleep complaints is observed, especially in middle-aged and older individuals. This susceptibility to sleep quality loss and/or to its consequences can benefit from a whole-brain modeling approach since this allows to study the shifts in the system, casting broader light on sleep quality mechanisms and its associated morbidities. Following this line, we sought to determine the association between the standard self-reported measure of sleep quality, the Pittsburgh Sleep Quality Index (PSQI) and brain correlates, in a normative aging cohort.

Materials and methods: 86 participants (age range 52-87 years) were recruited and provided information regarding sociodemographic parameters, subjective sleep quality and associated psychological variables. A multimodal magnetic resonance imaging (MRI) approach was used, with whole-brain functional and structural connectomes being derived from resting-state functional connectivity (FC) and probabilistic white matter tractography (structural connectivity, SC).

Results: Poor sleep quality is associated with a decrease in FC and SC of distinct networks, overlapping in right superior temporal pole, left middle temporal and left inferior occipital regions. An interaction effect between age and poor sleep quality was observed regarding FC. Age also displayed important associations with volumetric changes in the cerebellum cortex and white matter, thalamus, hippocampus, right putamen, left supramarginal and left lingual regions.

Conclusions: Overall, not only PSQI global score seems to act as a proxy of changes in FC/SC in middle-aged and older individuals, but also age-related regional volumetric changes appear to be associated to an adjustment of brain connectivity. Considering that the networks found share regions that have been shown to be affected in pathologies, such as depression and Alzheimer's disease, these findings represent a step further in the comprehension of the sleep health and disease continuum and its association with other disturbances.

C-REACTIVE PROTEIN MODERATES THE ASSOCIATION BETWEEN SLEEP AND INCIDENT DEMENTIA: THE FRAMINGHAM HEART STUDY

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Introduction: Sleep disturbances are risk factors for dementia. Because inflammation has been linked to both sleep and dementia, its presence might modify the association between sleep disturbances and incident dementia. Our objective was to evaluate whether C-reactive protein (CRP) levels moderate the association between sleep characteristics and incident dementia.

Materials and methods: We studied participants of the Framingham Heart Study Offspring cohort who completed in-home overnight polysomnography (baseline). Sleep exposures were continuous and included sleep quantity (duration, efficiency), wakefulness during the sleep period (sleep latency, wake after sleep onset, number of awakenings per hour of sleep, arousal index), and obstructive sleep apnea (apnea-hypopnea index). CRP levels were measured at baseline and participants were divided into 3 groups (low CRP < 1 mg/L; normal CRP 1-3 mg/L; high CRP >3 mg/L). Surveillance for incident all-cause dementia commenced at baseline and continued up to 22.5 years later. A series of Cox proportional hazards regression models were used to examine the association between sleep characteristics and incident dementia. Then, we tested for an interaction by CRP groups on this association. In the presence of significant interactions, the associations between sleep characteristics and incident dementia were stratified by CRP groups. All analyses included age and sex as covariates, and the significance was set at 5% level.

Results: The final sample included 291 dementia-free participants (mean age 67.5 ± 4.9 years, 51.6% men) followed on average for 13.4 ± 5.4 years, up to 22.5 years. We observed 43 all-cause dementia cases. No direct association between sleep and incident dementia was observed. However, there were interactions between variables representing wakefulness during the sleep period and CRP levels when predicting incident dementia ($p < 0.05$). In the high CRP group, higher risk of incident dementia was associated with longer wake after sleep onset (hazard ratio, 2.89 [95%CI, 1.31, 6.34], p=0.008) and more awakenings (4.55 [1.19, 17.38], p=0.03). Interestingly, in the low CRP group, lower risk of incident dementia was associated with more awakenings (0.07 [0.01, 0.68], p=0.02) and more arousals (trend, 0.14 [0.02,1.05], p=0.06). No interaction was observed with sleep variables representing sleep quantity and sleep apnea.

Conclusion: Our findings suggest that inflammatory levels moderate the association between sleep characteristics representing wakefulness during the sleep period and dementia risk. Longer and more frequent bouts of wakefulness during the sleep period were associated with an increased risk of incident dementia, but only in those with high levels of inflammation at baseline. Surprisingly, in those with low levels of inflammation at baseline, more frequent awakenings and arousals were associated with a lower risk of incident dementia. Inflammation may play a role in the association between poor sleep quality and cognitive decline.

ADOLESCENTS' SLEEP TRAJECTORIES OVER TIME: SCHOOL STRESS AS A POTENTIAL RISK FACTOR FOR THE DEVELOPMENT OF CHRONIC SLEEP PROBLEMS

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Introduction: Sleep is a complex behavior affected by biological, psychosocial and contextual factors typically present during adolescent development (Becker, Langberg, & Byars, 2015), including increasing autonomy from parents, increasing school demands, and socializing more with peers. However, these normative changes do not explain temporary vs chronic sleep disturbances. Who are the adolescents at risk for developing chronic sleep problems? Some risk factors have been identified as crucial, such as poor sleep hygiene and family stressors, others are not as clear, such as technology use (Bartel et al., 2015). The impact of another important stressor for youths other than family, the school context, has received less attention (Meldrum, 2018). The aim of this study was twofold; first, we explored sleep trajectories from early to mid-adolescence to be able to identify a risk group showing persistent sleep problems (including insomnia and short sleep duration); then, we investigated the role of school stressors (i.e., conflicts with teachers, performance, school-leisure conflict, attendance), controlling for well-established risk factors, in the development of chronic sleep problems in a large cohort of adolescents.

Materials and methods: We used three longitudinal waves of questionnaire data collected annually from a sample of Swedish adolescents (n = 1457; M_{age} = 13.2 [range: 12- 15 years], SD = .43; 52.7% boys). We collected the data from all schools in three communities in central Sweden, during school hours. Using established measures, the students reported on their sleep duration (calculated from reported bedtime, wake-time, and sleep onset latency; SSHS [Wolfson & Carskadon, 1998]), insomnia symptoms (ISI; Morin, 1993), sleep hygiene (ASHS; LeBourgeois, Giannotti, Cortesi, Wolfson, & Harsh, 2005), technology use, and perceived stress (including school, home and peer related stress) (ASQ; Byrne, Davenport, & Mazanov, 2007).

First we used latent class analysis (LCA) to identify adolescents' sleep trajectories, then we used regression analyses to predict the risk-group trajectory of chronic insomnia and short sleep duration, controlling for gender.

Results: We found four trajectories for adolescents' insomnia; 1) low-stable (69%), 2) low-increasing (18%), 3) high-decreasing (8%), 4) high-increasing (5%; 'risk-group'). For sleep duration, we found two trajectories; 1) ~8 h slightly decreasing (79%), 2) ~7 h decreasing (21%; 'risk-group').

School stressors including stress of fitting in with peers, stress of schoolwork leaving too little leisure time, a stressful home environment, poor sleep hygiene, and being female were risk factors for chronic insomnia symptoms. Conflicts with teachers, poor sleep hygiene, and being female were risk-factors for chronic insufficient sleep.

Conclusions: Over and above well-known risk-factors for poor sleep, such as poor sleep hygiene, (Bartel et al., 2015), school-related stress was a significant predictor of persistent sleep problems in adolescents. Therefore, helping adolescents to handle school stress might be a promising strategy to improve sleep health in this population.

EFFECTS OF TWO PHYSICAL ACTIVITY PROGRAMS ON SLEEP QUALITY IN MCI INDIVIDUALS: A PILOT STUDY

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Introduction: Aging is associated with physical and cognitive decline as well as both subjective and objective sleep impairments. Approximately 50% of elderly (65 years old and older) report sleep disturbances (Foley et al., 1995). These disturbances are associated with subjective and objective cognitive decline like memory and concentration deficits (Kamel & Gammack, 2006). It seems imperative to improve sleep in this population to reduce risk of worsening cognitive decline and to preserve quality of life. Compared to non-pharmacological approaches, several studies have reported that pharmacological treatments used for sleep difficulties are associated with greater side effects, notably greater risk of falls (Wilson et al., 2011; Woolcott et al., 2009). Moreover, drug therapies are not recommended for long-term use (Schutte-Rodin, Broch, Buysse, Dorsey & Sateia, 2008; National institute of health, 2005)*. Alternative treatment strategies shall thus be investigated.
Aim: The aim of this pilot study is to compare the effect of two physical activity programs on subjective and objective sleep in elderly with mild cognitive impairment (MCI).
Methods: Twelve 60 years old participants with MCI, suffering from insomnia and several self-reported depressive symptoms assessed by the Beck Depression Inventory were randomly assigned to one of two experimental 12-week cardiovascular or muscular training group. Polysomnographic data were recorded over two nights at home before and after the physical training sessions. Participants also completed two weeks of sleep diaries before and after these 12 sessions to assess subjective sleep including sleep latency (SL), total sleep time (TST), sleep efficiency (SE), total time awake in bed, total time awake during the night, total time spent in bed, early morning awakening, number of awakenings during the night and daytime sleepiness. Mixed linear models were performed to assess differences in sleep parameters between groups and highlight group-specific patterns.
Results: Five participants were eligible and provided data for the muscular group (3 female) and seven for the cardiovascular group (4 female). Pre- and post-treatment comparisons revealed a decreased on subjective number of awakenings during the night in both groups (F (1,10) = 10.35, p = 0.0092). Qualitatively, group-specific patterns were found. Means analysis revealed improvements on subjective time awake during the night and objective time spent in bed in both groups and subjective total sleep time in cardiovascular group. Nevertheless, these comparisons were non-significant (p > 0.20).
Conclusion: Participation in an exercise training program has significant effects on sleep quality in elderly. Nevertheless, a small sample size was assessed due to strict inclusion criteria. Moreover, qualitative analysis suggested that participation in an exercise training program has no adverse effect on subjective and objective sleep quality and can also improve sleep parameters. Thus, it is imperative to pursue this type of research with large sample. Physical activity could be a potential non-pharmacological approach to improve sleep quality in elderly. Furthermore, future research should study the link between physical activity, sleep and cognitive decline as it might be possible that cognitive decline stabilizes if sleep quality increases after physical activity.

VALIDATION OF THE PERSIAN VERSION OF THE PITTSBURGH SLEEP QUALITY INDEX IN ELDERLY POPULATION

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Introduction: Sleep is one of the human needs, especially during an old age, whose quality impairment can reduce daily function and quality of life and increase the risk of physical illness. The purpose of this study is to determine the validity and reliability of the Persian version of the Pittsburgh Sleep Quality Index in the elderly population.
Materials and methods: This is a methodological study that was conducted as a confirmatory factor analysis. 598 elderly people were selected by cluster sampling. In addition to analyzing the three-factor structure of PSQI, internal consistency reliability, structural validity, and its concurrent validity were examined. The structural credibility of PSQI with other tools that expected to be related to them, such as Sleep Health, Epworth Sleepiness, Insomnia Severity, Global Sleep Assessment, and Berlin indices. Finally, the concurrent criterion validity of PSQI was evaluated through multivariable regression analysis and all statistical analyzes were performed using SPSS AMOS software (version 16).
Results: The reliability of the test was 0.81 using Cronbach´s alpha. Confirmatory factor analysis indicators showed that the structural equation model fits to the data. The confirmatory factor analysis showed that the ratio of $\chi2 / df$ was 2.66 for the three-factor structure of PSQI, and the fitness indices of model were suitable for this structural model (RMSEA = 0.053, CFI = 0.98, TLI = 0.96, NFI = 0.97, GFI = 0.99). The internal consistency of the PSQI was 0.81. The scales correlation with the total score ranged from 0.48 to 0.71.
Conclusions: The results indicate that Persian version of Pittsburgh Sleep Quality Index has the required validity and reliability in the elderly population of Iran and can be used as a useful tool in related research.
Acknowledgements: We are grateful to the Deputy for Research and Technology, Kermanshah University of Medical Sciences, for cooperating in this research. We thank all the participants in the study.

FEASIBILITY OF SLEEP-CAFFEINE LOG AND INTERVIEW FOR ASSESSING CAFFEINE, TECHNOLOGY AND SLEEP BEHAVIORS IN EARLY ADOLESCENTS

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Introduction: Insufficient adolescent sleep is a major public health concern with approximately 73% consuming caffeine regularly and 95% using a smart phone daily (Branum et al., 2013; Crowley et al., 2018; Pew Research Center, 2018). Research on adults demonstrates an association between caffeine intake and adverse sleep outcomes, including delayed sleep onset (Roerhs & Roth, 2015). However, less is understood regarding caffeine's impact on early adolescents' sleep duration, timing, and regularity (Bonnar & Gradisar, 2015). The effects of light-emitting devices on circadian timing and vulnerability to light (Crowley et al., 2015), makes it critical to understand how evening technology use impacts sleep outcomes. Studies on caffeine intake in adolescents have relied on retrospective questionnaires, often without information on caffeine quantity and timing. The goal of this study was to assess the feasibility of the Sleep-Caffeine Log and interview developed for early adolescents and to begin to better understand of how caffeine intake and technology use are associated with early adolescents' sleep behaviors.
Materials and method: Participants were recruited from independent middle schools. The Sleep-Caffeine Log (adapted from Wolfson et al., 2015) queried about caffeine (time, amount, type), sleep behaviors (school-night (SN) and non-school-night (NSN) timing, duration, regularity), and technology use. To facilitate recall, log included a caffeine product list. Completed twice/day for 7 days, log was paired with a structured interview at the end of the week, where daily participant's caffeine, etc. was reviewed along with the feasibility of the log.
Results: Twenty-four participants (79.2% females, ages 11-14, $M = 13.1$, $SD = .96$) completed the Sleep-Caffeine Log. 95.8% participants provided positive/neutral feedback for the log and interview, reporting that the log was easy to complete. Over 50% of the participants reported insufficient SN (50%) and NSN (58%) sleep (< 9hr). 62.5% reported consuming caffeine during the week (daily $M = 46.3$ mg, $SD = 37.2$; mostly soda, coffee/tea). Participants averaged almost 3 hours of SN technology use ($M = 171.9$ min, $SD = 81.7$) and just about 3 hours on NSNs ($M = 195.6$ min, $SD = 98.8$). After 5pm, participants reported slightly under two hours ($M = 113.7$ min, $SD = 71.1$). Findings demonstrated significant associations between evening caffeine and later NSN BTs, daily caffeine and later NSN WTs and greater bedtime delays (more irregularity). Similarly, SN and NSN technology use was associated with later BTs, less total sleep, and greater BT delays.
Conclusions: The Sleep-Caffeine Log and interview approach was feasible. Caffeine consumption in this small sample of private middle school students was lower than some prior reports; however, it still reflected other nationally representative studies. Going forward, a larger field study will be implemented using actigraphy and the Sleep-Caffeine log and interview.

NAPPING, CIRCADIAN TIMING, AND EVENING SETTLING DIFFICULTIES IN EARLY CHILDHOOD

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Introduction: Parent-reported sleep problems are prevalent across early childhood. Specifically, ~35% of young children have evening settling difficulties (i.e., bedtime resistance, prolonged sleep onset latency), which are associated with attentional and behavioral problems. The sleep-wakefulness schedule of most toddlers includes a daytime nap, which declines as children transition to a consolidated nighttime sleep schedule. In napping toddlers, we have previously shown that later circadian timing predicts increased evening settling difficulties; however, whether this relationship changes when young children no longer nap remains unexplored. This study is a first step in examining the role of napping in the relationship between circadian phase and evening settling.

Materials and methods: We studied 8 healthy, regularly napping 2 year-olds (33.4 ± 2.2 months; 4 females) who completed annual longitudinal assessments between ages 2 and 5 years. Children followed a strict sleep schedule for ≥ 5 days before completing a dim-light melatonin onset (DLMO) assessment. Salivary samples were taken in-home every 30-min for 6-h up to 1-h past regular bedtime. Sleep timing was obtained using daily parent report (sleep diaries, phone calls). Nighttime settling behaviors were assessed with the Children's Sleep Wake Scale (CSWS). We focused on the Going to Bed and Falling Asleep subscales; higher scores indicate better success on each dimension. Paired t-tests were used to examine age-related changes in our parameters of interest, and Pearson correlations were used to assess relationships between napping frequency and evening settling measures.

Results: Our results replicate previous findings, documenting an age-related decline in napping: All children transitioned from a biphasic to a monophasic sleep schedule between ages 2 years (100%) and 5 years (0%). We found no age-related differences in circadian timing (2-years, $19:15\pm00:31$ minutes; 5-years, $19:23\pm00:34$ minutes; $p=0.66$) or parent-reported sleep onset latency (2-years, 19.7 ± 14.2 minutes; 5-years, 18.3 ± 17.9 minutes; $p=0.84$). With regard to the CSWS, children had greater success falling asleep at age 5 compared to age 2 years ($t=3.2$, $p=0.01$); however, their success in going to bed was similar ($t=1.6$, $p=0.15$). Although we found no significant relationships between napping frequency and measures of evening settling, a trend towards greater success going to bed with fewer days napping was observed ($r=0.33$, $p=0.08$).

Conclusions: This study used a small longitudinal sample to investigate the role of napping in evening settling behaviors across early childhood. We found that older, non-napping children had greater success falling asleep than when they were younger and habitually napping. Additionally, we identified a trend that children had greater success going to bed with fewer days napping. A possible explanation for these findings is that napping dissipates sleep pressure mid-day, and thus, results in less propensity to sleep at bedtime; however, individual differences in the rise time constants of the homeostatic process exist. These data provide a platform for future analyses, which will include objective sleep measures (i.e. actigraphy, rise time constants) and the addition of subjects using more sophisticated analytic strategies (i.e. mixed model) who did not complete assessments each year.

SLEEP SPINDLE DECLINE IN AGING AND ITS RELATION TO RESTING-STATE THALAMOCORTICAL CONNECTIVITY - PRELIMINARY FINDINGS

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Introduction: Healthy aging is accompanied by a concurrent decline in sleep spindle activity and changes in brain structure and function, including altered resting-state connectivity. Sleep spindles are generated and propagated through interactions between thalamocortical projections and the thalamic reticular nuclei, or TRN. However, it is unknown whether thalamocortical connectivity is altered in aging and whether these alterations are associated with deficits in sleep spindle expression.
Materials and methods: Ten older (age 61-80 years) and 10 younger (age 20-26 years) volunteers participated in the study. All subjects underwent two overnight polysomnography sessions (adaptation, experimental night), and a resting-state functional MRI scan following the second night. For preliminary analyses, we focused *a priori* on fast spindle density (12-15 Hz) during NREM sleep, and the connectivity of the thalamus with the cortex during wakeful rest in the two groups of younger and older subjects.
Results: Average thalamocortical connectivity was not significantly different in older and younger subjects in our limited sample, yet older subjects had lower average and larger variance in thalamocortical connectivity. No significant difference was observed in average fast sleep spindle density across central and parietal EEG channels although there was a tendency for reduced spindle density in older subjects. Moreover, fast spindle density did not significantly correlate with average thalamocortical connectivity (Pearson's r = 0.1351, p = 0.5930).
Conclusions: We did not find sufficient evidence for significantly altered sleep spindle occurrence nor thalamocortical functional connectivity in older subjects. However, increasing the sample size and studying complex relations with declarative memory outcomes is further warranted. The results point to the importance of studying sleep and functional brain changes as impaired sleep spindle generation processes and changes in thalamocortical connectivity may reflect common pathophysiological mechanisms underlying memory consolidation processes and long-term memory decline in aging.

SUBJECTIVE VS. OBJECTIVE SLEEP MEASURES FOR ASSESSING HABITUAL SLEEP PATTERNS IN THE FIRST YEAR OF LIFE: IMPLICATIONS FOR SLEEP QUALITY ASSESSMENTS

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Introduction: Infants sleep 12-18 hours/day during the first year, a time of numerous developmental milestones. Unsurprisingly, research has highlighted sleep as an important facilitator of healthy neurocognitive development (Scher, 2008). Reported sleep quality is an integral part of sleep science, e.g. subjective sleep quality is related to cognitive performance in older adults (Nebes et al. 2009). Assessing sleep quality in infants is challenging as infants are unable to report on their sleep quality and subjective parent-report alone is not reliable (Sadeh, 1996). Actigraphy can be used as an objective measure. This study examines completion rates and agreement between sleep questionnaires, a sleep diary and actigraphy in assessing habitual sleep patterns and quality, including sleep duration, fragmentation and circadian rhythm. Our main objective is to determine the extent to which subjective sleep measures coincide with each other and with the objective actigraphy measure, and to consider the implications for neurocognitive development.

Materials and methods: This study is part of a larger longitudinal study (up to 4 study visits/participant) exploring the relationship between sleep and early neurocognitive development. For this poster, N=65 (with 140 individual study visits) typically developing infants were studied (age: 4-14 months). The subjective measures were the Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004), the Sleep and Settle Questionnaire (SSQ; Matthey, 2001) and a 7-days sleep diary and the objective measure was actigraphy (w-GT3X-BT, ActiGraph Corp.). 1) Completion rates for each measure and 2) agreement (using correlational analyses and Bland-Altman plots) between measures were investigated. Systematic differences that might explain agreement/completion or lack thereof were examined. In a first proof-of-concept step, the agreement within the subjective measures (SSQ/BISQ) for the above-mentioned sleep variables was investigated.
Study data collection due for completion by February 2019.

Results: To date, results show that parents were more likely to fill out the BISQ (90.48 % fully completed, 8.57% partially completed) vs. SSQ (73.81% fully completed, 20% partially completed). Initial examination of subjective sleep measures yielded surprising results. For example, BISQ and SSQ showed moderate correlations for night time sleep duration ($r = .35$, $p=.001$) and day time sleep duration ($r= .3$, $p=.001$). Visual examination of the data showed no patterns regarding overall sleep duration assessed by SSQ/BISQ. Further analyses including overall completion and comparison with actigraphy and the sleep diary will be presented.

Conclusions: This poster shows that different sleep measures for assessing sleep in the first year of life vary in their agreement and completion rates. Ramifications for sleep quality assessment and cross-study comparisons as well as the relation of sleep quality and neurocognitive development will be discussed.

CHECKING-IN: WHAT FACTORS PREDICT PARENTS VISITING THEIR INFANTS DURING THE NIGHT?

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Introduction: Parents play a key role in the development of infant sleep. Infants of parents who report more active involvement in settling their infant to sleep have been shown to present more sleep-related problems compared to infants of parents who are less involved at night-time. However, associations between infant factors such as age and gender, and these critical parental behaviours, have received only limited research attention. Furthermore, assessment of parents' involvement in their infants' sleep process has predominantly relied on self-reports, which are subject to reporting bias, especially given that these behaviours occur during the night. Using novel computer vision technology, this study objectively assessed the number of nocturnal parental visitations to evaluate whether infant age and gender interact to predict parental night-time involvement in a large sample of infants.

Materials and methods: Participants were 622 families (52% infant boys; M_{age}=38.2 weeks, SD=19.9, range= 10-142 weeks). Parental nocturnal check-ins and infant sleep quality were objectively and naturalistically measured using the Nanit camera system, and automatically analysed using its computer vision algorithm. Metrics were averaged for each infant across 14 consecutive nights.

Results: Younger infants (β=-0.26, p< 0.001) and infants with lower sleep quality (β=-0.37, p< 0.001) were more frequently visited by parents during the sleep period (overall model fit was R^2=0.25). Infant gender did not predict parental check-ins, however the gender-by-age interaction effect was significant (β=0.20, p=0.004). While controlling for infant sleep quality, check-ins were more frequent with boys compared to girls at younger ages, but this pattern was reversed at ~10 months of age, after which the number of parental visits for girls was greater than its equivalent for boys.

Conclusions: Parental night-time check-ins were more frequent for younger infants, as well as for infants with poorer sleep quality, providing objective evidence for the link between parental involvement and deficient infant sleep. Additionally, a different developmental progression emerged for girls compared to boys as a function of age. Whereas parents checked-in with infant boys more often than girls earlier in development, check-ins were more frequent for girls compared to boys later in development. This effect was significant despite evidence for superior sleep quality in girls compared to boys throughout infancy. The sharper decline in parental involvement with boys may reflect specific gender-related cognitions and expectations (i.e., higher expected independence from boys, as opposed to greater tolerance for dependence in girls), that are progressively activated throughout development. These associations should be further examined in longitudinal investigations, to broaden our understanding of parental behaviours that are implicated in increased risk for infant sleep-related problems.

ASSOCIATIONS BETWEEN MIDLIFE POLYSOMNOGRAPHY-MEASURED SLEEP QUALITY AND 12-YEAR CHANGE IN COGNITIVE FUNCTION IN THE WISCONSIN SLEEP COHORT STUDY

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Introduction: Experimental literature is consistent in showing acute effects of poorer sleep quality on worse cognitive function the following day. Much less is known about how sleep quality during midlife may be related to cognitive function trajectories over time. The objective of this study was to investigate associations between baseline sleep quality measured in mid-adulthood and 12-year change in cognitive functioning.

Materials and methods: A subset of Wisconsin Sleep Cohort (n=362, 40% female, mean [range] age at baseline=51[30-71] years) completed in-laboratory protocols at approximate 12-year intervals that included overnight polysomnography (PSG), a cognitive test battery, and questionnaires about sleep and health. Linear regression models were used to estimate associations between baseline measures of sleep quality and 12-year changes (range 10-14 years, mean(SD) 12.2(0.9) years) in cognitive functioning. PSG-measured sleep variables included sleep efficiency and the percentage of sleep time spent in N3 and REM sleep. The cognitive test battery included the Trails B test (seconds, shorter is better), Symbol-Digit Modalities (seconds, shorter is better), Oral Word Fluency (words identified, more is better), Grooved Pegboard (seconds, shorter is better), Digit Cancellation (more digits is better) and the Auditory Verbal Learning Tests (words recalled, more is better). The test battery covered several domains of cognitive functioning, including executive functioning, verbal fluency, attention, task switching, motor skills and speed, memory, learning, psychomotor function, and eye-hand coordination. Models were adjusted for sex, age, apnea-hypopnea index (AHI), CPAP use, BMI, education, alcohol consumption, smoking status, cardiovascular disease, depression, diabetes, and circadian preference. We also tested whether circadian preference modified associations between sleep quality and cognitive change.

Results: Ten-percent less time spent in N3 sleep at baseline was associated with a one-point lower AVLT learning score (p=0.02) 12 years later, and 10% more time spent in REM sleep at baseline was associated with about a 1-point lower AVLT learning score (p=0.1). Greater sleep efficiency at baseline was associated with better scores on both the Trails B and the Oral Word Fluency (10% higher sleep efficiency was associated with a 4.4-point lower (better, p=0.1) score on the Trails test and a 0.9-point lower (better, p=0.04) score on the Oral Word Fluency) at 12-year follow-up. Baseline sleep quality was not associated with changes in the other cognitive tests, and circadian preference did not significantly modify the associations between sleep quality measures and cognitive change.

Conclusions: Better baseline sleep quality is associated with less decline in cognitive functioning after 12 years of follow-up, especially in the domains of memory and learning (AVLT), executive function (Trails B and Oral Word Fluency), and motor skills and attention (Trails B). Better midlife sleep quality may help protect against greater cognitive decline in older adulthood.

Aging and Developmental Issues
Board #017 : Poster session 3
NOVEL WORD LEARNING AND LEXICAL INTEGRATION IN MILD COGNITIVE IMPAIRMENT: ROLE OF SPINDLES AND SLOW WAVE ACTIVITY IN OVERNIGHT CONSOLIDATION.

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Introduction: The quantity and quality of sleep changes with older age. Changes in sleep neural oscillations measured using electroencephalography (EEG) also occur with aging. These changes are pronounced in those 'at-risk' of dementia and with Alzheimer's disease (AD). Disruption to key non-rapid eye movement (NREM) sleep neural oscillations involved in overnight consolidation such as slow wave activity (SWA) and spindles in NREM sleep may underlie accelerated cognitive decline and progression to AD. We examined the associations between NREM sleep EEG measures and performance on a lexical decision task (LDT) in older adults with and without mild cognitive impairment (MCI).

Materials and methods: Fifty-three older adults with amnestic MCI (n=14), non-amnestic MCI (n=20) and healthy controls (n=19) (62% female, M67 years) underwent comprehensive medical, neuropsychological assessment and an in-lab overnight polysomnography. The LDT, a test capturing learning and encoding of real words and non-words, was administered 1-2hrs before sleep and 1hr after waking. Average reaction times (RT) of target (primed) words (target words morning RT/target words evening RT) and control (non-primed) words (control words morning RT score/control words evening RT score) were calculated. Power spectral analysis was performed on EEG recorded at F4-M1 and C4-M1 electrode sites to compute absolute delta power (0.5-4.5 Hz) during NREM sleep, sigma power (12-15 Hz) during N2, slow (11-13 Hz) and fast (13-15 Hz) spindle density in N2 (spindles per min) using a validated automated spindle detection algorithm. Spearman's correlations were used to examine the relationship between sleep EEG and RT on the LDT.

Results: There were no significant group differences in target words and control words between the three groups ($F=.772$, $p=.467$; $F=.166$, $p=.847$). NREM delta power was positively associated with target words RT (C4: $rho=.693$, $p=.009$) and control words RT (C4: $rho=.599$, $p=.031$) in the aMCI group but not in the naMCI or control group. N2 sigma power was positively associated with control words RT in the control group (F4: $rho=.644$, $p=.007$; C4: $rho=.700$, $p=.004$). Fast spindle density was positively associated with control words RT (F4: $rho=.770$, $p=.009$) in aMCI group but not in the naMCI or control group.

Conclusions: These findings suggest that changes in microarchitecture during NREM sleep are associated with overnight consolidation of primed and non-primed words. Delta power, and fast spindle density in N2 are associated with superior lexical integration in aMCI, and sigma power in N2 associated with superior lexical integration in controls. Future studies may look to examine other clinical characteristics in order to delineate which groups of 'at-risk' older adults show the greatest impairment in sleep microarchitecture and in turn novel word learning and lexical integration. Deficits in these oscillations may be potential therapeutic targets for cognitive impairment in aging.

SLEEP AND CIRCADIAN RHYTHM ALTERATIONS IN OLDER PEOPLE WITH DEPRESSION

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Introduction: Depression in older people occurs commonly and is associated with underlying brain change and progression to dementia. While sleep disturbance is commonly documented in those with lifetime depression, it is unclear whether circadian misalignment also exists.

Materials and methods: Thirty-four older people meeting DSM-IV criteria for lifetime major depression (mean age = 63.9 years), and 30 healthy controls (mean age = 65.7 years) underwent a 3-night protocol including dim light melatonin onset (DLMO) assessment and overnight polysomnography (PSG). DLMO and phase angle of entrainment were computed.

Results: Participants with depression had a significantly longer phase angle of entrainment than controls (6.82h±1.45 *vs.* 5.87h±1.60, $p=0.02$, Cohens-d=0.62). There was a small to moderate yet non-significant difference in DLMO times, with those with depression having an earlier DLMO of 34±27 minutes (20:36±1:48 *vs.* 21:10±1:48, $p=0.22$, Cohens-d=0.32). Sleep latency and latency to rapid eye movement sleep were greater in those with depression compared to controls (all $p< 0.05$).

Conclusions: In older people with lifetime major depression and mild residual symptoms, both circadian misalignment and sleep disturbance are evident. These changes warrant evaluation and treatment even when symptoms are remitted particularly since sleep-wake disturbance is associated with cognitive decline, treatment responsiveness, depression recurrence and dementia.

RELATIONSHIP BETWEEN SLEEP AND HEALTH-RELATED FACTOR IN ADOLESCENTS

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Background: Insufficient sleep among adolescents is common and has adverse health and behavior consequences. The purpose of this study is to determine whether physical activity, afterschool behavior, and nutrition are associated with sleep.
Methods: Total of 1864 students, 8 middle schools (7-9th grade) were recruited. All students conducted self-reported questionnaires assessing regarding usual sleep/wake patterns over the previous 2 weeks, daytime function, physical activity, afterschool behavior and dietary factor. Students were divided by gender.
Results: A total of 1634 students (53.3% male, mean age 13.36±1.03) completed the survey. For both gender, the shorter sleep duration on school days (SD), the later bedtime was found to be on both school days and weekends. Shorter sleeper also reported more daytime sleepiness. Among boy, SD was positively associated with frequency and duration of both moderate and vigorous physical activity, but not significant. For both gender, SD was negatively associated with weekly internet use, but not significant. There are no association between SD and dietary factor.
Conclusions: These findings suggest that sleep duration of adolescent is positively related to physical activity, especially in boys. Sufficient sleep is recommended to adolescent for health benefits, yet more research is needed to understand if sufficient sleep should be recommended for improving health-related factor.

Aging and Developmental Issues
Board #018 : Poster session 3

CAN SLEEP QUALITY PREDICT LOW BACK PAIN INTENSITY OVER TIME? A LONGITUDINAL STUDY WITH OLDER ADULTS

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Introduction: Sleep disorders and low back pain are health conditions that impact the quality of life of the older population. However, it is not yet knowing if the poor sleep can be predicting low back pain over time in the older population. This study aimed to investigate whether sleep quality predicts pain intensity in the elderly population with low back pain.
Materials and methods: Participants were interviewed firstly at home and after 6 months, a follow-up data collection was done by phone. Only individuals over 60 years old and who had good cognition were included. Multivariable linear regression analyses were conducted to analyze the associations between low back pain and sleep quality, measured by the Numerical Scale of Pain and the Pittsburg Sleep Quality Index, respectively. The analysis was adjusted for the following covariables: age, gender, BMI, educational level, individual income, mental state, depression, alcohol consumption, smoking habits, comorbidities, diurnal sleepiness and disability.
Results: A total of 2015 older adults with low back pain were followed. The women percentage was 77%, the mean age [standard deviation] was 70.9 [7.4] and the mean BMI was 28.14 [5.02]. The final regression model showed that sleep quality predicts the intensity of low back pain in a 6-month follow-up (β = 0.14 95% CI 0.02 to 0.26).
Conclusions: The results suggest that older adults with poor sleep quality in the baseline evaluation may have high rates of low back pain in the future. This highlights the need for sleep quality assessment in clinical practice as this may adversely affect the intensity of pain over time.

Aging and Developmental Issues
Board #001 : Poster session 2

DIFFERENCE OF LONGITUDINAL SLEEP BEHAVIOR CHANGE BY GENDER IN THE MIDDLE AGE: THE KOREAN GENOME AND EPIDEMIOLOGY STUDY (KOGES)

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Introduction: Sleep profiles gradually change over a lifetime and have intrinsically different characteristics between men and women. However, not much study addressed the gender difference of longitudinal change of sleep behavior, especially in the representative sample of population on the beginning of aging process.

Materials and methods: We analyzed 2640 subjects (mean 49.77 ± 6.81 years old, 50.6% women) of the Korean Genome and Epidemiology Study (KoGES) participants, who completed both baseline and follow-up sleep surveys (mean interval 12.00 ± 0.16 years). Multivariable regression analysis was performed to examine the associations of age and gender on longitudinal sleep change.

Results: Women reported significantly poor sleep quality from the baseline, and the degree of deterioration was also more severe as measured by Pittsburgh Sleep Quality Index (PSQI) ($p < 0.001$). The sleep quantity trajectories were severe in women significantly - more significantly decreased sleep duration (SD), sleep efficiency (SE) and increased sleep latency (SL) ($p < 0.001$), however, the overall phase advance was more evident in men measured by Mid-Sleep on Free days Corrected for Sleep deficits during weekdays (MSFsc) ($p < 0.001$) in this age group. The most significant age effect on the deterioration of the sleep quality and quantity parameters was observed in men´s 40s (ΔTIB, $p = 0.029$) and women´s 50s (ΔPSQI, $p = 0.005$; ΔSD, $p = 0.008$; ΔSE, $p = 0.017$). However, the sleep phase parameter exhibited the most substantial advancement in both men and women´s 40s. The effect of gender on the baseline value and the deterioration of SL was significant ($p = 0.003$ and $p < 0.001$, respectively), but the effect on age was not apparent. Interestingly, women in menopause exhibited significant longer SL compared to pre-menopause women regardless of age at the baseline; and women who experienced the peri-menopause process tended to have more SL deterioration than women who did not, although they were not statistically significant ($\beta = 1.698$, $p = 0.640$).

Conclusions: In both genders, increasing age was associated with more inferior sleep quantity and quality in addition to the phase advancement but with different degree and timing of trajectories. The sleep amount deterioration is become worse along with aging, which is possibly completed at an even more earlier age in women, but the overall phase advancement is most evident under the age of 50 in both gender.

Aging and Developmental Issues
Board #016 : Poster session 2
SLEEP STATUS DURING PREGNANCY AND THE APPROPRIATE MOMENT OF SCREENING

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Introduction: For many pregnant women, pregnancy-related sleep disturbances arise as pregnancy progresses. Thus, the change of the sleep problems across pregnancy is of interest. However, there have been few longitudinal surveillance of sleep problem during pregnancy in Korea. The aim of this study was to examine the longitudinal sleep status during pregnancy, and to identify the appropriate moment of screening test for sleep disturbance.

Materials and methods: This study is a prospective multicenter study including clinic of obstetrics a university hospital, a general hospital and two regional public health care centers (public institution), and performed from September 2017 to December 2018. Pregnant women filled out a series of questionnaire including the Pittsburgh Sleep Quality Index (PSQI), the Insomnia Severity Index (ISI), the Epworth Sleepiness Scale (ESS), the STOP, and the short-form 36 (SF-36) once a month.

Results: This is a longitudinal study of 83 pregnant women's sleep and mood status. Body mass index, ISI and BAI were gradually increased through the three trimesters. The mean age was 33.11±3.99. Their body mass index and ISI, ESS, PSQI, BDI, BAI gradually increased; and SF-36 gradually decreased through the three trimesters. There was statistically significant difference of ISI between fifth and ninth month (6.62±3.59 vs. 9.45±5.68, $p< 0.001$), of ESS between seventh and ninth month (5.27±3.19 vs. 7.22±3.77, $p< 0.001$), of PSQI between fifth and ninth month (6.81±2.82 vs. 8.88±3.62, $p< 0.001$), and of SF-36 between sixth and ninth month (66.64±17.54 vs. 60.57±17.66, $p=0.009$). There was no patient with high risk of sleep apnea in STOP, and no significant difference of BAI neither BDI during pregnancy.

Conclusions: We need to pay attention to the quality of sleep as well as life during pregnancy. Pregnant women are complaining more sleep problems including insomnia, excessive daytime sleepiness, and poor sleep quality as their pregnancy period continues. Screening of sleep disorder after 5th or 6th month of pregnancy may be considered.

SHORT SLEEP PUPILS IN JAPAN: CURRENT STATUS AND ASSOCIATED FACTORS

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Background: Several recommendations of sleep duration have been published for adolescents to secure their healthy lives. This study aimed to compare the sleep duration of middle and high school pupils in Japan with these recommendations and to know the factors associated with their sleep duration.
Methods: A total of 1766 completed questionnaires were obtained from grades 7 to 12 pupils in Japan. Queries included issues on sleeping, eating, defecation, physical activity, screen time, after-school activity, body mass index, and self-reported academic performance. On self-reported academic performance, pupils were asked to select their overall academic performance from the following four choices; very good, good, not good, poor.
Results: The mean sleep duration of school nights did not reach the lowest level of former recommendations in all grades. By means of multiple linear regression analysis, significantly predictable regression formulae for sleep duration of both school nights (adjusted R^2 = 0.2046, F = 38.84, $p < 0.001$) and non-school nights (adjusted R^2 = 0.093, F = 16.15, $p < 0.001$) were obtained. For both school and non-school nights, grade (standardised partial regression coefficient (β); -0.321 for school days and -0.176 for non-school days), after-school activity (β; -0.100 for school days and -0.142 for non-school days) and school day screen time (β; -0.097 for school days and -0.092 for non-school days) showed significant associations with sleep duration. Self-reported academic performance was not associated with sleep duration of both school and non-school nights. According to the multiple comparison test, the mean school nights' sleep duration of pupils who scored themselves as "poor" was significantly shorter than that of pupils who scored themselves as "good".
Conclusions: The mean school nights' sleep duration did not reach the former lowest recommendation levels in all grades. After-school activity and school day screen time were associated with sleep duration.

THE ASSOCIATION BETWEEN REM SLEEP AND MORTALITY IN THE MROS AND WISCONSIN SLEEP COHORTS

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Introduction: Sleep disorders and sleep dysregulation have been associated with several systemic and brain-based diseases, including cardiovascular disease, type 2 diabetes, dementia, and major depressive disorder. Additionally, sleep disorders and sleep characteristics (e.g. sleep duration) have been linked to higher risk of mortality. Despite the emerging evidence of a sleep-mortality association, associations of sleep architecture with mortality are not well understood. For instance, it's plausible that rapid eye movement (REM) is associated with adverse health outcomes. After all, REM has been linked with multiple aspects of mental and physical health and REM sleep is the first stage to rebound after total sleep deprivation. We hypothesize that reduced REM sleep will be associated with increased mortality risk.

Materials and methods: The Outcomes of Sleep Disorders in Older Men (MrOS) Sleep Study is a population-based, longitudinal study of 2,675 community-dwelling older men who underwent in-home polysomnography at study enrollment. Cox proportional hazards regression models were used to evaluate the association between percent REM and mortality rate. A core set of covariates were selected a priori based on clinical experience to include in the multivariate models. Additional covariates commonly associated with sleep architecture were evaluated using a 6-fold cross validation, forward step-wise feature selection algorithm to obtain the best candidate final regression models. A threshold effect was suspected based on Kaplan-Meier curves, so separate models were run with percent REM as a binary variable with 15% as the cut point. Several sensitivity analyses were performed to rule out alternative explanations for the findings. Data from the Wisconsin Sleep Cohort (WSC) were used to replicate the findings.

Results: The mean age in the MrOS sample was 76.3 years (SD=5.51) and the median follow up time was 12.1 years. There was a 13% higher mortality rate for every 5% reduction in REM sleep (hazard ratio [HR]= =1.13, 95% CI, 1.08-1.19) after adjusting for multiple demographic, sleep and health covariates, including study site, age at sleep visit, race, education, medication use, smoking status, caffeine intake, respiratory disturbance index, and actigraphy measures. The association was also present for cardiovascular disease-related mortality (CVD) (HR=1.18, 95% CI, 1.09-1.28), cancer related mortality (HR=1.14, 95% CI, 1.03-1.26), and non-cardiovascular, non-cancer related mortality (HR=1.19, 95% CI, 1.10-1.28). The WSC included 45.7% women and the mean age of the 1,388 individuals included was 51.5 (SD=8.5); the median follow up time was 20.8 years. The effect size for 5% reduction in REM on risk of all-cause mortality was similar in this cohort despite the younger age, inclusion of women, and longer follow-up period (HR=1.22, 95% CI, 1.07-1.39).

Conclusions: We found a negative association between percentage of REM sleep and all-

cause mortality in two independent cohorts. These robust findings held up across different causes of death and sensitivity analyses.

SLEEP STATUS DURING PREGNANCY: A MULTICENTER STUDY IN KOREA

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Introduction: For many pregnant women, pregnancy-related sleep disturbances arise as pregnancy progresses. Thus, the change of the sleep problems across pregnancy is of interest. However, there have been few surveillance of sleep problem during pregnancy in Korea. The aim of this study was to examine whether sleep problems and sleep quality increase or degenerate during pregnancy.

Materials and methods: This is a multicenter study including a university hospital, a general hospital, and a regional public health care center. From July 2017 to October 2018, all pregnant women visiting clinic of obstetrics in the university hospital, or the primary health care center were asked to fill out a series of questionnaire including the Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), and STOPBANG. All patients received questionnaire only once at the initial visit, and patients who participated more than once were excluded.

Results: A total of 295 pregnant women's sleep and mood status were estimated. There were 30, 155, and 110 subjects in 1st, 2nd, and 3rd trimester, respectively. There is no significant difference in age (33.30 ± 3.48, 33.49 ± 3.91, and 33.49 ± 4.11, respectively, $p=0.957$); but body mass index (22.46 ± 4.21, 24.26 ± 3.96, and 26.71 ± 4.27, respectively, $p< 0.001$), and ISI (6.63 ± 4.06, 7.68 ± 4.50, and 9.54 ± 5.61, respectively, $p< 0.002$) were gradually increased. There were significant degenerations of BMI, ISI, ESS, and PSQI from the second trimester of pregnancy to the third.There are 1 (3.3%), 6 (3.9%) and 16 (14.5%) subjects in 1st, 2nd and 3rd trimester showed clinically significant ISI (≥15.5). It suggests that the prevalence of insomnia increases as pregnancy continues. There are 1 (3.3%), 13 (8.4%), and 30 (27.3%) subjects in 1st, 2nd and 3rd trimester showed ESS above 10.5. There are 9 (30%), 62(40%), and 59 (53.6%) subjects in 1st, 2nd and 3rd trimester showed PSQI above 8.5. There was no subjects of suspected sleep breathing disorders (3 or more in STOPBANG).

Conclusions: This study suggests that significant excessive daytime sleepiness increases progressively, and that progressive worsening of sleep quality during pregnancy.

Acknowledgements: None

ASSOCIATION BETWEEN SLEEP DURATION, BED TIME AND OBESITY IN COMMUNITY-DWELLING HONG KONG CHINESE ELDERLY: A POPULATION-BASED STUDY

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Introduction: Obesity is an important cardiometabolic risk factor among elderly population because it is associated with many life threatening diseases. Previous studies suggested that sleep duration was associated with obesity, but most of these studies were focusing on younger adults. Numerous studies showed that elderly people generally had poorer sleep patterns than those of younger adults, as elderly had poorer sleep quality but with earlier bedtime. It remains lack of knowledge if poor sleep patterns increase obesity among elderly population. Thus, this study aimed to examine the association of sleep duration and bed time with body fat percentage (fat%), waist circumference (WC) and BMI among Hong Kong Chinese elderly.

Materials and methods: We recruited 208 adults who were aged 65 or above during April - September 2018. We used a standardized questionnaire to collect participant's information on habitual sleep patterns and other variables. During the recruitment interview, we also measured their anthropometric parameters including height, weight, WC and fat% in their light cloth. Obesity was defined as BMI$\geq$ 25, WC $\geq$88 in women and $\geq$102 in men.We used R program version 3.5.1 to analyze our data. Multiple linear regression, multivariate logistic regression and multinomial logistic regression were used to calculate the association of sleep duration and bed time with fat%, WC and BMI respectively.

Results: On average, participants went to bed at 22:12 and slept for 7.82$\pm$1.23 hours. The mean of bedtime shifted from 22:26 in younger elderly (< 70 years old) to 21:49 in older elderly ($\geq$80 years old). Compared to the category "habitually slept 7-9 hours per day", elderly who slept < 7 hours tended to have higher WC (adjusted odds ratio (AOR)=2.50, 95% confidence interval (95%CI) = 0.91-6.99) after adjusting their age, sex, BMI. Elderly who slept >9 hours have higher fat% (adjusted β = 1.95; p = 0.04), but the association became attenuated with borderline significance (adjusted β = 1.76; p = 0.07) after further adjusting for educational attainment, income per capital, total minutes spent on vigorous and moderate physical activities, and red meat consumption. Compared with those who went to bed at 22:00 - 23:00, elderly who slept earlier was associated with higher WC (AOR=4.59, 95%CI=1.71-13.46), and elderly who slept later was associated with higher fat% (adjusted β = 1.79; p = 0.06) after adjusting the possible confounders. However, there were no significant associations of sleep duration or bed time with BMI.

Conclusions: Our study suggested that poor sleep patterns including sleep < 7 hours, >9 hours, and both early and late bedtime were associated with increased fat% and WC among Hong Kong elderlies. If these associations were confirmed prospectively, healthy sleep via means of intervention would be a way to control of the obesity epidemics among elderly.

Acknowledgements: The authors would like to thank Hiu Man TSOI, Ho Ling KWOK and Ka Yin LAM for their assistance in participants' recruitment preparation and data collection. Special thanks to Kitty SIN, Karen YIU, CHAI Man Hon, LO Kin Hei, Dan SHUM, Yue Hon WONG for site arrangement.

Aging and Developmental Issues
Board #019 : Poster session 2

ASSOCIATION BETWEEN RISK OF OBSTRUCTIVE SLEEP APNEA AND COGNITIVE DECLINE IN OLDER ADULTS

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Introduction: Recent studies have suggested that obstructive sleep apnea (OSA) is a risk factor for cognitive deficits in cognitively healthy older adults. However, whether this association exists in older adults who present abnormal cognitive decline is unknown. This study aims at characterizing the relationship between risk of OSA and episodic memory in subjects with and without abnormal cognitive decline. To achieve this goal, we used the Quebec Consortium for Early Identification of Alzheimer's Disease cohort that includes subgroups of cognitively healthy older adults, those with mild cognitive impairment and with dementia of Alzheimer's type.

Materials and methods: 271 participants underwent a comprehensive neuropsychological and a medical assessment for mild cognitive impairment and dementia of Alzheimer's type diagnosis. 158 cognitively healthy older adults (72 ± 5 years), 82 participants with mild cognitive impairment (76 ± 6 years) and 31 participants with dementia of Alzheimer's type (77 ± 7 years) matched for education levels were included in the present study. Risk of OSA was determined by using the validated STOP-BANG questionnaire which is scored on eight points; high scores indicating a higher risk of OSA. This scoring algorithm combines eight predicting factors for OSA: Snoring; daytime Tiredness; Observed apnea; high blood Pressure; Body mass index; Age; Neck circumference and Gender (here, sex). We used Rey Auditory Verbal Learning Test (RAVLT) immediate and delayed recall scores as a measure of episodic memory. Correlation analyses were performed between STOP-BANG and RAVLT scores in the three subgroups separately.

Results: The cognitively healthy subgroup was younger ($p < 0.001$) and included more women ($p = 0.003$) than the other groups. Scores on the STOP-BANG did not differ between groups ($p > 0.05$). We found a negative relationship between STOP-BANG and RAVLT immediate ($r = -0.300$; $p < 0.001$) and delayed ($r = -0.235$; $p = 0.003$) recalls in cognitively healthy participants. More specifically, higher risk of OSA was associated with poorer memory recalls in this subgroup. However, these correlations were not observed in participants with mild cognitive impairment (immediate recall: $r = -0.114$, $p = 0.308$; delayed recall: $r = -0.127$, $p = 0.253$) or with dementia of Alzheimer's type (immediate recall: $r = 0.021$, $p = 0.912$; delayed recall: $r = -0.225$, $p = 0.241$).

Conclusions: The association between higher risk of OSA and poorer memory performance was only observed in cognitively healthy older adults, but not in those presenting mild cognitive impairment or dementia of Alzheimer's type. Our results suggest that when possible neurodegenerative processes are ongoing, OSA does not worsen cognitive deficits. Whether OSA-related memory difficulties among cognitively healthy adults predict further cognitive decline needs to be investigated longitudinally. Moreover, whether OSA treatment has different effects on memory performance depending on the stage of cognitive decline needs further attention.

Aging and Developmental Issues
Board #020 : Poster session 2
LONGITUDINAL ASSOCIATION BETWEEN CIRCADIAN ACTIVITY RHYTHMS AND RISK OF INCIDENT PARKINSON'S DISEASE IN OLDER MEN

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Introduction: Circadian rhythm disruptions are common in older adults, especially in those with neurodegenerative diseases, including Parkinson's disease (PD). Preliminary evidence suggested that disruptions in circadian rhythm activities could also precede PD, but there is a lack of longitudinal studies to address this relationship.

Materials and methods: We examined rest-activity rhythms in 2930 community-dwelling older men (mean age 76.3 ± 5.5 years) without PD and followed them for incident PD over the next 11 years. We used wrist actigraphy to measure a range of activity rhythm parameters, including amplitude, mesor, robustness and acrophase, as well as nighttime sleep duration and efficiency. Incident PD cases were defined as either physician-diagnosed PD or PD medication use at each follow-up visit. We used multivariable logistic regression to examine the longitudinal relationship between rest-activity rhythms and risk of incident PD over the follow-up.

Results: We identified 133 incident PD cases over 11 years (mean follow-up: 7.8 years). After adjustment for age, clinic site, race, education, depressive symptoms, body mass index, physical activity, benzodiazepine use, alcohol intake, caffeine intake, smoking, comorbidities and cognitive function, those in the lowest quartile of rhythm amplitude, mesor or robustness had about double the risk of PD compared to those in the highest quartiles [Odds ratio (OR), Q1 vs. Q4 = 1.90 (1.10-3.27), 2.03 (1.19, 3.46) and 2.01 (1.16-3.50), respectively]. The ORs per SD decrement in amplitude, mesor and robustness were 1.41 (1.13-1.77), 1.35 (1.08-1.68) and 1.42 (1.14-1.78), respectively. Further adjustment for nighttime sleep duration and efficiency did not alter the results. The results remained after introducing a 2-year time lag. Acrophase was not associated with risk of incident PD.

Conclusions: Among older men without PD, those with decreased circadian activity rhythm amplitude and robustness have increased risk of incident PD over 11 years. Further studies are needed to determine underlying mechanisms and to explore if interventions aimed at improving circadian activity rhythms might help reduce the risk of PD in high-risk elders.

SLEEP AND INFLAMMATION IN AGING INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT

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Introduction: Alzheimer's disease (AD) and Mild cognitive impairment (MCI) population shows important modifications in inflammatory markers, which are implicated in sleep modulation. Studies on sleep in AD also show important changes in polysomnographic variables and slow wave sleep (SWS) modifications are also found in subjects with MCI. Since SWS plays an important role in the consolidation of memory processes, learning and cerebral plasticity and inflammatory regulation process, understanding the dynamics of sleep changes in MCI patients, especially during SWS related to the decline of cognitive functions and inflammatory process, could prove most beneficial.

Materials and methods: Pro-inflammatory cytokine IL-1 and anti-inflammatory cytokine IL10 were measured in 55 subjects coming in for PSG recording of a complete night sleep and were distributed in three Sleep groups:
(1) 17 Healthy Controls,
(2) 18 Insomniacs,
(3) 20 MCI.
All subjects were between 60 and 85 years of age. Subjects in the Control group were free of sleep or cognitive problems. Subjects in the Insomniacs group were categorized according to their PSQI >7 and ISI >14 scores. Subjects in the MCI group were categorized according to NIA-AA criteria. For each of the inflammatory markers, two groups were formed by using a cut-off point to establish a "High" level group and a "Low" level group. For IL10, the cut-off point was the median, for IL1, having a lot of subjects with no marker at all, the cut-off point was established as > 0. For each inflammatory marker, a factorial ANOVA was conducted to assess the relationship between the two factors (Inflammatory group and Sleep group) using SWS as a dependent variable.

Results: For IL10, interaction between the two conditions was significant ($p < 0,05$). In the Low IL10 condition, amount of SWS minutes tends to steeply augment with the group alignment (mean[SD]): Controls (11,9[15,3]), Insomniacs (25,5[18,1]), MCI (33,8[11,8]). Whereas they tend to slightly decrease in the High condition: Controls (19,1[11,2]), Insomniacs (17,8[15,1]), MCI (15,3[16,8]). For IL1, interaction between the two conditions was also significant ($p < 0,05$). Occurring mainly between Controls and Insomniacs, the trend is however in the opposite direction as it was for IL10. Amount of SWS minutes decreases sharply with the group alignment in the Low condition (Controls (22,1[8,3]), Insomniacs (17,1[14,5])), while it increases in the High condition (Controls (10,0[14,8]), Insomniacs (27,7[18,4])).

Conclusions: The results of both these factorial ANOVAs, showing reversals from opposite directions, is consequent with the fact that Cytokine IL10 is thought to be an anti-inflammatory marker, while Cytokine IL1 is considered a pro-inflammatory marker. These preliminary analysis shows clear indication that there is a complex relationship between cognitive impairment, sleep and inflammation. If it was to be found that sleep and inflammation do directly influence each other, we could have a new avenue to understand and address problems relating to dementia and aging.

SUBJECTIVE SLEEP QUALITY AND SLEEP ARCHITECTURE IN AGING

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Introduction: It has often been noted that subjective evaluation of sleep is not straightforwardly related to sleep parameters. Sleep architecture, and especially sleep stages, as defined by EEG and categorized by long standing accepted criteria, is however still believed to be of consequence to one´s subjective impression of the rest gained from sleeping and its ensuing comforting sensation. In older adults, sleep complaints are frequent and changes in sleep architecture obvious, providing fertile grounds to investigate the relationship between sleep staging and subjective impression of sleep quality. A novel approach is proposed by which sleep stages, acting as predictors of an immediate subjective sleep evaluation, allows for the identification of specific characteristics relevant to personal assessment of one´s sleep quality.

Materials and methods: Participants were 163 adults with a mean age of 69,4 (SD=6,0) (38% men, 62% women) selected from the laboratory database. Sleep measures included objective (one night of polysomnography), subjective (self-report diary) measures and a number of psychological and sleep questionnaires. In the morning, subjects responded to the following question: "Overall, my sleep last night was..." (1: Very restless to 5: Very restful), which was then recoded in a binary grouping variable where values "1" and "2" , and values "4" and "5" respectively formed "badSleep" and "goodSleep" groups. Subjects with middle value "3" from the original database were ignored. A logistic regression was trained on the entire dataset with percentage of sleep stages as predictors of the binary grouping variable. The resulting 4 groups (bad/good sleep, well classified and not) were then used to perform ANOVAs on a number of variables (including sleep stages): Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Apnea/Hypopnea Index/hr (AHI), Periodic leg movement during sleep/arousal Index/hr (PLMSa), Micro-arousal Index/hr (MAI), Sleep efficiency (SE), Wake after sleep onset (WASO), Sleep onset latency (SOL), Wakefulness, Stage1, Stage2, Stage3, REMsleep. Since the goal was to form groups across the dataset, possibly overfitting the data was not deemed detrimental to further analysis conducted on the same dataset.

Results: The regression allowed to form the following four groups:
1- goodSleep categorized as good (n=41),
2- goodSleep categorized as bad (n=28),
3- badSleep categorized as good (n=29),
4- badSleep categorized as bad (n=65).
Groups 1 and 4 are adequately categorized, groups 2 and 3 are not. ANOVA was significant for the following variables (p< 0,05): PSQI, ISI, PLMSa, Micro-arousal index/hr, SE, WASO, Wakefulness, Stage1, Stage2. Moreover, posthoc tests (Tukey) identified the following group differences (p< 0,05): PSQI, ISI: 1-4, 2-4; PLMSa: 1-4, 2-4; Micro-arousal/hr: 1-4, 3-4; SE, WASO, Wakefulness: 1-2, 1-4, 2-3, 3-4; Stage1: 1-4.

Conclusions: Although subjective evaluation of sleep quality remains an indirect correlate of sleep stages, this analysis demonstrates that general subjective sleep evaluations, immediate subjective sleep assessments and sleep parameters do form a real, although complex, relational space.

NATURAL FLUCTUATIONS IN SLEEP DURATION AND SATISFACTION IN CHILDREN AND A ROLE FOR PUBERTAL DEVELOPMENT

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Introduction: The National Sleep Foundation recommends 9 to 11 hours of sleep for school-aged children. Even within this range, some children may be satisfied with their sleep while others experience dissatisfaction and greater waking deficits on cognition and emotion.
Materials and methods: This study investigated the association between self-reported sleep duration and satisfaction with self-reported emotion reactivity and regulation in a sample of 241 Canadian children (Grade 4-9). Participants also reported their development on the Pubertal Development Scale (PDS) to investigate its role in this relationship, with the aim to predict those more impacted by poor sleep. A latent class analysis was conducted to determine different patterns of sleepers in the sample using sleep duration during the week and weekend, and sleep satisfaction.
Results: Three classes emerged that differed on the extent to which participants reported feeling "bothered" by their sleep pattern (Satisfied Sleepers (n= 99), Moderately Satisfied Sleepers (n = 72), Dissatisfied Sleepers (n = 70). There was a significant effect of class membership on both emotion reactivity ($F(2,221) = 9.54$, $p < .001$) and emotion regulation ($F(2,220)= 11.97$, $p < .001$). For emotion reactivity, Dissatisfied Sleepers reported greater reactivity than both Satisfied Sleepers ($t(160) = - 4.554$, $p < .001$) and Moderately Satisfied Sleepers ($t(126) = 2.138$, $p = .034$). For emotion regulation, Moderately Satisfied Sleepers and Dissatisfied Sleepers reported greater difficulty with emotion regulation than Satisfied Sleepers ($t(155) = -2.995$, $p = .003$; $t(160) = -4.707$, $p < .001$). To investigate the association between sleep satisfaction and pubertal development, PDS score was compared between classes for girls and boys. In girls, there was a significant effect of class on pubertal scale score ($F(2,103) = 4.284$, $p = .016$). Follow up- analyses revealed Dissatisfied Sleepers were higher on their degree of pubertal development than Satisfied Sleepers ($t(74) = 2.924$, $p = .005$). To investigate pubertal development as a predictor of individual differences in the association between sleep and emotion, we conducted correlations of pubertal status by emotion reactivity and regulation within each class. In the Dissatisfied Sleeper group only, there was a significant correlation between difficulties with emotion regulation and pubertal development in girls ($r = .422$, $p = .013$), such that being further along in development was associated with greater emotion regulation difficulties.
Conclusions: Low sleep satisfaction may be a marker of insufficient fulfillment of sleep need. This study suggested that this discrepancy of sleep need and sleep duration may play an important role in daytime emotion functioning, and specifically that greater dissatisfaction is associated with worse emotion functioning. Our results suggest that the discrepancy may be associated with pubertal development in girls, and that girls who have the combination of poor sleep satisfaction and are further along in pubertal development have the most difficulties with emotion regulation. Future research should investigate the role of sex hormones over development in the relationship between sleep and waking emotion function.

THE STABILITY OF SLEEP EEG MICROSTRUCTURE AND VIGILANCE MEASURES ACROSS TWO CONSECUTIVE NIGHTS OF LABORATORY POLYSOMNOGRAPHY IN COGNITIVELY NORMAL OLDER ADULTS

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Introduction: The phenomena of a 'first-night effect' (worse sleep) or the 'reverse first-night' effect (better sleep) has ensured that many sleep research protocols employ multiple nights' of in-lab polysomnography (PSG), at the cost of increased financial and participant burden. Although previous investigations in healthy and sleep disordered populations show high night-to-night variability of PSG macrostructure metrics, it is suggested that there is considerable stability in EEG microstructure and respiratory measures. Findings relating NREM EEG microstructure measures to Alzheimer's disease (AD) pathology (tau and β-amyloid burden) make sleep a potential biomarker of AD risk. Given that variability is always a major concern, we assessed the night-to-night variability of sleep macro and microstructure, respiratory and psychomotor vigilance test (PVT) measures in a group of normal elderly participating in aging and memory studies.

Materials and methods: 39 participants (66± 6.4 years-old and 72% female) attended 2 consecutive nights PSG and completed a 20-minute morning time PVT. 78 PSGs were scored according to AASM guidelines for sleep staging and sleep disordered breathing (SDB). Sleep EEG (Fz, Cz, and Pz derivations) were analyzed in 62 PSGs using a quantitative EEG (qEEG) automatic algorithm (DETOKS) for detection of NREM microstructure measures: spindle and K-complex (KC) density and amplitude, relative slow wave activity (SWA), and change in slow wave activity surrounding KCs (ΔSWAK)). Differences between night 1 and 2 for total sleep time (TST), rapid eye movement (REM), slow wave sleep (SWS) and stage 2 (NREM 2) duration, wake after sleep onset (WASO), respiratory disturbance indices (RDI), EEG microstructure and PVT performance measures were assessed using t-tests and Wilcoxon rank sum tests where appropriate. Intraclass correlations (ICCs) were used to determine measurement agreement between the two nights for all measures.

Results: There were no significant differences demonstrable between night 1 and 2 for any PSG macrostructure, SDB, EEG microstructure or PVT measure. NREM 2, TST, WASO, REM and ΔSWAK had ICCs between 0.27-0.53. However, ICC's were higher for parietal spindle density (0.96), frontal KC amplitude and density (0.94 and 0.82), RDI (0.80), frontal SWA (0.74), and SWS (0.62). There were no significant differences between morning 1 and 2 PVT performance measures (lapses and mean reaction time (RT), and ICC's were high (Lapses = 0.87, RT = 0.82).

Conclusions: EEG microstructure, SDB and PVT performance measures show good to excellent intra-individual stability across two consecutive nights of PSG. One night of in-lab PSG is enough to provide reliable estimates of an individual's sleep microstructure and vigilance using measures of spindles, KC's, SWA, RDI and PVT.

DO NAPS IN YOUNG CHILDREN AFFECT NIGHT-TIME SLEEP OUTCOMES? IF SO, WHEN? AN APPLICATION OF MULTILEVEL MODELLING

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Introduction: Naps among preschool and early-school-age children decline with age. However, the relation between naps and nighttime-sleep outcomes is not well understood in young children. Previous studies have demonstrated napping can influence nighttime-sleep duration. However, the relation between other sleep outcomes is unclear. Further, previous studies have not accounted for day-to-day variance in naps or nighttime-sleep outcomes. This study evaluated the influence of naps and other factors on nighttime-sleep duration and sleep onset latency (SOL) using multilevel modelling (MLM) and the evaluation of cross-level interactions (i.e., stable factors predicting nighttime-sleep outcomes). Hypotheses: (1) naps are particularly linked to nighttime-sleep outcomes when children are transitioning from daily napping; (2) longer nap duration and naps taken later in the day predict poorer nighttime-sleep outcomes; and (3) the negative relations between nap duration and timing are stronger with higher sleep problem severity, lower child emotional functioning, and/or lower parent emotional functioning. This study is among the first to apply MLM to children's sleep research.

Materials and methods: Parents (N = 279) of 1-10-year-old children from Canada, the United States, and Australia completed questionnaires (i.e., child sleep problems, emotional functioning, parent emotional functioning) and a week of sleep diaries on napping and nighttime-sleep (at least 3/7 days completed). Night-to-night variation and overall sleep duration and onset latency were evaluated using an MLM-model building approach. These models were supported by simple t-test analyses comparing napping and non-napping nights within children who napped frequently (i.e., at least twice in a week, but not daily) and children who napped only once during the sleep diaries. These analyses are contrasted with results from simple multiple regression analyses.

Results: Napping behavior varied amongst children: 41% did not nap over the 7-days, 9% napped only once, 19% napped frequently, and 31% napped daily. Children who napped only once had significantly shorter nighttime-sleep durations (Cohen's d = -.398) and longer SOL on napping nights (Cohen's d = .375); further, children who napped frequently had significantly longer SOL on napping nights (Cohen's d = .573). Children who had at least one nap were included in two MLM-models with child nighttime-sleep duration and SOL as outcomes. Nap duration (longer naps) and child sleep problem severity (more problems) were significant predictors of shorter nighttime-sleep duration and longer SOL in separate models. Parent and child emotional functioning did not predict nighttime-sleep outcomes. Results from the simple regression present similar findings but fail to account for the daily fluctuations in napping behaviour and its relation to nighttime-sleep outcomes.

Conclusions: Longer naps significantly impact nighttime-sleep outcomes amongst children who nap. Napping may be particularly linked to nighttime-sleep outcomes for children transitioning out of their naps. MLM is demonstrated as a sound statistical approach to investigate day-to-day variation in napping and sleep outcomes. MLM is a more appropriate approach to exploring sleep diary/actigraphy data, as sleep outcomes vary across observations. The unique application of MLM to sleep diary data will be discussed in the context of this study.

CHILDHOOD SLEEP PATTERNS LONGITUDINALLY PREDICT LATER POST-TRAUMATIC STRESS AFTER HURRICANE HARVEY

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Introduction: Prior research suggests that exposure to natural disasters often results in significant stressors for children and adolescents, which can alter the course of development and impact long-term functioning. Preliminary evidence suggests that sleep may impact adjustment to trauma in youth. Among children exposed to Hurricane Katrina, many youth experienced sleep problems up to two years later, which predicted worse functional outcomes (Hall-Brown et al., 2011). Yet, the influence of premorbid sleep in shaping children's developmental stability and change in response to a natural disaster is currently unknown. Understanding these processes is especially important for adolescents who may be more vulnerable due to heightened neuroplasticity and significant ongoing socioemotional changes that are occurring during this developmental period.

Materials and methods: Sixty-nine pre-pubertal youth residing in Houston, TX completed a comprehensive sleep assessment (one week of actigraphy and one night of polysomnography) between the ages of 7-11, approximately 3 years prior to Hurricane Harvey (Time 1). Participants completed a follow-up assessment as early to mid-adolescents approximately 6-9 months after the hurricane (Time 2). At Time 2, participants provided reports of their hurricane adversity (e.g., displacement), stress during the hurricane (e.g., feelings of safety), and current post-traumatic stress symptoms. Participants also provided 3 days of waking salivary cortisol, and emotional reactions to hurricane-related images during an in-lab experimental task were assessed (measured via self-report, facial expressions, and electrodermal activity).

Results: A series of regression models examined associations between sleep at Time 1 and feelings of stress during the hurricane along with emotional functioning 6-9 months after the hurricane, including reports of post-traumatic stress, reactivity to hurricane-related stimuli in the lab-based task, and waking cortisol levels. All models controlled for sex, time 1 age, time between assessments, pre-hurricane mental health symptoms, and amount of hurricane-related adversity (e.g., having their home or school flood). Sleep characteristics prior to the hurricane including lower sleep efficiency (Beta = -.38, p = .001), longer sleep onset latency (Beta = .25, p = .03), and less slow wave sleep (Beta = -.31, p = .02) were associated with greater stress during the hurricane (e.g., feeling stressed, scared, or like they or a loved one were going to die). A longer sleep onset latency (Beta = .36, p = .003) prior to the hurricane was also associated with greater post-hurricane post-traumatic stress symptoms. Children who exhibited lower sleep efficiency prior to the hurricane reported greater post-traumatic stress symptoms (Beta = -.25, p = .03), greater arousal when viewing images of the hurricane (Beta = -.25, p = .06), and had higher levels of cortisol (Beta = -.25, p = .06) 6-9 months after the hurricane.

Conclusions: As natural disasters are expected to increase in frequency and severity, identifying youth at the highest levels of risk is critical. Importantly, these longitudinal findings suggest that particular sleep problems may foster either resilience or vulnerability for maladaptive responses to trauma during the sensitive, transitional period from childhood to adolescence.

DEVELOPMENT OF INTELLIGENT STROKE MONITORING SYSTEM FOR THE ELDERLY DURING SLEEPING

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Introduction: World population is aging rapidly and aged population is getting much more concern nowadays. Population aging is taking place in nearly all the countries of the world. Age-related decline in sleep efficiency hampers quality of life for an elder. In addition, sudden stroke onset during sleeping poses a serious threat to the life of elderly adult. So, Real-time heath monitoring is most important for detecting stroke onset.

Materials and methods: Smart IoT devices embedded in bed mattress, wearable devices and cloths monitors physiological parameters such as brain-wave, movement during sleep, muscle activity etc. in order to understand physiological parameters of elderly adults. Sleep monitoring devices will observe sleep quality and find out sleep disorder if happens. Entire system will feed physiological data to cloud engine to compare real-time data and already stored reference data in order to detect stroke of elderly people. In this study, five elderly subjects are monitored using AiSleep wearable sleep devices. Sleep quality was evaluated and compared with Polysomnography (PSG).

Results: Accuracy of sleep quality evaluation using wearable sleep device is quite good enough as compared with PSG.

Conclusions: This study provides information about framework and prototype of Real-time stroke detection system using IoT sleep monitoring devices for elderly adults. Sleep wearable devices is simple, easy to wear compared with complicated PSG and monitors drivers physiological parameters in order to understand physiological status of elderly adults during sleeping.

Aging and Developmental Issues
Board #010 : Poster session 1
ESTABLISHING SLEEP RESEARCH PRIORITIES WITH AUTISTIC ADULTS

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Introduction: Sleep is essential for physical and mental health. Sleep difficulties are more common in autistic adults than the general population. Current sleep research suggests that sleep problems lead to a number of adverse effects, including physical health, mood, memory, academic performance and employment. Sleep problems may reduce an autistic person's opportunities for community participation. Yet, improving the sleep of autistic adults has not been a significant research focus to date. Moreover, we do not have any first-hand accounts how autistic people feel about sleep, what triggers their night time wakings, what helps them fall asleep, what ways sleep and physical or mental health relate and what they see as research priority in sleep.

Materials and methods: Initial focus group discussions and interviews highlighted the need to consider the views of personal sleep accounts of autistic people. In line with that, our Lab research team in collaboration with members of the autistic community co-created an autistic friendly survey in order to understand sleep experiences and priorities of the autistic community. The survey included open- ended questions which autistic adults might have in relation to the sleep issues they are facing.

Results: A total of 731 people provided full responses to the online survey. 632 participants were autistic adults (18-74 years old) and responded by stating at least 1 research priority. 90% of participants reported poor quality and quantity of sleep with frequent long night waking. Over 70% reported sleep onset delay due to factors such as sensory issues and high anxiety levels. Based on their answers 3 main research priorities were established and will be discussed in the current presentation. A large number of powerful personal quotes and experiences/perspectives on sleep issues were also gathered from the autistic adults who attended the focus group.These were analysed using thematic analysis. The master themes that emerged included: (i) Difficulty to access sleep clinics and contact sleep professionals who are also trained in autism (ii) Sleep Difficulties and their impact in the quality of life (iii) Sleep and co-existing sensory and mental health issues (iv) Suggested social/environmental adaptions.

Conclusions: We do not have any first-hand accounts how autistic people think about sleep, what triggers their night time wakings and what helps them fall asleep and what they see as research priority in sleep. By co-establishing sleep research priorities with autistic adults we maximise the possibilities for future research that is addressing their perceived needs and a greater real life impact in areas that they have chosen for themselves.

Acknowledgements: Cos Michael and Jon Adam for their support and collaboration during this research effort.

MIDLIFE SLEEP DURATION AND SUBSEQUENT 12-YEAR CHANGES IN COGNITIVE FUNCTIONING IN THE WISCONSIN SLEEP COHORT

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Introduction: On a day-to-day basis, cognitive functioning is sensitive to inadequate sleep. However, the relation between usual sleep duration in midlife and changes in cognitive functioning throughout older adulthood, is unknown. Further, it is unclear how circadian preference - subjective chronotype - interacts with midlife sleep duration in predicting changes in cognitive function. We examined the association of baseline sleep duration with within-subject changes in cognitive functioning over 12 years of follow-up in the Wisconsin Sleep Cohort Study—a randomly selected cohort of middle-aged employed adults followed to older age (regardless of continuing employment status) from 1988 to present.
Materials and methods: A subset of Wisconsin Sleep Cohort participants (n=362; 40% female; mean [range] age=51[30-71] years at baseline) participated in baseline in-laboratory overnight polysomnography studies as well as baseline and 12-year follow-up cognitive test battery protocolsand additionally provided self-reported usual sleep duration, subjective chronotype using the Horne-Ostberg questionnaire, and information on a breadth of covariates at baseline.Cognitive function protocols included the Trails B test (seconds, shorter is better), Symbol-Digit Modalities (seconds, shorter is better), Oral Word Fluency (words identified, more is better), Grooved Pegboard (seconds, shorter is better), Digit Cancellation (more digits is better) and the Auditory Verbal Learning Tests (words recalled, more is better). Mixed-effects linear regression modelling estimated associations between baseline sleep duration and 12-year change in cognitive outcomes, controlling for age, sex, body mass index, education, sleep apnea treatment, alcohol and cigarette use, depression symptoms, cardiovascular disease or diabetes diagnoses, and subjective chronotype. Additionally, effect modification of sleep duration by subjective chronotype was tested (adjustments for multiple comparisons were made to interaction testing, requiring a p-value< 0.01 to be considered statistically significant).
Results: Usual sleep duration (in hours, as both linear and quadratic terms) were examined for associations with the six cognitive outcomes. Twelve-year Oral Word Fluency was strongly associated with baseline sleep duration: each 1-hour less sleep duration at baseline was associated with a reduction of 1.5 words identified (95% confidence interval = 0.7 to 2.4 words, p< 0.001) from baseline to 12-year follow-up. Also, the 12-year change in the Grooved Pegboard test was borderline-significantly associated with baseline sleep duration: each 1-hour less sleep duration at baseline was associated with a 4.0 seconds increased duration in time to complete the task (95% confidence interval = -0.1 to 8.2 seconds, p=0.056) from baseline to 12-year follow-up. Baseline sleep duration was not significantly associated with 12-year change in other cognitive test scores and no significant interactions were found between sleep duration and subjective chronotype.
Conclusions: In a non-clinical sample, baseline shorter sleep duration was associated with accelerated reductions in cognitive performance over 12 years of follow-up on Oral Word Fluency and Grooved Pegboard tests - assessing verbal fluency, executive- and psychomotor-functioning - after adjustment for confounding factors. This suggests that habitual sleep duration in midlife may be related to rate of decline in specific domains of cognitive functioning in older adulthood.

Aging and Developmental Issues
Board #023 : Poster session 3
ARE PARENTS OF INFANTS WITH SLEEP PROBLEMS AT RISK FOR DAYTIME DYSFUNCTION?

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Introduction: Sleep problems are prevalent in 20-30% of infants. While some research has investigated the detrimental effects of poor sleep in infants (e.g., emotional and behavioural problems), less is known about the consequences for parents of poor sleeping infants. There is emerging evidence to suggest that poor sleep in infants is negatively associated with parents' sleep quality and mental health, however the implications for daytime functioning (e.g., driving, social and occupational performance) in this population of parents is under researched. Using the novel Nanit camera sleep tracking system and algorithm to objectively measure infant sleep, this study aimed to investigate the subjective daytime dysfunction in parents of infants with and without a sleep problem.

Materials and methods: A total of 619 families (52% infant boys; M_{age}=37.8 weeks, SD=17.3, range= 10-142 weeks) participated in this cross-sectional study. Infant sleep quality was objectively measured in the infant's naturalistic setting using the Nanit camera system, and automatically analysed using its computer vision algorithm. Sleep metrics were averaged for each infant across 14 consecutive nights. The Brief Infant Sleep Questionnaire was used to assess the presence of infant sleep problems as reported by parents. Daytime dysfunction was measured using the corresponding sub-component (component 7) of the Pittsburgh Sleep Quality Index, from which a binary measure was derived (0=No daytime dysfunction; 1=Daytime dysfunction). Both questionnaires were completed by parents online. Logistic regression analysis was performed to assess odds ratios for daytime dysfunction as a function of the model predictors.

Results: Parents who perceived their infant to have a sleep problem were approximately 3 times more likely to report daytime dysfunction (OR=2.85, CI95%=1.86, 4.32, $p< 0.001$). Interestingly, objective sleep quality and infant age did not independently predict daytime parental dysfunction. However, infant age moderated the association between infant sleep problems and parental daytime dysfunction. For parents of infants with a sleep problem, the likelihood of reporting daytime dysfunction increased as infant advanced in age (OR=1.04, CI95%=1.01, 1.07, p=0.03), whereas for parents with infants without a sleep problem, daytime dysfunction was not associated with infant age.

Conclusions: Parents of infants with sleep problems had a ~3-fold risk of experiencing daytime dysfunction compared to parents of infants without sleep problems. This association was moderated by infant age, as the likelihood of reporting daytime dysfunction for parents of infants with sleep problems increased with age by 14% per month. This increase in daytime dysfunction could be explained by an accumulative effect of sleep disturbance for parents over time in the first years of their infant's life. It may alternatively be due to changes in age-related expectations that occur throughout infancy. Future studies should explore these postulations using longitudinal designs and objective measurement of daytime parental dysfunction. The clinical and societal significance of the present findings are of vast importance, given that they identify a distinct population at risk for impaired daytime performance (in driving, and also social and professional settings), that may affect their physical safety and mental well-being.

WHAT APPS?: TECHNOLOGY AND (RESTRICTED) SLEEP IN ADOLESCENTS

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Introduction: Adolescents are engaging with a range of technological devices including mobile phones, laptops, video games and more. What separates modern day adolescents from those in the last millennium, is the sharp increase of internet accessibility and portability of devices. Portable devices are of specific interest, as these light-emitting, interactive devices are easily transported into the bedroom and used not only before sleeping but also during the night. The aim of this research was to investigate what technological devices Australian adolescents are using, including apps, and their relationship with sleep duration on school nights.

Materials and methods: A total of 107 adolescents (68% female, M_{age}= 16.1 years, SD=1.1, range 13-18 years) participated in an online survey. Sleep variables were measured using the School Sleep Habits Survey (SSHS) and from this, total sleep time (TST) was calculated. Technology use was measured by asking adolescents to estimate the average time in minutes over the past week spent on devices (e.g., phones/iPads) and on apps (e.g., Instagram, YouTube) at three time points: in bed, after lights out (i.e., before sleep-onset), and during the night (i.e., after sleep-onset). Correlations were performed between TST and the total amount of evening use per device and app.

Results: Mean sleep-onset time for school nights was 9:24pm and mean sleep-offset time was 6:57am on school mornings. Mean TST was 8.2 hrs. Most adolescents used phones (89.7%), and around half used iPads (61%) and laptops (46.7%) during these evening time periods, suggesting multi-screen use. The least used technology type was gaming (15.9%). On portable devices, Instagram was the most used app (72%), followed by Snapchat and YouTube (both 67.3%), text messaging (57.9%), Facebook (50.5%) and Music apps (47.7%). Of the 89.7% that used their phones in bed or during the night, there was a significant negative correlation with TST (r= - .416, N= 73, p = < .0001), laptop use (r= - .688, N= 23, p = < .0001), and gaming (r= - .564, N= 17, p= .018). In contrast, there was no significant correlation between iPad use and TST (p= .46). For the apps, there was a significant negative correlation between using Instagram and TST (r= - .39, N= 50, p= .005), Facebook (r= - .63, N= 32, p= < .0001) and YouTube (r= - .69, N= 46, p= < .0001). In contrast, there was no significant correlation between text messaging and TST (p= .40) or snapchat (p= .95) and music apps (p= .92).

Conclusions: While on average, adolescents in this study obtained the lower end of the recommended amount of sleep on school nights, the use of portable forms of technology (e.g., phone) allowed more opportunity to displace and restrict sleep for many teenagers. Yet what apps they use (Instagram, YouTube, Facebook) may be more harmful than others. These findings have implications for focusing on what activities on technological devices could be modified to improve sleep health in young people.

EFFECTS OF RESISTANCE TRAINING ON N3 SLEEP AND MUSCULAR FUNCTION IN OLDER ADULTS WITH SARCOPENIA: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Sarcopenia is a multifactorial syndrome that causes reduced function and muscle mass. Although elderly individuals present alterations in several parameters of sleep, little attention is given to this during the development of this syndrome. Resistance training is the main option for treating sarcopenia and can also improve sleep patterns in the elderly, including N3 or slow wave sleep, which has been involved in muscle mass recovery. The objective of the present study was to investigate whether improvements of the muscular function in community-dwelling older adults with sarcopenia co-occur with changes in sleep parameters, including N3 sleep

Materials and methods: 26 sarcopenic older adults from both genders were randomly allocated into 2 groups for 12-week interventions. For the control group (CTL), weekly meetings with lectures on lifestyle changes were offered. The resistance exercise training group (RET) underwent a progressive loading protocol. The diagnosis of sarcopenia was made using the guidelines suggested by the European Consensus on Sarcopenia (2015). Sleep was evaluated by an overnight polysomnography. Assessment of skeletal muscle function was made by peak torque (PT) isokinetic and isometric were evaluated. Percentage of total sleep time (TST) in stage N3 was considered the primary endpoint and used for sample size estimate. An intention to treat analysis was carried out and intervention responses (differences between pre and post intervention assessments) were compared by Wilcoxon rank-sum (Mann-Whitney). For all comparisons we assumed 0.05 as significance level using two-sided tests. All analyses were performed using STATA software.

Results: A total of 28 older individuals (18 women) with sarcopenia completed the study. Resistance training positively impacted N3 sleep in RET (median: 0.7, min: -13.5, max: 25) vs CTL (median: -4.9, min: -15.2, max: 19.1; $p < 0.05$). Similarly, sleep onset latency improved after the exercise intervention (RET (median: -6.2, min: -20.5, max: 1.5) vs CTL (median: 5.2, min: -15.0, max: 30.0; $p < 0.05$). The PT delta variation after 12 weeks intervention for the RET group was greater than the CTL group for absolute isokinetic knee extension (median: 7.3, min: 0.0; max: 18.5 vs median: 0.0, min: -13.0, max: 5.9; $p < 0.05$) and relative to body mass (median: 10.2, min: 0.3, max: 31.8 vs median: -2.5, min: -26.7, max: 10.2; $p < 0.05$) as well as for isometric PT of extension of absolute knee (median: 9.95, min: 2.4, max: 26.9 vs median: -16.15, min: -54.7, max: 0.1; $p < 0,05$) and relative (median: 17.4, min: 6.8, 34.7 vs median: -4.5, min: -53.4, max: 4.6; $p < 0.05$). No serious adverse events were observed in both groups.

Conclusions: Twelve weeks of progressive load resistance training improved objective parameters of sleep, including stage N3, in combination with benefits observed in muscle function among older adults with sarcopenia. Sleep-related mechanisms promoted by resistance training may in part be involved in the muscle recovery, particularly in individuals with sarcopenia

ASSOCIATIONS BETWEEN HABITUAL SLEEP DURATION AND CIRCADIAN PREFERENCE WITH SCHOOL ATTENDANCE AMONG MIDDLE SCHOOL STUDENTS

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Introduction: School attendance, particularly chronic absenteeism, remains a persistent, challenging, and complex problem for schools. In the last few years, school start times have become a more prominent focus of education policy and practice. Prior studies have demonstrated that delayed school start times for adolescents result in increased sleep duration, as well as improved academic performance, reduced daytime sleepiness, depressive symptoms, tardiness, and attendance. This study was conducted to determine whether sleep duration and circadian preference are also cross-sectionally associated with school attendance among middle school students at baseline, prior to a scheduled multi-year plan for delaying school start times in the Madison (Wisconsin) Metropolitan School District (MMSD).
Materials and methods: All MMSD middle school students (grades 6-8) were invited to complete an online survey regarding sleep habits, symptoms, and attendance in the spring of 2019. Circadian preference was determined using the self-morningness/eveningness (Self-ME) questionnaire. Habitual sleep duration was estimated as the weighted self-reported sleep time on school days and non-school days. Linear mixed effect models were utilized with attendance rate as the primary outcome variable, with age, sex, race, English language learner status, homelessness, parental educational level, free-and-reduced lunch status, circadian preference, and habitual sleep duration as covariates. School was accounted for as a source of nonindependence. To minimize outlier effects on models, students with reported sleep duration < 4 or >12 hours were excluded.
Results: Data from 2,715 students (mean age=11.9±0.9 years; 51.8% female) were included in the analysis. In the fully adjusted model, weighted sleep duration (β=0.55, SE=0.16, p=0.01) and circadian preference (β=-0.44 SE=0.15, p=0.02) were each significantly associated with attendance rate, such that reduced sleep duration and a delayed circadian preference were related to decreased attendance.
Conclusions: These results suggest that sleep duration and circadian preference are factors that are associated with school attendance in early adolescence. These findings strengthen calls for delayed school start times that account for circadian preference and target increasing sleep duration among students. Future research that examines within-subject effects of delaying school start times, as well as qualitative aspects of such interventions are warranted.

THE PRESENCE OF EITHER INSOMNIA OR SLEEP APNEA ATTENUATE THE BENEFITS ACHIEVED FROM STRESS MANAGEMENT TRAINING FOR REDUCING DAYTIME SYMPTOMS OF HYPERAROUSAL BY CARDIOVASCULAR PATIENTS

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Introduction: Stress management training (SMT) is a component of treatments provided to cardiovascular patients during their Cardiac Rehabilitation programs. The goal of SMT is to reduce levels of daytime hyperarousal (symptoms of anxiety, psychological distress, and depression) among medical patients recovering from cardiac events. Sleep disorders like Insomnia Disorder (ID) and Obstructive Sleep Apnea (OSA) are common co-morbidities of medical patients with cardiovascular illness. However, the presence of sleep disorders in patients attending standard SMT training in Cardiac Rehab has not been studied. This study investigated the presence of a variety of common sleep disorders (SD) among cardiovascular patients enrolled in a SMT program. In particular we were interested in the relationships between SDs and daytime measures of autonomic dysregulation at the start of treatment, and the impact of those SDs on the outcomes achieved by patients in their standard SMT program.

Materials and methods: 124 medical patients enrolled in SMT offered as a treatment option during their Cardiac Rehabilitation program. All subjects completed self-report measures of anxiety (Beck Anxiety Inventory), psychological distress (K6), and depression (Centre for Epidemiological Studies-Depression) at the beginning and end of a seven-week SMT program. The presence of SDs was evaluated with the Sleep Assessment Questionnaire (SAQ), a questionnaire developed to identify Global Sleep Disturbance and to identify six individual SDs (ID, OSA, Excessive Daytime Sleepiness, Non-Restorative Sleep, Restlessness, and Sleep Schedule Disorder). The SAQ was validated with sleep polysomnographic data obtained for a full range of SDs in patients presenting with clinically significant sleep disturbances.

Results: 85% of 124 patients enrolling in the SMT program had clinically elevated Global SAQ scores, indicating that sleep disturbances are common in this population. 41% had severe sleep disturbances suggesting the presence of more than one sleep disorder. Individuals who scored positive for SDs on their Global SAQ Scores had significantly higher baseline levels of all three symptom difficulties (anxiety, psychological distress, and depression) than individuals without SDs. Individuals who scored positive for Sleep Schedule Disorder, Non-Restorative Sleep, and Excessive Daytime Sleepiness did improve on all three daytime symptom measures. Patients meeting criteria for OSA did not show any benefit from the SMT on any symptom outcome measure. Patients meeting criteria for ID and Restlessness showed improvements in levels of anxiety and depression, but not psychological distress.

Conclusions: These results demonstrate that the majority (85%) of cardiovascular patients attending SMT treatment had significant underlying sleep disturbances. The presence of SDs has not been assessed in SMT studies, and was clearly related to higher levels of all daytime symptom difficulties (anxiety, distress, depression) at baseline. Outcomes of SMT treatment was attenuated by two of the six SDs. Patients with Sleep Apnea or Insomnia did not receive the same benefit from standard SMT in resolving daytime hyperarousal symptoms. Adding routine screening for Sleep Apnea, for patients enrolling in SMT is highly recommended. Finally, integrating CBTi interventions into standard SMT protocols may improve outcomes of SMT treatments by adding the targeting of nighttime hyperarousal to SMT improvement of

daytime hyperarousal.

THE MODERATING ROLE OF SLEEP IN THE RELATIONSHIP BETWEEN SOCIAL ISOLATION AND INTERNALISING PROBLEMS IN EARLY ADOLESCENCE

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Introduction: Depression and anxiety commonly develop in early adolescence, and social isolation may be a unique risk factor for internalising symptoms during this developmental period. However, optimal sleep may protect adolescents from the emotional sequela of social isolation. The present study aimed to investigate whether sleep moderates the relationship between social isolation and symptoms of anxiety and depression in early adolescence.

Materials and methods: Five hundred and twenty eight early adolescents (*M*= 11.18yrs, *SD*=0.56, range: 10-12 yrs, 51% male) completed online questionnaires assessing social isolation, sleep duration, daytime sleepiness and symptoms of generalised anxiety, social anxiety, separation anxiety and depression. Sleep duration was also measured through parental report.

Results: Sleep duration moderated the effect of social isolation on symptoms of generalised anxiety, social anxiety and depression, but not separation anxiety. Daytime sleepiness emerged as an additional sleep-related risk factor in the relationship between social isolation and depressive symptoms.

Conclusions: Socially isolated early adolescents, with shorter sleep duration (and higher daytime sleepiness, for depression) reported the highest symptoms of anxiety and depression. Therefore, sleep may be an important modifiable risk/ protective factor to target, in order to prevent the onset of socioemotional disorders in adolescence.

Aging and Developmental Issues
Board #196 : Poster session 3

ASSOCIATION OF OBSTRUCTIVE SLEEP APNEA SYNDROME AND SPEECH DELAY IN CHILDREN: A CASE-CONTROL STUDY

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Introduction: There is a definite paucity of evidence regarding the association between OSA in children and speech delay (SD). Speech is a complex developmental process requiring proper function of phonatory structures, the neural processes behind verbalization and the auditory acquisition of phonemes. Our hypothesis was that OSA was associated with SD through a potential impairment of all these pathways.

Materials and methods: We decided to include the totality of the pediatric patients referred to our sleep laboratory for PSG with past medical history of SD. The study dates were from 9/2003 to 12/2018. We expected the frequency of OSA in the case group to be 70% and 50% in the control. In order to guarantee a 5% significance level with 80% power, we decided to pair them with age and sex matched controls 2:1. The controls were selected consecutively from the same database, starting in 9/2003. We excluded patients presenting with Congenital malformations of the upper airway (not including cleft palate), Autism, Tracheostomy, CNS lesions, Mitochondrial diseases and any other congenital or acquired conditions expected to cause SD. We aimed to identify the OR of OSA, Hypoventilation and Snoring in the presence of SD.

Results: We found 123 cases (63% males, median age 3, range 1-11). They were matched (age and sex) per protocol to 246 consecutive controls. We found a significant difference in the frequency of OSA in the case group 73.9% and the controls 45.9%. (OR 3.34 CI:2.09-5.41, $p < 0.001$). The OR for SD and snoring or hypoventilation are not statistically significant. We found that 14% of the SD cases with OSA did not snore.

Conclusion: OSA is strongly associated to SD in a manner independent to that of snoring or hypoventilation. It is plausible for this association to be a causal one. It is necessary to explore the indication of PSG in children with SD, to identify comorbid OSA, even in the absence of other clinical signs. Prospective studies are needed to evaluate prevention or improvement of SD with treatment of OSA.

Acknowledgements: Work by Drs. Dalai and Cheema on data collection is greatly appreciated.

ACUTE SLEEP RESTRICTION AND CORTISOL REACTIVITY IN EARLY CHILDHOOD

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Introduction: Early childhood is a sensitive developmental period during which both sleep and stress regulation undergo rapid changes. Stress regulation is modulated by the hypothalamic pituitary adrenal (HPA)-axis, which stimulates release of the hormone cortisol. Cortisol stress reactivity (CSR) is an adaptive response marked by a rapid rise and then a decline in cortisol levels following daily stressors. Although experimental research on the relationship between sleep and stress in young children is limited, we have previously shown that when 2-year-olds nap they adapt better to challenges via a healthy stress response than when they are nap-deprived. The purpose of this study was to extend this research by examining the effects of acute nighttime sleep restriction on CSR in older preschoolers who no longer nap. We hypothesized that in comparison to optimal sleep, sleep restriction would overwhelm the body's adaptive capacity to respond to stress, thereby demonstrating increased cortisol production and reduced cortisol recovery.

Materials and methods: Healthy, non-napping children (n=20) ages 4.5-5.0 followed a stabilization sleep schedule for $\geq$5 days before completing counter-balanced, in-home, behavioral assessments that included both high cognitive load and a frustration task. Assessments occurred in the mornings after each condition: baseline (night of normal sleep) and sleep restriction (3-hour bedtime delay). Salivary cortisol was measured at 6 timepoints spanning before, during, and after both assessments. Saliva samples were immunoassayed for cortisol concentration (mg/dL). We then captured cortisol stress reactivity by calculating total cortisol secretion as area-under-the-curve with respect to ground (AUCg) and minimum-maximum percent change (PC). Paired t-tests were used to compare differences in AUCg and PC between baseline and sleep restriction conditions.

Results: Following baseline sleep, mean AUCg was 0.31(SD=0.14) and mean PC was 217.47 (SD=187.19). After sleep restriction, mean AUCg was 0.34 (SD=0.13) and mean PC was 355.59 (SD=379.13). Although mean values of AUCg and PC were lower at baseline than after sleep restriction, we found no significant differences in our measures of stress reactivity between baseline and sleep restriction conditions (AUCg: t=-1.18, p=0.26; PC: t=-1.28, p=0.22).

Conclusions: This novel study in preschool-age children simulated a night of acute sleep loss and tested subsequent morning stress reactivity at a time when children would likely encounter high cognitive demands and other stressors. Our experimental findings suggest that acutely reducing nighttime sleep duration does not impact stress reactivity in healthy young children; however, further research in children with or at-risk for behavioral or emotional problems may tell a different story. Future studies should also examine early developmental trajectories in sleep-dependent changes in stress reactivity and their associations with cognitive performance and emotion processing.

EFFECTS OF A CBT-I TREATMENT FOR PARENTS OF INFANTS AND TODDLERS ON CHILDREN'S REGULATION ABILITY CONCERNING SLEEPING AND CRYING PATTERNS

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Introduction: Regulation problems are one of the earliest indicators of mental health difficulties in childhood. In the first years regulation problems often occur in difficulties to sleep, excessive crying episondes or feeding problems. Especially sleeping disorders and excessive crying often cooccurs. Early regulation problems have longtime effects on self-regulatory competence, behaviour problems, social-skills and parent-child-relationship. Therefore early intervention in young age is necessary. The Mini-KiSS treatment, an CBT-I program, is adressing parents of young children up to 4 years of age suffering from sleep problems and disorders - mainly insomnia. A first pilot study has shown that 84,6% of the children additionally had crying patterns which are perceived by the parents as problematic. After the Mini-KiSS treatment not only sleep problems but also the children's crying patterns were significantly improved. However, in the present study this first result ought to be verified with a lager sample.

Materials and methods: The Mini-KiSS treatment for parents of children 0.5-4 years with sleep problems is a structured CBT-I age-oriented program addressing within 6 sessions common sleep and bedtime problems as bedtime resistance, sleep anxiety, night waking, or daytime sleepiness (Schlarb, 2013). In sum 53 families with infants and toddlers suffering from insomnia according to ICSD-3 criteria were included. 35 families joined the training in individual sessions and 18 families participated at the training in small groups of 4-5 familys. To evaluate the children's regulation behavior concerning sleep and crying, an extendes sleep related questionnaire and further specific questionnaires (CSHQ; SFS) as well as a sleep diary were implemented. The analyses in this study includes data before and after the Mini-KiSS treatment.

Results: Concerning the children's sleep behavior the results regarding sleeping problems, bedtime resistance, sleep anxiety, night waking, daytime sleepiness, duration of going to bed ritual, use of external support to maintain sleep and sleeping in the parents bed will be focused.
Regarding the children's crying behavior frequency of crying in the morning, afternoon and evening, knowledge of the crying's cause, and reaction to the reassurance of the parents before and after the treatment will be included and calculated. A particular focus is on the perceived burden of the parents by the children's crying. In addition, the chidlren's self-regulation ability and parental co-regulation before and after the treatment will be presented.

Conclusions: The Mini-KiSS treatment influences in infants and toddlers suffering from insomnia the sleeping patterns and furthermore the crying behavior as well as the children's selfregulation ability.

DEVELOPMENTAL TRAJECTORY OF SLEEP DISTURBANCES IN A SHANK3 MOUSE MODEL OF AUTISM

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Introduction: Sleep problems affect a higher proportion of children with autism spectrum disorder (ASD) compared to typically developing children and are a strong predictor of severity of ASD core symptoms and behavioral problems. Children with ASD have difficulty falling asleep, poor sleep maintenance, and reduced sleep time from very young ages, resulting in chronic sleep deficiency throughout development. Studies in animal models suggest that sleep is important for brain development and function, but little is known about what causes sleep disturbances in ASD.
We focused our studies on *SHANK3*, a high confidence ASD gene candidate. Individuals with Phelan-McDermid Syndrome (PMS) carry deletions in chromosome 22q13.3, a region that includes *SHANK3*. Approximately 75% of PMS individuals have an ASD diagnosis and about half report chronic sleep problems including difficulty falling asleep and reduced sleep time. However, the link between *SHANK3* mutations and sleep is not understood. Sleep need is homeostatically regulated, increasing with time awake and decreasing during sleep, and homeostatic responses to sleep loss emerge during development. We tested the hypothesis that loss of *SHANK3* interferes with the development of homeostatic responses to sleep loss, leading to problems falling and staying asleep.
Methods: In this study, we used questionnaire data to guide our studies in mouse models. Sleep questionnaire data was obtained from the PMS International Registry from PMS individuals with confirmed *SHANK3* mutations. We also performed electroencephalographic (EEG) and electromyographic (EMG) recordings in transgenic mice carrying a mutation in *Shank3* (Shank3ΔC) and wildtype littermates. EEG/EMG was recorded during undisturbed baseline sleep, and following acute sleep deprivation by gentle handling. Mice were recorded from weaning age (24 days old) through adulthood (90 days old).
Results: We find that *SHANK3* mutations are associated with sleep disturbances in both humans and mice. Children with PMS have sleep problems that are more apparent at 5-12 years of age, including problems falling asleep, repeated awakening, and reduced sleep time. Similarly, we find that adult Shank3ΔC mutant mice have reduced sleep time, reduced EEG slow-wave (0.5-4Hz) activity in non-rapid eye movement (NREM) sleep, and delayed sleep onset following sleep deprivation. Juvenile (24 day old) Shank3ΔC mice have normal NREM slow-wave activity and sleep latency. Adult responses to sleep deprivation emerge during adolescence in mice.
Conclusions: We show that sleep problems in PMS individuals emerge during early childhood. Sleep problems in Shank3ΔC mice also change across development. Adult Shank3ΔC mutant mice have sleep phenotypes similar to those reported in PMS patients, specifically increased sleep onset latency and reduced sleep time. Differences in sleep onset latency and NREM slow-wave activity in Shank3ΔC mice emerge during the post-weaning period. Overall, our study shows that *SHANK3* is an important modulator of sleep during development.

GLUTATHIONE ENZYMES ACTIVITY IN MENOPAUSAL WOMEN WITH INSOMNIA

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Introduction: Some studies have shown that sleep problems are reported by 39%-47% of perimenopausal women and 35%-60% of postmenopausal ones. The results of experimental investigations have demonstrated that sleep loss may cause oxidative stress, which is a result of imbalance between free radicals production and antioxidant system activity. Antioxidant defense system includes different non-enzymatic components and enzymes and glutathione system is the one of the important part of its. The data about glutathione enzymes activity and insomnia association are ambiguous. The aim of this research is to assess glutathione peroxidase, glutathione S-transferase and glutathione reductase activity in menopausal women with insomnia.

Materials and methods: *Examined 126 menopausal women divided into perimenopausal (n=56) and postmenopausal (n=70) groups. Each group divided into control (without sleep disorders) and main group (insomnia and insomnia with obstructive sleep apnea syndrome (OSAS)).* Pittsburg Sleep Quality Index, Epworth Sleepiness Scale, Insomnia Severity Index, polysomnography were used for the assessment of sleep disorders. Exclusion criteria: exacerbation of chronic diseases; hormone replacement therapy; surgical menopause; the presence of chronic sleep disorders before menopause; the use of hypnotic pills in the previous two weeks; shift work. Glutathione peroxidase, glutathione S-transferase and glutathione reductase activity by spectrophotometric methods were determined. *Statistical analysis was performed by non-parametric tests* with $p < 0.05$ as the level of significance.

Results: It was shown that glutathione reductase activity is higher (1.20 times; $p < 0.05$) and glutathione peroxidase activity is lower (1.37 times; $p < 0.05$) in perimenopausal women with insomnia compared with control. Glutathione S-transferase activity is higher (1.44 times; $p < 0.05$) and glutathione peroxidase activity is lower (1.20 times; $p < 0.05$) in perimenopausal women with insomnia and OSAS compared with control. There were no statistically significant differences in glutathione enzymes activity in postmenopausal women depending on the presence of sleep disorders.

Conclusions: Both insomnia and insomnia with OSAS are associated with changes of the glutathione enzymes activity only in perimenopausal women.

LIPID METABOLISM PARAMETERS IN CAUCASIAN AND ASIAN MENOPAUSAL WOMEN WITH INSOMNIA

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Introduction: Menopause is a risk factor for sleep disorders. It is possible that sleep has a regulating role in lipid homeostasis. Moreover, it has been shown that the lipids concentration depends on the circadian system. It has been suggested that dyslipidemia and insomnia association depends frequent insomnia. However, there are investigations that do not confirm it. The aim of this research is to assess lipid profile in Caucasian and Asian menopausal women with insomnia and insomnia with obstructive sleep apnea syndrome (OSAS).

Materials and methods: 181 menopausal women divided into Caucasian (Russian ethnic group, *n=91) and Asian (*Buryat ethnic group, *n=90) groups were examined. All women underwent clinico-anamnestic examination.* The ethnic groups were formed in terms of the genealogical anamnesis and by self-identification taking into account the elements of the phenotype. *Each group divided into control (without sleep disorders) and main group (insomnia and insomnia with OSAS).* Pittsburg Sleep Quality Index, Epworth Sleepiness Scale, Insomnia Severity Index, polysomnography were used for the assessment of sleep disorders. Lipid metabolism parameters (total cholesterol *(TC),* low-density lipoprotein cholesterol (*LDL-C*), triacylglycerol (TG), very-low-density lipoprotein cholesterol (VLDL-C), high-density lipoprotein cholesterol (HDL-C)) by the enzymatic method were determined. *Statistical analysis was performed by non-parametric tests* with p< 0.05 as the level of significance.

Results: It was shown that *TC and LDL-C* levels are higher both in Caucasian and Asian perimenopausal women with insomnia and OSAS compared to control. Moreover, *TC and LDL-C* levels are higher in Caucasian perimenopausal women with insomnia and OSAS compared to insomnia. In postmenopause TC, TG, *LDL-C*, VLDL-C levels are higher and HDL-C level is lower in Caucasian women with insomnia and OSAS compared to control and group with insomnia. Also, TC, *LDL-C* levels are higher and HDL-C level is lower in Asian postmenopausal women with insomnia and OSAS compared to control and TC, LDL-C levels are higher in group with insomnia and OSAS compared to women with only insomnia.

Conclusions: Insomnia is not associated with changes of lipid profile in menopausal women. Dyslipidemia found in menopausal women only with insomnia and snoring comorbidity.

SLEEP PHYSIOLOGY ACROSS DEVELOPMENT IN DUCHENNE MUSCULAR DYSTROPHY DISORDER

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Introduction: Duchenne Muscular Dystrophy (DMD) is one of the most prevalent genetic disorders affecting 1 in 3,500 male births and is most known for its progressive muscle degeneration. Additional features include cognitive impairments, sleep disorders due to compromised respiratory profiles, and poor sleep architecture likely due to CNS abnormalities. Specific physiological features of sleep like slow waves and sleep spindles are known to play an important role in cognition and motor learning. In typically developing children from toddlerhood through late adolescence, there is a n anterior shift in location of delta power dominance during sleep mirroring brain morphology maturation. Here, we investigate the longitudinally characteristics of slow oscillations to evaluate if those with the disorder show the same progression as neurotypical children and if the developmental patterns of sleep physiology parallel DMD disease progression.
Materials and methods: We retrospectively analyzed the clinical sleep studies of twenty-eight males diagnosed with muscular dystrophy disorder (Duchenne or Becker) between the age of 4 and 18 years old. Each polysomnogram had 6 EEG channels (Frontal, Central, and Occipital) which we averaged inter-hemispherically. We applied a slow oscillation algorithm to each electrode which has previously been used in healthy adults to investigate the change in slow oscillations across development. We altered the algorithm for older children We separated our 28 males into 2 age groups (Young, Middle, and Old) and analyzed the amplitude and density (per second).
Results: We conducted repeated measures ANOVA design using within-factors (stage and electrode) and between-factors (age). For amplitude, we found a significant two-way interaction between stage ad electrode ($F(2,48) = 4.008$, $p = .025$) but no other effects. For slow oscillation density, we found main effects of age electrodes, and stage (p's< .001) and two-way interactions of stage by electrode ($F(2,50)= p< .001$) and stage by group ($F(2,25)=28.259$, $p< .001$). We did not find a three-way interaction of age group by stage by group. Post-hoc analyses show significant difference between each electrode locations (p's < .002), with the greatest activity in the frontal v. occipital locations.
Conclusions: In the context of pre-existing developmental sleep literature, our preliminary results also suggest age related changes in slow oscillation amplitude and density from early childhood to late adolescence. However, we find similar patterns between young and old with more activity at frontal than posterior electrode locations and do not see a posterior-anterior shift in density or amplitude. Future analyses will include comparison to age-matched controls, and longitudinal development of spindle morphology. Importantly, these results may help identify times in which sleep-specific interventions may be critical to boost slow oscillation power and density resulting in potential cognitive improvements.

SLEEP PROBLEMS IN PEOPLE WITH INTELLECTUAL DISABILITY (ID); DIAGNOSIS AND TREATMENT

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Introduction: People with an intellectual disability are prone to sleep problems. Sleep problems in people with intellectual disability comprises an intertwining of intrapersonal and environmental conditions. Symptoms of sleep pathology are often mistaken for behavioural problems or psychiatric conditions. To elucidate the prevalence, clinical characteristics, diagnoses and feasibility of treatment of people with ID, a cohort of 143 patients with ID in our tertiary sleep wake centre is analyzed.

Materials and methods: Questionnaires, clinical interviews, actigraphy and polysomnography (PSG), home recording or clinical, were used if considered feasible. Care dependent people, like people with ID, often can`t meet the AASM criteria for insomnia, therefore insomnia was defined as a complaint of the patient and or caregiver about initiation and or maintenance of nocturnal sleep, without fulfilling the diagnostic criteria for other sleep disorder. Other sleep disorders such as sleep disordered breathing (SDB) and circadian disorders were diagnosed and treated according to international guidelines. Effect of the treatment was evaluated by clinical interviews, actigraphy and/ or PSG.

Results: Patients (age 1-92yr, 80 male/ 63 female) had mild to profound intellectual disability with varying co-morbidities. The most frequent reasons for referral were sleep maintenance difficulties (n=74), daytime functioning difficulties (n=64), snoring (n=43), and sleep onset difficulties (n=31). In 58% of patients there was more than one reason. 134 patients (94%) underwent actigraphy successfully. 54 patients had prominent sleep hygiene problems and started our insomnia treatment protocol straightaway. The remaining 89 patients were eligible for polysomnography. 80 patients underwent PSG successfully. Diagnosis (n=143): 64% (n=92) insomnia, 32% (n=46) SDB, 2% (n=3) circadian problems, 1% (n=2) disorder of arousal, no cases of primary hypersomnia or presumed restless legs syndrome. PLMD was only seen in combination with DSPS (n=1) or SDB (n=4). Insomnia was comorbid in all patients with other sleep disorders. Prevalence of SDB in patients with Down's syndrome (n=12) was 67%.

Therapy: Insomnia was successfully treated in 68% of the patients who completed the protocol (n=26), 34 patients were lost to follow up. SDB treatment (n=27): 42% was successfully treated with CPAP/BiPAP. Non-PAP therapy (n=13) such as ENT treatment, position therapy and medication was successful in 25% . No therapy (n= 6) was started when de SDB was mild whilst the insomnia complaints prominent. When insomnia was co-treated in SDB, the number of patients with substantial clinical improvement went up to 80% for CPAP/BiPAP therapy.

Conclusions: Causes of sleep problems in people with intellectual disability comprise an intertwining of intrapersonal and environmental conditions. In this cohort insomnia was the most frequent diagnosis in 64% of the referred patients, the second most frequent diagnosis was SDB in 32%. Diagnostic procedures and treatment are feasible when personalized.

NON-PARAMETRIC ANALYSIS OF REST-ACTIVITY RHYTHMS AND RISK OF INCIDENT MILD COGNITIVE IMPAIRMENT AND DEMENTIA IN OLDER WOMEN

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Introduction: Circadian rhythms are frequently disrupted in older adults, and desynchronized rhythms have been associated with medical illness, including Alzheimer Disease. We previously demonstrated using a parametric extended cosine model that timing and rhythmicity of rest-activity patterns are associated with risk of developing mild cognitive impairment (MCI) or dementia in older women. However, parametric approaches require strong assumptions about the shape of the 24-hour activity rhythm, which may not be optimal. Therefore, we applied an established non-parametric analysis to test the association of rest-activity patterns with incident MCI and dementia in older women.

Materials and methods: Wrist actigraphy was used to collect 24-hour rest-activity rhythms in community-dwelling older women who participated in the multi-center Study of Osteoporotic Fractures. Among 2165 women who had >=2 24-hrs periods of actigraphy data and did not have evidence of probable dementia at baseline, 1232 returned for a follow-up neuropsychological test battery approximately 5 years later and were adjudicated by an expert panel as normal, MCI, or dementia. Using the non-parametric approach developed by Van Someren et al, rest-activity patterns were used to quantify interdaily stability (IS), intradaily variability (IV), least active 5-hour period (L5), most active 10-hour period (M10), and relative amplitude (RA). Logistic regression models were used to determine the association of non-parametric exposure variables with risk of incident MCI or dementia over the 5-year follow-up period. Models were adjusted for age, clinic site, race, education, body mass index, functional status, comorbidities, medication use, and health habits.

Results: Among 1232 women who completed the follow-up neuropsychiatric test battery, 287 (27%) were classified as having MCI, 178 dementia (14%) and 767 normal cognitive function (62%). In contrast to our previously published findings based on parametric analysis, none of the non-parametric rest-activity rhythm exposure variables were associated with risk of MCI. Having an earlier midpoint of the L5 interval (1 standard deviation or more below the mean) was associated with increased risk of incident dementia (odds ratio=1.6; 95% confidence interval 1.0 - 2.5; p< .05). In addition, those with lower RA (quartiles 1, compared to quartile 4) had significantly greater risk of dementia (1.8; 1.0 - 3.1; p< .05). Intradaily variability, interdaily stability, and M10 were not associated with risk of MCI or dementia.

Conclusions: Using a non-parametric approach to analyzing 24-hour rest-activity rhythms, we demonstrated that indices reflecting timing and amplitude predict risk of incident dementia, but not MCI. In contrast, our prior parametric analysis identified parameters related to risk of both MCI and dementia. Additional work should focus on identifying optimal parametric and non-parametric approaches to analyzing 24-hour activity patterns in older populations.

Aging and Developmental Issues
Board #028 : Poster session 2

IMPACT OF DIAPERS ON A SLEEP-WAKE RHYTHM OF 2-MONTH OLD INFANTS; EVALUATION BASED ON CORTISOL AWAKENING RESPONSE

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Introduction: An appropriate sleep-wake rhythm is important for the health and development of infants, and a sleep problem in infants often make their caregivers stressful. The cortisol awakening response (CAR) is frequently used to evaluate in phyconueroendocrinological research for sleep. We examined whether the difference in pressure placement of diapers affected sleep of 2-month old infants by using CAR and measuring their motor activity.

Materials and methods: After the explanation of the study design with careful ethical consideration, 32 pairs of mothers and their infants (2-months old) provided written consent and participated in the study. The participants used both diaper P designed with appropriate pressure placement based on the body shapes of infants and commercially available diaper Q with higher pressure than diaper P for 3 days at home, respectively. We asked the mothers to collect their infants' saliva in the time of wakening immediately and 30 min after awakening over study period. Additionally, we asked the mothers to place an actigraphy on the left upper arm of infants. This study was conducted after obtaining the approval of the research ethics committee of the Graduate School of Integrated Arts and Sciences, Hiroshima University and Shiga University.

Results: The total cortisol area under the curve (AUC) in diaper P was significantly higher than in diaper Q ($p < .05$). Sleep parameters from actigraphy indicated that the proportion of sleep at night of the total sleep in 24 hours (Rate) in diaper P was significantly higher than in diaper Q ($p < .05$).This Rate also indicated a significant correlation with daily physical activity amounts ($p < .01$). No significant difference was observed between diaper P and diaper Q in terms of time in bed, wake after sleep onset, sleep efficiency, or sleep latency.

Conclusions: The results of AUC and activity level suggest that the use of diapers with optimized pressure may support the formation of a sleep-wake rhythm in 2 months old infants.

ALDOSTERONE RENIN RATIO IN OBSTRUCTIVE SLEEP APNEA AND HYPERTENSION

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Introduction: Primary aldosteronism was thought to be a rare cause of hypertension with a low prevalence among the general hypertensive population. Resistant hypertension and primary aldosteronism are also associated with obstructive sleep apnea (OSA), although the causality of this association is still unknown. We propose to prove that primary aldosteronism with high aldosterone renin ratio is prevalent in OSA
Materials and methods: Subjects aged 30 to 65 were consecutively recruited by home visits in Jakarta, Indonesia. Subjects with moderate to severe OSA and hypertension were recruited in this study. Subjects were screened with Berlin questionnaire, high risk subjects were tested using unattended type 2 portable monitor (Alice Pdx). Hypertension was diagnosed when morning blood pressure exceeded 140/90 mmHg or subjects were on anti-hypertensive drugs. Serum concentration of aldosterone and renin were determined using ELISA method. Primary aldosteronism (PA) was screened with aldosterone renin ratio (ARR) $\geq$20.
Results: We recruited 40 subjects in this study consisting of 26 male and 14 female subjects, median age was 52.5 years, BMI 27.46 kg/m^2, AHI 40.05 times/hour, nadir 81.5%, serum renin concentration 366.75 pg/mL, aldosterone was 5189.07 pg/mL, and ARR 16.34. While most subjects had low renin levels, aldosterone levels were more evenly spread in the higher and lower levels. ARR were mostly low, but some subjects had extremely high ratio. We found 16 (40%) OSA subjects with PA and 24 non PA. There was no correlation between aldosterone serum concentration and AHI in both OSA with PA and non PA groups. However**,** there was correlation between BMI and ARR in OSA subjects with PA only
Conclusions: Subjects with moderate to severe OSA and hypertension had high prevalence of primary aldosteronism as reflected by ARR, also that obesity played an important role in the development of primary aldosteronism in OSA. It is important to screen moderate to severe OSA subjects with hypertension for the presence of PA, especially in obese subjects.

AGE-RELATED CHANGES IN THE NAPPING CORTISOL AWAKENING RESPONSE (CAR) DURING EARLY CHILDHOOD

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Introduction: The cortisol awakening response (CAR) is a distinct part of cortisol's 24-hour diurnal rhythm. It is marked by a sharp increase in basal cortisol levels peaking 30-45 minutes post awakening. This physiological phenomenon occurs after both nighttime sleep episodes and daytime naps. The CAR after nighttime sleep episodes is frequently assessed in sleep and neuroendocrine research in adults, but findings about how the CAR changes during early childhood, particularly in the context of napping, are scarce and inconsistent. In this study, we tested the hypothesis that the napping CAR would show age-related changes, becoming less robust as young children increase in age.

Materials and methods: Eighteen healthy children (9 females) were studied at 2.5-3.0 y (T1) and 3.5-4.0 y (T2). At both time points, children followed a strict sleep schedule for ≥ 5 days before completing 2 randomly ordered CAR assessments: One following a late morning nap and another after a mid-afternoon nap. Wake time was verified with actigraphy and sleep EEG. Saliva samples were obtained immediately after nap awakening (0 min) and then at 15 min, 30 min, 45 min, 1.5 h, and 2.25 h. Saliva was assayed for cortisol (µg/dL). We computed total cortisol secretion as area under the curve with respect to ground (AUCg) and the dynamic of the response as minimum-maximum percent change (PC). Paired t-tests for both morning and afternoon naps were used to compare differences in AUCg and PC between T1 and T2.

Results: Children's AUCg for the morning nap CAR showed a decrease from T1 to T2 (0.805 ± 0.340 vs. 0.598 ± 0.189 mg/dL^2; $t = 2.95$, $p = 0.01$, $d = 0.75$); however, we found no significant difference in the dynamic of the CAR (PC). Additionally, we observed no difference in either CAR measures between T1 and T2 for the afternoon nap.

Conclusions: Our findings indicate that the CAR after a morning nap but not an afternoon nap shows an early age-related change, becoming less robust from age 2 to 3 years. This decrease in the morning nap CAR suggests that as young children age, their ability to adapt to upcoming stressors across the day increases. Future research should examine how both the morning and afternoon napping CAR continue to develop as children transition into preschool (3-5 years old) and how the CAR is related to behavioral and cognitive outcomes. Such data could lead toward the possibility of using the CAR as a biomarker of stress resilience for young children in early life.

Aging and Developmental Issues
Board #016 : Poster session 1
SLEEP QUALITY AND CORRELATION BETWEEN ANTHROPOMETRY AND ELDERLY WOMEN OF THE SENIOR UCS PROGRAM

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The objective of this study was to evaluate the sleep quality and its relationship to anthropometry based on a sample of elderly women participating in the UCS Senior Extension Program. This is a cross-sectional study, based on the UCS NUTENV project database. The sample consisted of 130 elderly women whose demographic, socioeconomic, anthropometric and sleep quality variables were analyzed. The results showed that most of the elderly women have completed higher education, are married, and have a monthly income of 2 to 4 times the Brazilian minimum federal wage. As for the anthropometric evaluation, 46.9% of the elderly women are at a very high risk for CVD, considering WC. Regarding BMI, 56.2% are overweight. The elderly women sleep an average of 7.24 hours, and those classified as having low-weight BMI sleep less than those with an overweight BMI. There was no significant correlation for insomnia and increased waist circumference. It is suggested that further studies be conducted on the relation between anthropometry and sleep.

Aging and Developmental Issues
Board #029 : Poster session 2

INFLUENCE OF DEMOGRAPHIC, SOCIOECONOMIC, CLINIC AND BEHAVIORAL FACTORS IN SLEEP QUALITY IN CLIMATERIC WOMEN

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Introduction: According to the World Health Organization (WHO), the climacteric is a biological phase of life and not a pathological process, which comprises the transition between the reproductive and non-reproductive period of woman´s life[1]. The age of the woman is one of the main factors associated with the alterations in the sleep since, among the elderly, the awakenings increase significantly[2]. Concerning schooling, the lower the schooling, the more severe are the symptoms in the climacteric. This fact is due to access to information and search for better life quality[3]. The objective of this work is to establish a correlation between demographic, socioeconomic, behavioral, and clinical factors with quality sleep in climacteric women in the city of Caxias do Sul.

Materials and methods: A cross-sectional study in the Ambulatório de Climatério and at the Cirurgia Ginecológica, belonging to the Ambulatório Central of the Universidade de Caxias do Sul (AMCE), Brazil from January 2010 to April 2011. Data were collected from 551 women in the age group of 40 to 65 years complete.

Results: The prevalence of short sleep duration (> 5 hours) was 15.1%. The average hours of sleep were 7 hours. About 27.9% have family income and 0-2 minimum wages, with 74.0% having 4 or more meals. About 45.7% of the women were in the perimenopause, and 77.9% of the women had minor psychiatric disorders.

Conclusions: Low educational level, the presence of minor psychiatric disorders and quantity of meals/day (> 3) had an association with sleep less than 5 hours. Sleep cannot be neglected during the clinical care of climacteric women since insomnia is observed in a significant sample in this period.

Keywords: Climacteric; socioeconomic factors; behavioral factors; clinic factors; demographic factors

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"DID MY CHILD SLEEP TODAY?": COMMUNICATION BETWEEN PARENTS AND EDUCATORS IN CHILDCARE SETTINGS

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Introduction: Early Childhood Education and Care (ECEC) services are sleep environments that may influence sleep patterns in two key ways. First, ECEC practices may maintain or disrupt 24-hour sleep patterns established in the home environment. Second, as attendance at ECEC coincides with the transition to monophasic sleep in which children's needs for daytime sleep decrease, ECEC practices may respond to prolong napping. Communication between parents and educators is therefore critical in ensuring regularity and responsiveness to children's sleep needs and behaviours yet knowledge about if and how this happens is limited. We sought to address this gap.
Materials and methods: Survey data, from 116 parents and 39 educators across 20 Australian ECEC services were analysed to assess the type and regularity of communication strategies between educators and parents. Qualitative analyses investigated content of sleep-related communications.
Results: In-person communication at pick-up and drop-off times were the most commonly used communication method. Communication was often one-way, educator to parent. Some parents (19%) reported that they never communicated about sleep at home. Communications focused primarily on the occurrence (Did my child sleep today?) or duration of sleep (How long?) during the ECEC day. Communication about home practices were less common.
Conclusions: Communication between parents and educators is imbalanced. Educators share more sleep-related information about children with parents, than parents do with educators. Additionally, there was a focus on quantity of sleep. Communication that could support continuity of practices and consistency of timing across home and ECEC is limited. This study highlights potential barriers to communication and the need for improved communication between educators and parents to support children's sleep health.

MANY NAPS, ONE NAP, NONE: TRACKING THE DEVELOPMENTAL SIGNIFICANCE OF SLEEP TRANSITION IN EARLY CHILDHOOD

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Introduction: Current understanding of the processes underpinning the normative transition from multiple sleep-wake cycles seen in infancy (*polyphasic sleep*) through to consolidation of sleep into a single night period (*monophasic sleep*) is limited. Age at cessation of napping occurs anywhere between age 1 and 5 years. Yet the extent to which this timing holds significance for ongoing learning, behavior and health, is not well understood. Care practices almost certainly influence this timing, but we do not understand in what way or to what effect. The absence of such evidence generates controversy. For example, while 80% of Australian childcare settings allocate a mandatory sleep time for preschool children, 79% of parents do not want them to nap. Understanding the developmental meaning of changing sleep patterns, the association of individual sleep patterns with variation in care environments, and the pathway from these to long-term child outcomes are all necessary steps in identifying appropriate care. The 'Sleep transitions' study aims to (1) *Characterise* the developmental transition of sleep patterns from *polyphasic* (multiple naps) to *monophasic* sleep (cessation of napping) using objective sleep-wake measurement and developmental assessments; (2) *Identify* individual characteristics and environmental factors that predict variation in early sleep patterns, timing of napping cessation, and ongoing associations with learning, behaviour, and health; and (3) *Translate* findings into meaningful guidance for care practices and educational policy.

Materials and methods: A 4-year prospective longitudinal study of 300 Australian children tracked from 12 months to 5 years, with linkage to government education databases at school entry, will be undertaken. Intensive objective measurement of sleep-wake, together with measurement of learning, emotional regulation, and behaviour is applied to assess the association between sleep patterns and child development.

Repeated objective measurement of 24-hour sleep patterns will be assessed objectively. Children will wear an actigraph (*Axivity UK*) on their non-dominant wrist *continuously for 2 weeks every 6 months* to measure sleep-wakes states. The *Ages and Stages Questionnaire (ASQ-3)*, will be used to assess learning and behaviour. ASQ-3 is designed for repeat measurement at close intervals, and therefore is suitable for the proposed measurement schedule. To allow for measurement of executive control and congnitive processing at ages 3 and 4, the computerised NIH Toolbox Early Childhood Cognition Battery is added to the measurement suite. Sleep environment at home and at ECEC will be assessed using a customized environmental measurement system that combines measurement of light, temperature, and noise.

Results: First, we will use group-based trajectory modelling to understand the changing patterns of sleep functions within and across episodes. Second, the associations between early biological and social environments and sleep patterns will be examined. Third, we will assess impacts on development across early childhood. And finally, we will explore the mechanisms of the pathways between individual characteristics, care environment, sleep trajectories and outcomes.

Conclusions: The research outcomes are targeted to inform parents and non-parental carers about the impact on all children through improved lifetime health and educational trajectories.

SLEEP PATTERNS, SLEEPINESS, AND COGNITIVE PERFORMANCE AMONG ISRAELI ADOLESCENTS: A FIELD STUDY

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Introduction: Cognitive performance - memory, attention and other cognitive performance-depends on quality of sleep, especially during adolescence. Research analyzing self-report sleep data has consistently presented associations between sleepiness and a decline in cognitive ability. This field study extends previous findings by examining objective and subjective sleep patterns, sleepiness, and cognitive performance among Israeli adolescents aged 12-19.

Materials and methods: The study subjects were 59 adolescents (32 female) in seventh to twelfth grade, middle and high schools in urban and rural middle-class communities in northern Israel (16.29±1.86 years). Sleep duration and quality were objectively measured using actigraphs (Actiwatch 2, Respironics, Philips), for seven consecutive days, including both school and non-school days. To measure sleepiness, subjects completed the Karolinska Sleepiness Scale (KSS), a 9-point Likert scale self-reporting their sleepiness, ranging from 1 ("Very alert") to 9 "Very sleepy-fighting sleep". To assess cognitive performance, participants completed a visual psychomotor vigilance task (PVT) and a Digit Symbol Substitution Test (DSST).

Procedure: The subjects were collected using the snowball method. Participants wore the Actiwatch for six consecutive days. Subjective sleepiness (KSS) and cognitive performance were measured three times daily (morning, noon, and nighttime) on two school days and one non-school day. The study was approved by the ethics committee at Emek Yezreel College (2017-5 EMEK YVC).

Results:

Night Sleep: The duration and pattern of sleep differed significantly between school and non-school days. On non-school days, subjects fell asleep later (01:16±1:45 vs. 23:47±1:04), woke up later (9:12±1:45 vs. 7:09±0:49), had longer sleep latency (33:35±39:04 vs. 19:10±15:35) and longer sleep duration (8:05±1:31 vs. 7:21±0:54). There were no significant differences in sleep efficiency.

Sleepiness: Mixed model analysis revealed a statistically significant difference in reported sleepiness between school and non-school days ($F_{(1,334)}$=8,83, $p< .003$), as well as between different times of day. On non-school days, adolescents reported lower KSS (mean=4.70) than on the non-school days (mean=5.28). KSS was lower on weekday afternoons than in the morning ($p< .001$) or night KSS ($p< .001$). KSS was significantly higher on non-school days night than morning and afternoon KSS ($p< .001$).

Psychomotor Vigilance Test (PVT): Mixed model analysis found significantly more errors (6.0 vs. 4.4; $F_{(1, 278)}$=6.47, $p< .01$), higher mean reciprocal RT fastest (185.9 vs. 179.9; $F_{(1, 278)}$=4.64, $p< .05$), more lapses system variability min (4.8 vs. 3.4; $F_{(1, 278)}$=6.29, $p< .01$), more lapses system variability max (6.8 vs. 5.3; $F_{(1, 278)}$=4.52, $p< .05$) on school days than on non-school days. Subjects offered significantly fewer responses to the DSST test in the morning than at noon or night-time ($F_{(2, 277)}$=3.54, $p< 0.05$).

Conclusion: Actigraphic recording and subjective sleep reports support a shift among adolescents in sleep-wake pattern toward late evening, a late rise time on school days, and an even later one on non-school days. About 24% of participants were sleep deprived, slept less than 7 hours a night, 52% slept between 7-8 hours, and 24% slept longer than 8 hours. Sleep deprivation led to higher KSS and poor performance on the PVT and DSST during school compared to non-school days.

FUNNEL CHEST IS ASSOCIATED WITH SLEEP-RELATED SYMPTOMS IN CHILDREN

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Introduction: The purpose of the study was to estimate the prevalence of funnel chest, and to elucidate its association with sleep-related symptoms.

Materials and methods: This is a part of Matsuyama Children's Study, conducted between 1 October 2014 and 31 March 2015. We delivered nearly 25,000 set of a questionnaire to the care givers of all the school children in Matsuyama city, and identified children with high risk for sleep disordered breathing, who were invited for a detailed examination, including physical examination and assessment of their sleep disordered breathing (SDB) by type 3 portable sleep monitors.

Results: The data of 481 children was analyzed and funnel chest was observed in 27 children, suggesting that the prevalence of funnel chest is estimated to be 1 to 5 percent. The present study also showed that funnel chest was associated with disrupted breathing, and not with RDI values. The dissociation was caused by the presence of children who were witnessed to have disrupted breathing, but have RDI lower than 1. In addition, the association was observed even in a group who showed disrupted snoring a night per week.

Conclusion: The present study showed that funnel chest was associated with a minimal frequency of disrupted breathing and snoring.

THE ASSOCIATION BETWEEN SLOW-WAVE ACTIVITY (SWA) AND PROCESSING SPEED IN TODDLERS

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Introduction: During early childhood, the brain undergoes massive morphological changes and cognitive functions mature. Additionally, slow-wave activity (SWA), a marker of the depth of sleep, shows an inverted U-shaped time course during development. Specifically, maximal SWA undergoes a posterior to anterior shift from early childhood (2 years) to late adolescence (20 years), which may reflect cortical maturation. In preschool-aged children, we previously showed that greater slow sigma power during sleep predicted faster reaction time. To date, little is known about the relationship between SWA and processing speed, a basic fundament underlying complex cognitive skills in early development.

Materials and methods: This project examined the relationship between SWA and processing speed in 2.5-3.0-year-old children (n=26, 50% males) via home-based assessments. All children enrolled in the study were regular nappers. After a 5-day stabilization sleep schedule, a baseline sleep EEG recording was performed on participants at 4 electrode placements: Fz, Oz, C3, and C4. SWA EEG spectral power was quantified in the 0.75-4.5 Hz range during the first 60 minutes of NREM sleep. Processing speed was obtained as part of a standard cognitive assessment via a computer-based task one hour after waking from a midday nap. All assessments were performed in the homes of participants. Pearson correlations were used to assess associations between processing speed and SWA from each of the four electrode sites.

Results: On average, reaction time (processing speed) was 2111 ± 408 ms and SWA was 856.4 ± 300.7 μV^2/Hz. Although we examined spectral power in three different ranges (delta, theta, sigma), we found only a significant correlation between SWA and processing speed in the occipital region. Increased SWA in the occipital region was predictive of a longer reaction time and therefore slower processing speed (r = 0.44, p = 0.03). Observation of this relationship showed differences between sexes, suggesting that females (r = 0.26, p = 0.07) may show a stronger association between SWA in the occipital brain region and processing speed than males (r = 0.09, p = 0.33). Average SWA from electrodes C3 and C4, as well as the frontal-to-occipital ratio, showed no association with processing speed.

Conclusions: Interestingly, these findings contradict our hypothesis based on previous data with older children indicating that greater SWA was associated with more advanced behavioral and cognitive skills. This discrepancy may potentially reflect the stark individual differences that are present within this rapidly maturing age group. Future research should not only examine the relationship between processing speed and SWA longitudinally across early childhood, but also include complex executive functions and other sleep parameters (e.g., slow and fast sigma activity).

SLEEP AND MEDIA USE IN 3-6 YEAR-OLD CHILDREN: DIFFERENCES BETWEEN GOOD AND POOR SLEEPERS

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Introduction: The technological revolution has changed media and the way children interact with it and their world. Existing data indicate that increased media use is associated with poor sleep quality in school-age children and adolescents. To date, very little is known about links between sleep and media in young children, even though recent surveys estimate that electronic media use in this age group is increasing and behavioral sleep problems are prevalent. In this study, we employed assessments of sleep and media use and tested the hypothesis that poor sleeping children would be more likely to engage with media than good sleeping children.

Methods: Participants were 35 children from two different cohorts: (1) Healthy, good sleepers (n=17, 7 males, 4.1±0.5 years) who reportedly obtained ≥10.5 hours per night and had no behavioral sleep problems and (2) Poor sleepers (n=18, 9 males, 5.5±0.7 years) who reportedly obtained chronic insufficient sleep ≤9 hours/night and/or had behavioral sleep problems (e.g., bedtime resistance, sleep onset delay) for ≥6 months. Sleep duration, sleep onset latency (SOL), and bedtime were quantified through 7 nights of actigraphy and verified with sleep diaries. Parents completed the Children's Sleep-Wake Scale (CSWS), a multi-dimensional measure of behavioral sleep quality (higher scores=better). Media use was assessed across 2 weekdays and 2 weekend days through a parent-reported media diary. We defined digital media as any electronic device involving screen time (e.g., tablet, smart phone) that engages children in a variety of activities (e.g., games, reading). A chi-squared test compared the proportion of children who used media, and independent t-tests compared the duration of media use, actigraphy variables, and CSWS scores between groups.

Results: As expected and as evidence of the validity of our groups, we found that poor sleeping children on average had longer SOL (28.4±25.5 vs. 19.8±15.2minutes, t=-3.2, p< 0.01), shorter sleep duration (591.8±53.1 vs. 627.7±44.0 minutes, t=5.8, p< 0.01), and reduced behavioral sleep quality (3.4±0.8 vs. 4.7±0.5, t=6.2, p< 0.01) compared to good sleeping children. Additionally, average daily media use duration was higher in poor than good sleepers (124.9±112.8 vs. 74.7±63.8 minutes, t=-3.4, p< 0.01), and poor sleeping children were more likely to use media across the 4 days (92% vs. 81%, χ2=4.3, p=0.04) compared to good sleeping children.

Conclusions: Our findings indicate that media use likely plays an important role in early childhood sleep health. Young children who use more media are more likely to take longer to fall asleep, have poorer behavioral sleep quality, and shorter sleep duration overall. Time displacement (time spent using media instead of sleeping), psychological stimulation, and the effects of screen light on circadian timing are potential mechanisms underlying these associations. It is important to note that media use and sleep have a bidirectional relationship, and parents should consider the timing and reasoning behind their child's media use, especially in the 1-2 hours before bedtime. Future research should incorporate more complex assessment of media use and examine more dynamic changes in media and sleep health pre-post intervention.

EFFECTS OF MENOPAUSE ON SLEEP SYMPTOMS: CANADIAN LONGITUDINAL STUDY ON AGING

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Introduction: Sleep complaints are one of the most common symptoms related to the menopausal transition, affecting 40-60% of women. However, it is difficult to disentangle changes in sleep that are due to aging from those directly due to menopause. The aim of this study was to compare different types of sleep disorders in 45-60-year menopausal and pre/peri-menopausal women in a large population-based study.

Materials and methods: Women aged between 45-60 years who self-reported menopausal status were selected from the Canadian Longitudinal Study of Aging (CLSA), excluding those with prior hysterectomy. Participants completed assessments for overall sleep satisfaction, hours of sleep per day, sleep-onset insomnia disorder, sleep-maintenance insomnia disorder, daytime somnolence disorder, rapid eye movement sleep behavior disorder (RBD), restless leg syndrome (RLS) and obstructive sleep apnea (OSA). Each sleep variable was compared between post-menopausal and pre/peri-menopausal women using multivariate regression, adjusting for age, hormone replacement therapy, number of child-bearings, body mass index, anxiety, depression, and other potential confounders.

Results: Among 6179 women included in the analyses, 3713 (60.1%; mean age=55.7±3.3) were post-menopausal and 2466 (39.9%) were pre/peri-menopausal (mean age: 49.80±3.1). Compared to pre/peri-menopausal women, post-menopausal women were more often reported requiring ≥30 minutes to fall asleep (20.4% vs. 15.5%, Adjusted OR=1.24, 95%CI=1.00-1.53) and were more likely to meet criteria for possible sleep-onset insomnia disorder (10.8% vs. 7.3%, AOR=1.51 [1.07-2.12]). Plotting symptom onset according to menopausal onset, exhibited that the majority of women reported the onset of insomnia symptoms within 2 years before and 6 years after menopause onset. Post-menopausal women were also more likely to screen positive for OSA (14.6% vs. 10.4%, AOR=1.48 [1.14-1.92]). The two groups did not differ on sleep dissatisfaction (32.4% vs. 29%), daytime somnolence disorder (1.6% vs. 1.3%), sleep-maintenance insomnia disorder (17% vs. 14.5%), RLS (23.5% vs. 20.9%) or RBD (3.9% vs 4.0%).

Conclusions: Compared to pre/peri menopausal women of similar age, menopausal women have increased insomnia, which appears to be specific to sleep-onset difficulties, and with an onset of symptoms that is commonly timed to the onset of menopause. Menopausal women also are more likely to screen positive for OSA. However, menopausal status is not associated with sleep-maintenance, somnolence, or RLS, and RBD.

SOCIAL JET LAG, SCREEN TIME, PHYSICAL ACTIVITY AND SLEEP QUALITY IN INDIAN YOUNG ADULTS

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Introduction: Acute stress levels have been shown to be associated with BMI, physical activity, screen time, and ambient noise exposure. These factors are also associated with poor sleep quality. We hypothesize that BMI, physical activity, screen time, and ambient noise exposure affect acute stress levels via their effect on sleep. If the role of sleep is removed from this association, the strength of association becomes weaker.

Materials and methods: A self-administered questionnaire survey was conducted online, to assess the BMI, level of physical activity, screen time, ambient noise exposure and sleep . Severity of acute Acute stress Stress symptoms Symptoms was analysed using American Psychiatry Association-National stressful Stressful events Events survey Survey acute Acute stress Stress disorder short Short scale (APA-NSESS). Sleep was assessed by Pittsburgh sleep quality index (PSQI) global score, sleep duration during weekdays, Sleep duration during weekends/holidays, latency of sleep, efficiency of sleep and, Social jet lag). Sleep parameters (excluding social jet lag) were assessed using PSQI questionnaire. Social jet lag was calculated as the difference between the mean of average bedtime and average wake-up time on weekends and on weekdays. BMI was calculated using the self- reported height and weight. Level of physical activity was first categorised as moderate or vigorous, and then the hours per week of exercise was calculated using hours per day and number of days the activity is performed in a week.

Results: 503 (237 were females, 259 as males after exclusion of 7 individuals on the basis of inclusion-exclusion criterion) young adults aged 18-25 years living in New Delhi, India filled the questionnaire. 7 participants were excluded on the basis of inclusion-exclusion criteria. 237 were females, 259 were males. The data was analysed using SPSS (version 26, 2019, IBM Co). Average sleep duration on weekdays and weekends were 6.49 +/- 0.80 and 7.17 +/- 0.61 hours respectively. 71 (14.3%) participants had a social jet lag >=2 hours, and 207 41.7% had a social jet lag of 1-2 hours. Strong significant correlations (p< 0.001) were present between severity of acute stress symptoms and PSQI global score (pearson Pearson's correlation coefficient (r) =0.324), Sleep duration-weekdays (r=-0.214), Sleep latency (r=0.208), Sleep Efficiency (r=-0.205). Significant correlations (p< 0.05) were present between severity of acute stress symptoms and Screen screen time (r=0.100), Social social jet lag (r=0.106), Sleep sleep duration-weekends/holidays (r=-0.140). No combination of three variables (one from each category - independent, mediating and dependent) were significantly correlating with one another, hence we cannot apply the Sobel test for mediation analysis.

Conclusions: Positive correlation of acute stress with Increased latency of sleep, and social jet lag, decreased sleep efficiency and lesser duration of sleep are associated with higher levels of acute stress. Longer sleep duration during both weekdays and weekends is associated with lower acute stress levels. Sleep duration during weekdays is more significantly associated with acute stress than sleep duration during weekends/holidays. Sleep does not mediate the relationship between acute stress levels and BMI, physical activity, screen time, and ambient noise exposure.

Basic Research
Board #030 : Poster session 3
FREQUENCY AND PREDICTORS OF SLEEP DURATION MISPERCEPTIONS: RESULTS FROM THE ELSA-BRASIL STUDY

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Introduction: Previous evidence using subjective data have associated both short and long sleep duration (SD) with cardiometabolic conditions like obesity, diabetes and hypertension. However, recent studies using objective data of SD in the subject's routine have questioned he real frequency of short and long sleepers as well as the aforementioned cardiometabolic associations. The objectives of this study are: 1) to explore the agreement of self-reporting against objective measurements of SD using wrist actigraphy; 2) identifying the burden and predictors of SD misperceptions (either underestimation or overestimation) in a cohort of adults no referred to sleep studies.
Materials and methods: We recruited participants from the ELSA-Brasil study who completed a clinical evaluation, a wrist actigraph device for 7 days and answered questions about self-reported SD. All participants also performed a home sleep study (Embletta Gold™) for the diagnosis of obstructive sleep apnea (OSA). The mean differences, the Bland-Altman method and Pearson correlation coefficients (r) were assessed for to explore the bias and agreement between the self-reported and actigraphy SD data. Was used multinomial logistic regression for identify sociodemographic and sleep characteristics associated with SD underestimation (subjective SD≥-1 hour compared to the objective data) and SD overestimation (subjective SD≥+1 hour compared to the objective data).
Results: Data from 2,036 participants were used in the analysis (42.7% males; mean age: 49±8 years). The frequency of overall SD matching (difference between self-reported and actigraphy data < 1h) was 60.9%. The remaining comprised 395 participants (19.4%) who underestimated and 401 participants (19.7%) who overestimated. Overall, the average SD was 6.6±1.2h by self-reported and 6.6±1.0h by actigraphy. However, a poor correlation (r=0.264) and agreement (average difference of 0.0h, with 95% CI: -2.56, 2.57, p=0.0016) were found between two methods. Among participants with short SD (< 6h) using objective data, 49% of them overestimated and 2% of them underestimated SD. In contrast, for those who sleep more than 9h, only 6% of them overestimated while 47% underestimated SD. Mixed race (OR 1.74), black race (OR 2.76), excessive daytime sleepiness (OR 1.46), objective SD (OR 2.98) and wake after sleep onset (OR 2.38) were independent variables associated with SD underestimation. On the other hand, Asian/other race (OR 0.49), married (OR 0.70), education beyond High School (OR 0.75), excessive daytime sleepiness (OR 0.72), and objective SD (OR 0.37) were protective variables for overestimation, while wake after sleep onset (OR 2.24) and number of awakenings (OR 1.02) were risk factors. The presence of OSA was not a predictor of both over or underestimation of SD.
Conclusions: The agreement between self-reported and actigraphy-assessed SD is poor, reinforcing the need to avoid subjective data in this scenario. Self-reported SD has shorter bias when actual SD is between 6 and 9 hours. Different factors were associated with underestimation and overestimation of SD. For example, in relation to the white race, mixed and black people underestimate more SD, while the Asian race overestimate less. In addition, excessive daytime sleepiness has a protective role for overestimation and is a risk factor for underestimation of SD.

HIGHER ACUTE STRESS AND SCREEN TIME BUT NOT SOCIAL JET LAG ARE ASSOCIATED WITH HIGH RISK OF SLEEP APNOEA IN INDIAN YOUNG ADULTS

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Introduction: Young adults with high BMI have been shown to be at higher risk for obstructive sleep apnoea. A number of factors such as acute stress levels, physical activity, screen time, and ambient noise exposure also affect the relationship. These factors are also associated with poor sleep quality. This study examined the association of high risk of sleep apnoea with acute stress, BMI and social jet lag.

Materials and methods: A self-administered questionnaire survey was conducted online to assess the risk of obstructive sleep apnoea, BMI, level of physical activity, screen time, ambient noise exposure and sleep quality . Risk for OSA was assessed by Berlin questionnaire, severity of acute acute stress stress symptoms symptoms was analysed using American Psychiatry Association-National stressful Stressful events Events survey Survey acute Acute stress Stress disorder short Short scale (APA-NSESS). Sleep quality was assessed by Pittsburgh sleep quality index). Social jet lag was calculated as the difference between the mean of average bedtime and average wake-up time on weekends and on weekdays. The data was analysed using SPSS (version 26, 2019, IBM).

Results: 503 (237 were females, 259 as males after exclusion of 7 individuals on the basis of inclusion-exclusion criterion) young adults aged 18-25 years living in New Delhi, India filled the questionnaire. 7 participants were excluded on the basis of inclusion-exclusion criteria. 237 were females, 259 were males. Average sleep duration on weekdays and weekends were 6.49 +/- 0.80 and 7.17 +/- 0.61 hours respectively. 71 (14.3%) participants had a social jet lag >=2 hours, and 207 41.7% had a social jet lag of 1-2 hours. Strong significant correlations ($p < 0.001$) were present between severity of acute stress symptoms and Berlin questionnaire score (pearson Pearson's correlation coefficient (r) =0.367, $p < 0.001$), BMI and Berlin questionnaire (r= .128, $p < 0.001$) and screen time and Berlin questionnaire (r=0.123, $p < 0.001$). High risk for OSA was also inversely associated with duration of sleep on weekdays (r=-1.31, $p < 0.001$). Social jet lag did not demonstrate a significant correlation with sleep apnoea.

Conclusions: High risk of obstructive sleep apnoea is associated with higher acute stress levels, higher screen time and decreased duration of sleep during weekdays. Social jet lag was not associated with high risk of sleep apnoea.

PSYCHOLOGICAL FACTORS ASSOCIATED WITH SELF-AWAKENING ABILITY

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Introduction: Some individuals, defined as "self-awakeners", report the ability to spontaneously awake from nocturnal sleep, at a desired time, without the aid of any alarm clock or other external stimuli[1]. This ability possibly implies planning one's awakening time at sleep onset and automatically triggering during sleep a gradual change of physiological variables leading to the transition to wakefulness.

While a number of studies have described the modifications of physiological[2] and behavioural[3] variables in proximity of awakening, as well as the objective sleep features of self-awkeners[4], only few others have investigated psychological factors (e.g. self-efficacy[5], motivation[6] and chronotype[7]), so that it still remains largely unclear which of them, and to what extent, are involved in successful self-awakening.

Here we compare a group of Self- and Forced awakeners on a set of psychological and chronobiological variables (i.e., personality traits, anxiety, depression levels and chronotype) with the aim of assessing the possible role of these factors in the modulation of self-awakening ability.

Materials and methods: A sample of 1176 young volunteers (F=903; M=273; age=21.9 ± 4.3) completed the following self-report instruments: (1) a questionnaire on sleep habits[8] to distinguish Self-Awakeners (SA) from Forced Awakeners (FA) (two items were considered as inclusion criteria for the SA group: not habitually using any alarm to wake up, self-reported ability to wake up at a predetermined time); (2) the Morningness - Eveningness Questionnaire, MEQ[9]; (3) the Pittsburgh Sleep Quality Index, PSQI[10]; (4) the Ten Item Big Five Inventory, TIBI[11] ; (5) the State-Trait Anxiety Inventory, STAI[12]; (6) the Beck Depression Inventory, BDI-II[13].

For continuous variables, between-groups differences were assessed through non parametric Mann-Whitney Test, due to non normal distribution of the variables verified through the Shapiro test. Chi square test was performed, instead, to address differences in chronotypology.

Results: Our sample includes 136 SA (11,6%) and 1040 FA (88,4%) ($\chi2(1)$= 1176,0; p=< .001).

Compared to FA, SA are more frequently morning types ($\chi2(2)$= 21,900; p=< .001) and show a higher degree of Conscientiousness (U=59086,0; p=.002) and Neuroticism (U=59471,0; p=.002). No significant inter-group differences emerged, instead, in depression, anxiety, extraversion, agreeableness, openness and subjective sleep quality scores.

Discussion: Our findings confirm extant literature on the association between morning chronotypology and self-awakening ability (Crabb, 2003). Moreover, they suggest that, along with physiological and chronobiological factors, interindividual differences in personality traits (namely conscientiousness and neuroticism) may play a significant role in modulating this ability.

References:
1) Moorcroft et al., 1997;
2) Born et al., 1999;
3) Abourdan et al., 2006;
4) Lavie et al., 1979;
5) Matsuura et al., 2010;
6) Hawkins, 1989;
7) Crabb, 2003;

8) Zilli et al., 2009;
9) MEQ italian version by Mecacci & Zaini, 1983;
10) PSQI italian version by Curcio et al., 2013;
11) TIBI italian version developed by Chiorri et al., 2014;
12) STAI italian version by Pedibrassi & Santaniello, 1989;
13) BDI-II italian version by Ghisi et al., 2006.

IMPACT OF NON-INVASIVE VENTILATORY SUPPORT IN AN OBSTRUCTIVE SLEEP APNEA COHORT OF PATIENTS: A 10-YEARS FOLLOW-UP STUDY ON CARDIOVASCULAR EVENTS INCIDENCE

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Introduction: Obstructive sleep apnea (OSA) has gained a huge relevance, mainly due to its proven impact in multiple cardiovascular (CV) events. Accumulating evidence suggests that successful OSA treatment with positive airway pressure (PAP) can improve CV outcomes.
This study aimed to evaluate the incidence of CV and CeV events and related mortality in 89 males with moderate-to-severe OSA treated with PAP over 10 years, and to assess its relation with PAP adherence.

Results: Of the 89 patients included (mean age 53.5±11.7 years, BMI=33.2±4.9 kg/m^2, initial AHI=52.9±20.6 events/h, Epworth scale=12.2±5.3), 17 were active smokers, 63 had hypertension, 1 hyperuricemia, and 5 had previous CV and/or CeV events. Over follow-up, AHI and Epworth scale decreased significantly (p< 0.001) reaching minimum levels of 2.6±1.8 events/h and 4.2±3.9, respectively. Most of patients were PAP adherent (mean objective compliance= 93.8±13.9%, with 6.5±1.6 h/use/day). At time of last evaluation, mean adherence rate and hours use/day were, respectively, 98.1±3.1% and 7.0±1.4, being found a progressively strong negative correlation between PAP adherence and CeV/CV events, mostly after the 6th year. Over this period, 9 patients had CV and 5 CeV events, and 2 experienced both events. Mean survival time was 123.9±25.9 months: lower in those who had CV and/or CeV events (p< 0.001). Ten patients died (3 by CVD complication, 1 myocardial infarction, 2 stroke, and 1 cardiopulmonary arrest).

Conclusions: Although AHI presented an immediate and sustained decrease with PAP treatment, only an effective PAP adherence (especially after 24 months) seems to be effective in decreasing CV/CeV events, especially when used for more than 6 years.

Acknowledgements: Sleep Unit, Pneumology Service Centro Hospitalar e Universitário de São João

PREDICTIVE FACTORS OF OSA: THE ROLE OF METABOLIC SYNDROME

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Introduction: OSA is a disease with increasing prevalence and is reported to have a metabolic profile pedisposing to cardiovascular disease. The aim of this study was to assess the association between OSA and metabolic alterations and to evaluate the role of hypoxemia on metabolic abnormalities
Materials and methods: To this end, we performed a prospective study
of patients who underwent seep study in Constanta Sleep Disorders Center, between 2015-2019. General physical measurement, blood sampling and overnight polygraphy were performed for all patients. OSA was consider present when AHI >15. The patient group consisted of 178 patients out of which 104 (58.42%) patients were found to have metabolic syndrome.
Results: The prevalence of metabolic changes among OSA patients increased with increasing AHI and increasing desaturation index. Among the risk factors associated with these pathologies, obesity is the most important causal factor for metabolic disease as well as for OSA. OSA has also been associated with the development or aggravation obesity, dyslipidemia, metabolic syndrome, nonalcoholic fatty liver disease and insulin resistance or type 2 diabetes mellitus. However, the role of metabolic abnormalities in determining or aggravating OSA is still unknown. Metabolic disorders and OSA share common pathogenic pathways, including alterations in autonomic nervous system regulation, increased inflammatory activity, and alterations in adipokine levels and endothelial dysfunction. Overall, the association between OSA and metabolic alterations is complex with confounding determinant elements. In addition..
Conclusions: The severity of OSA and hypoxemia may have a role in the pathogenesis of metabolic dysfunctions independent of obesity and therefore this association is complex and bidirectional and should be evaluate in every patient.

Basic Research
Board #005 : Poster session 2
THE CORPUS CALLOSUM IS ESSENTIAL FOR THE CROSS-HEMISPHERIC PROPAGATION OF SLEEP SLOW WAVES: A HIGH-DENSITY EEG STUDY IN TOTALLY CALLOSOTOMIZED PATIENTS

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Introduction: The slow waves of NREM-sleep (0.5-4Hz) reflect experience-dependent synaptic plasticity and play a direct role in the restorative functions of sleep. Importantly, slow waves behave as traveling waves and their propagation is assumed to reflect the existence and structural properties of cortico-cortical white matter connections. Based on this hypothesis, the corpus callosum (CC) may represent the main responsible for cross-hemispheric slow wave propagation. Studies in birds and cetaceans also suggested that the absence of cross-hemispheric connections may favor the emergence of uni-hemispheric sleep. To test these hypotheses, here we studied a peculiar group of patients who underwent total callosotomy due to drug-resistant epilepsy.

Materials and methods: Overnight high-density (hd)-EEG recordings (256 electrodes) were performed in 5 epileptic in-patients (CPs; age range 40-53y, 2F) who underwent total resection of the CC, in 3 control non-callosotomized in-patients (NPs; 44-66y, 2F, 1 epileptic male), and in an additional control sample of 24 healthy subjects (HSs; 20-47y, 13F). The analyses were focused on the first 5-h of sleep recording, starting from the time of 'lights-off'. Sleep scoring was performed according to standard criteria, and periods containing artefactual or non-physiological activity were excluded from subsequent analyses. Slow waves were detected using an automated algorithm and their properties and propagation patterns were computed. For each slow wave parameter and for each patient, the relative z-score and the corresponding p-value were calculated with respect to the distribution represented by the HS-group. Group differences were considered significant only when a Bonferroni corrected $p < 0.05$ was observed in all the 5 CPs and in none of the 3 NPs. A regression-based adjustment was used to exclude potential confounding effects of age.

Results: Slow wave density, amplitude, slope and propagation speed did not differ across CPs and HSs. In all CPs slow waves displayed a reduced probability of cross-hemispheric propagation and a stronger inter-hemispheric asymmetry. Such asymmetry was also confirmed when slow waves were sorted into five equally subdivided amplitude percentile classes. In addition, we found that the incidence of large slow waves (peak-to-peak amplitude >75uV) tended to differ across hemispheres within individual NREM epochs, with a more common predominance of the right over the left hemisphere in both CPs and HSs. Of note, the absolute magnitude of this inter-hemispheric difference was significantly greater in CPs relative to HSs. This latter effect does not depend on differences in slow wave origin within each hemisphere across groups.

Conclusions: Present results indicate that the CC is essential for the cross-hemispheric traveling of sleep slow waves, thus supporting the assumption of a direct relationship between white matter structural integrity and slow wave propagation. Our findings also imply a prominent role of cortico-cortical connections, rather than cortico-subcortico-cortical loops, in slow wave cross-hemispheric synchronization. Finally, they indicate that the lack of the CC does not lead to differences in 'sleep depth', in terms of slow wave generation/origin, across the two hemispheres. This is in line with previous evidence suggesting that the absence of the CC is not sufficient, for the occurrence of uni-hemispheric sleep.

SLEEP SLOW WAVES ARE ASSOCIATED WITH INCREASED THALAMIC ACTIVITY AND WITH A DELAYED DECREASED ACTIVITY IN PRIMARY SENSORY CORTICES

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Introduction: Sleep slow waves appear in the EEG signal thanks to the coordinated activity of cortical neuronal populations whose membrane potentials oscillate between a hyperpolarized 'down-state' of neuronal silence and a depolarized 'up-state' during which neurons fire. Although slow waves are thought to be generated at cortical level, evidence indicates that their occurrence may be associated with coordinated changes in subcortical activity. The study of such interactions in humans is however limited by the low spatial resolution and accuracy of scalp EEG. Thus, here we performed a combined EEG-fMRI study to gain new insight regarding changes in cortical and subcortical activity associated with the occurrence of sleep slow waves.

Materials and methods: Twenty healthy volunteers (29.7±3.9yrs, 11F) underwent simultaneous EEG (32 electrodes, 1kHz) and fMRI recordings (3T, TR=2s) during an afternoon nap opportunity (2:30-4:00PM). EEG recordings were preprocessed using EEGLAB (FMRIB-plugin and Independent Component Analysis). Sleep scoring was performed according to standard criteria, and slow waves were automatically detected in N1/N2/N3 epochs on the negative-envelope of the EEG-signal computed across all electrodes (no amplitude threshold). Three subjects were excluded from further evaluation as they did not reach stable sleep and/or showed strong artefactual activity. The preprocessing of fMRI data (AFNI) included: despiking, slice timing and motion correction, spatial smoothing (6mm-FWHM), normalization, and signal cleaning based on removal of motion parameters, signal from CSF and temporal autoregression (ARMA-1). Brain regions associated with slow wave occurrence were first identified through a voxel-wise regression. In the regressor each slow wave was modelled as a square wave, using the onset time (timing of the positive-to-negative zero-crossing), maximum negative amplitude and duration of the descending slope (from first zero-crossing to wave-peak), convolved with a standard gamma hemodynamic response.

Results: Slow waves were associated with a significant BOLD signal increase ($p< 0.005$, FDR corrected) in bilateral thalamus and cerebellum, and with a significant BOLD decrease in bilateral visual cortex and sensorimotor cortex and in the right primary auditory cortex. An analysis of the average temporal profile of the underlying hemodynamic response in each significant cluster revealed that the thalamic BOLD increase was temporally aligned with the beginning of the slow wave. On the other hand, the negative deflection in primary sensory cortices was delayed by 2-4s with respect to the beginning of the slow wave, and was preceded by a slow, positive BOLD deflection that started 4-8s prior to slow wave onset.

Conclusions: Present results are consistent with previous evidence indicating an association between cortically detected sleep slow waves and changes in thalamic activity, and may in part reflect the triggering of sleep spindles during the down-to-up-state transition. In addition, we showed here that slow waves are consistently associated with a negative hemodynamic deflection which occurs later in time after the slow wave onset. Such delayed response may explain why this effect was missed by previous investigations. Interestingly, the regional specificity of the BOLD negativity, which was confined to primary sensory cortices, suggests a potential causal relationship between slow waves and sensory

disconnection during NREM sleep.

Basic Research
Board #031 : Poster session 3
INFLUENCE OF SIMULATED OBSTRUCTIVE SLEEP APNEA ON THORACIC FLUID VOLUME AND AIRWAYS RESISTANCE IN ASTHMATIC AND HEALTHY SUBJECTS

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Introduction: Obstructive sleep apnea (OSA) is common in asthmatics, with overlap of 12-50%. OSA prevalence increases with increasing asthma severity, suggesting a pathophysiological link between the two. OSA is also a risk factor for frequent nocturnal asthma exacerbations. Overnight rostral fluid shift from the legs into the neck and peripharyngeal tissues increases upper airway resistance and severity of OSA. Recently, we showed that in asthmatics while supine, rostral fluid shift into the thorax increases lower airways resistance (R_{LA}). During an obstructive apnea, generation of exaggerated negative intrathoracic pressure could draw blood into the thorax and increase thoracic fluid volume (TFV). We therefore hypothesized that generation of exaggerated negative intrathoracic pressure by inspiratory efforts against an occluded upper airway to simulate obstructive apneas, will draw fluid into the thorax and induce a greater increase in R_{LA} in asthmatics than in healthy subjects.

Materials and methods: Healthy and asthmatic subjects lay supine for 30 mins and were randomized in a crossover design to a control or intervention study arm with a 1-hour seated washout period between them. In the control arm, subjects breathed normally. In the intervention arm, subjects performed Mueller maneuvers (MM) by making inspiratory efforts against an occluded mouthpiece to simulate OSA. 25 MMs were performed for 15 seconds each at esophageal pressure of -40 cmH_2O followed by 20 seconds of normal breathing. TFV, as well as change in respiratory system reactance at 5Hz ($\Delta X5$, representing the change in R_{LA}) were measured before and after the control and intervention periods. Changes in variables within and between the two groups were compared using repeated measures analysis of variance (ANOVA).

Results: Ten healthy and 11 asthmatic subjects completed the study to date. During the MM arm, there was a significantly greater increase in TFV of 131ml in healthy subjects and 97ml in asthmatic subjects than in the control arm (P < 0.001). In healthy subjects, X5 did not change significantly during MMs compared to control (0.0±0.3 vs -0.2±0.5 cmH_2O/L.s, P = 0.34). However, in asthmatic subjects, the reduction in X5 during MMs was greater than that in the control arm (-1.0±1.1 vs -0.7±1.0 cmH_2O/L.s, P = 0.04), indicating a greater increase in R_{LA}.

Conclusions: These results indicate that MMs draw fluid into the thorax. In healthy subjects this fluid did not affect R_{LA}. However, in asthmatics, the increase in TFV was accompanied by an increase in R_{LA}, indicating that the increase in TFV narrowed the lower airways. This suggests that one mechanism by which OSA could worsen asthma is through increases in TFV resulting from negative intrathoracic pressure swings during obstructive apneas.

ADVERSE INSULIN SENSITIVITY PROFILE ASSOCIATED WITH THE OBSERVED INCREASE IN CIRCULATING HORMONE FGF-21 LEVELS AND ALTERED PERIPHERAL TISSUE PROMOTER DNA METHYLATION FOLLOWING ACUTE SLEEP LOSS IN HUMANS

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Introduction: Sleep loss and circadian misalignment alter energy metabolism in a tissue-specific manner and, when chronic, increase the risk of metabolic disease. FGF-21 is a fasting-induced hormone with tissue-specific effects on metabolic substrate utilization, e.g. increasing insulin sensitivity of adipose tissue. Notably, circulating levels of FGF-21 have been found to be increased in metabolic conditions such as type 2 diabetes and obesity. However, as of yet, the potential role of FGF-21 in relation to adverse metabolic changes that result from sleep and circadian disruption has not been investigated.
Materials and Methods: In a randomized, 2-session, 2-condition, crossover clinical study involving 15 healthy young men, serum samples were obtained in the fasted state and after an oral glucose tolerance test (OGTT), following one night of overnight wakefulness (simulating overnight shift work) and following one night of sleep (8.5 hrs), for analysis of glucose, and serum insulin and FGF-21 levels by ELISA. Skeletal muscle and adipose tissue biopsies were collected in the morning fasting state in both conditions, for targeted DNA methylation and qPCR analyses.
Results: Even though the OGTT increased FGF-21 levels across conditions ($P=0.0001$), FGF-21 levels were significantly higher across timepoints after overnight wakefulness compared with after sleep ($p=0.022$). A similar increase was seen in a separate cohort with cumulatively matching partial sleep loss (8.5 hrs). A sub-group analysis revealed that only participants with lower but not higher ($P=0.031$ vs $P=0.41$) insulin sensitivity, in response to the OGTT after sleep loss, exhibited a significant increase in serum FGF-21 levels after sleep loss compared with normal sleep. The promoter region of the FGF-21 gene exhibited increased DNA methylation after sleep loss compared with sleep ($P< 0.05$), both in skeletal muscle and adipose tissue, and this effect was also driven by increased DNA methylation in those with lower but not higher insulin sensitivity in response to our sleep loss intervention. mRNA expression profiling of FGF-21 and downstream response genes (e.g. FGFR1 and PGC1α) did not reveal any changes in peripheral tissues in response to overnight wakefulness.
Conclusions: Increased circulating levels of FGF-21 that primarily occurs in individuals with reduced insulin sensitivity, may constitute a counter-regulatory mechanism through which the body tries to ameliorate adverse effects of sleep and circadian disruption. Increased levels of FGF-21 may also contribute to sleep loss-induced changes in peripheral metabolism that have been previously described by us, such as tissue-specific alterations in metabolic fuel utilization, as well as increased ketone levels and glucose uptake by adipose tissue. It remains to be determined whether altered DNA methylation of the promoter of FGF-21 in peripheral tissues such as adipose tissue results in long-term shifts in peripheral production and release of FGF-21 across the sleep/wake cycle.

Basic Research
Board #024 : Poster session 1

GABA AND GLYCINE NEURONS FROM THE REM SLEEP CONTROLLING VENTRAL MEDULLARY REGION INHIBIT HYPOGLOSSAL MOTONEURONS: A MECHANISM FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a common disorder characterized by repetitive sleep related losses of upper airway patency that occur most frequently during rapid eye movement (REM) sleep. Hypoglossal motorneurons (HMNs) play a key role in regulating upper airway muscle tone and patency during sleep. REM sleep active GABA and glycine neurons in the ventral medulla (VM) induce cortical desynchronization and skeletal muscle atonia during REM sleep; however, the role of this brain region in modulating hypoglossal motor activity is unknown.

Materials and methods: We combined optogenetic and chemogenetic approaches with in-vitro and in-vivo electrophysiology, respectfully, in GAD2-Cre mice of both sexes to tests the hypothesis that VM GABA/glycine neurons control the activity of HMNs and tongue muscles.

Results: Here we show there is a pathway originating from GABA/glycine neurons in the VM that monosynaptically inhibits brainstem HMNs innervating both tongue protruder genioglossus (GMNs) and retractor (RMNs) muscles. Optogenetic activation of ChR2-expressing fibers induced a greater postsynaptic inhibition in RMNs than in GMNs. In-vivo chemogenetic activation of VM GABA/glycine neurons produced an inhibitory effect on tongue electromyographic (EMG) activity, decreasing both the amplitude and duration of inspiratory-related EMG bursts without any change in respiratory rate

Conclusions: . These results indicate that activation of GABA/glycine neurons from the REM VM inhibits tongue muscles via a direct pathway to both GMNs and RMNs and this inhibition likely plays an essential role in REM sleep associated upper airway obstructions that occur in patients with OSA.

ENDOCANNABINOIDS AND SLEEP: IMPACT OF MONOACYLGLYCEROL LIPASE INHIBITION IN RODENT MODELS

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Introduction: The hypnogenic properties of cannabinoids have been known for many years and have been attributed to the activation of the central cannabinoid-1 receptor (CB1R). The endocannabinoid 2-arachidonoylglycerol (2-AG) acts as a full CB1R agonist in the brain, and inhibition of monoacylglycerol lipase (MAGL), the key enzyme responsible for the degradation of 2-AG, offers an alternative strategy for potentiating the cannabinoid system. MAGL inhibitors have a broad therapeutic potential including treatment of pain, inflammation, depression and anxiety. In the present study, the effects of functional MAGL inhibition on EEG sleep were investigated in pharmacological and genetic rodent models.
Materials and methods: EEG sleep effects of the MAGL inhibitor JNJ-42226314 (30 mg/kg) were evaluated after oral dosing at the beginning of either the light or dark phase in rats and mice implanted with telemetric devices for the recording of EEG/EMG waveforms. In MAGL knockout (KO) and wild type (WT) littermate mice, EEG sleep was evaluated under baseline conditions and after pharmacological treatment with JNJ- 42226314.
Results: When administered at the beginning of the light phase in rats, the MAGL inhibitor JNJ-42226314 produced biphasic effects on NREM and REM sleep duration, first a decrease in the first part of the light phase, then an increase during the subsequent dark phase. In rats treated at dark onset, similar biphasic effects on sleep were observed but occurred within the dark phase. These effects were comparable to those elicited by injection of the CB1R agonist CP-55940 (0.03 mg/kg ip). EEG power spectra changes observed at either time of treatment included an increase in NREM delta power and a decrease in gamma power in all sleep-wake states. Under baseline conditions, MAGL KO mice spent more time in wake and less time in NREM sleep than WT mice throughout the light/dark cycle. REM sleep duration was decreased only during the first part of the light phase. In MAGL WT but not in KO mice, administration of JNJ-42226314 in light phase induced a decrease in REM sleep duration in the first 2h post dosing while NREM sleep duration was increased during the next 4h.
Conclusions: Pharmacological MAGL inhibition produced biphasic and time-dependent effects on sleep in rats possibly reflecting the diurnal variations in 2-AG levels, and which are also consistent with an activation of CB1R. Additionally, species differences in 2-AG basal levels that are substantially lower in mice than in rats could account for the differential sleep response in mice. In MAGL KO mice, the reduced baseline amount of sleep during the entire light/dark cycle might result from the desensitization of CB1R causing a functional antagonism of the endocannabinoid system.
Acknowledgements: NA

PREVALENCE OF SLEEP DISORDERS AND SLEEP PROBLEMS IN AN ELITE SUPER RUGBY UNION TEAM

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Introduction: It is estimated that approximately one third of the general population will experience a sleep disorder at some time during their life. In the general population the most common sleep disorders are obstructive sleep apnea (OSA), insomnia, and restless legs syndrome.They are associated with many adverse short and long-term health consequences. Despite the potential for sleep disorders to negatively affect athletic performance there is very little information in the sports science and medicine literature on the prevalence of sleep disorders in elite athletes.The aim of this study was to determine the prevalence of sleep disorders in an elite rugby union team using in-laboratory polysomnography (PSG) and sleep questionnaires.
Materials and methods: Twenty-five elite rugby union players underwent a night of PSG during the "off season" of the Super Rugby competition. Of interest were measurements that detected the presence of obstructive sleep apnea (OSA; apnea hypopnea index >5 events/hr) and the presence of moderate-severe periodic leg movements during sleep (PLMs; >15 events/hr). Players also completed sleep-related questionnaires to assess daytime sleepiness, perception of insomnia, risk of OSA, and the presence of restless legs syndrome (RLS) as well as undergoing basic anthropometric assessments including body mass index and neck circumference.
Results: OSA was present in 24% (n=6) of players and PLMs>15 events/hr in 12% (n=3). Questionnaire responses showed that all players had insomnia defined subthreshold insomnia and excessive daytime sleepiness, two players were identified as being at risk for OSA and none were classified as having RLS.
Conclusions: This study has shown that sleep disorders and excessive daytime sleepiness are common in elite rugby union players. These findings indicate the need for a more proactive approach in the management of sleep and its disorders in professional rugby union. Such a process, whereby sleep disorders and poor sleep habits are identified, diagnosed, and managed could serve to optimise the players physical recovery and athletic performance. In addition, it can safeguard the long-term health of players, since sleep disruptions have been associated with cardiovascular disease, diabetes, obesity, cancer, and early mortality
Acknowledgements: Many thanks to the staff and players at the Western Force, Super Rugby team.

Basic Research
Board #026 : Poster session 1
SURGICAL APPROACH FOR OBSTRUCTIVE SLEEP APNEA PATIENTS, OUR LOCAL EXPERIENCE

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Introduction: Sleep surgery success rates, for patients with obstructive sleep apnea (OSA), decline as the body mass index (BMI) increases. Kuwait has a very high occurrence of obesity amongst its population. This means that more people are at risk of surgery failure due to obesity. The aim of our study is to share our local experience and results of surgical treatment in OSA patients and investigate the effects of sleep surgery on obese patients.
Materials and methods: A retrospective cohort study is conducted on data involving 240 adults who underwent different types of multilevel surgery for OSA from 2014 to 2018. Of the 240, only 65 patients completed a pre and post-operative sleep study, and only these patients were included. Furthermore, all of the participants completed the Epworth Sleepiness Scale (ESS), STOP-BANG, Berlin questionnaires, and Visual Analogue Score (VAS) for snoring. The patients were divided into four groups: Group A (BMI < 25), Group B (BMI 25-30), Group C (BMI 30-35), and Group D (BMI>35) where the reduction of AHI was compared between groups.
Results: In the study, 65 patients were enrolled, of which 52 were male and 13 were female. The average participant age was 40.5 years, and the mean BMI was 30.1. Group A, B, C, and D had 6, 24, 23, and 12 patients respectively. Sleep surgery improved the mean Apnea-Hypopnea Index (AHI) from 27.0 to 10.3 (p=0.001). The mean AHI was reduced with statistical significance in all the 4 groups was found < 0.01, < 0.001, < 0.05, and < 0.01. Moreover, there was no difference with regards to the reduction of the mean AHI between the four groups. The surgical success rate in our study, according to the Sher criteria, was 70.8% with a decrease equal to or greater than 50% in postoperative AHI, and a postoperative AHI less than 20 in patients whose preoperative AHI was greater than 20. While the surgical cure rate, defined as AHI reduced to less than 5, was 38.5%. It is worth mentioning that all of the study patients did not use continuous positive airway pressure (CPAP) post-operatively, which was against the advice of the sleep surgeon. Another important note is that there was no significant difference in the post-op BMI change compared to that of the pre-op BMI (30.1 and 30.0, respectively). Secondary outcomes, such as ESS and VAS for snoring, significantly improved from 12.5 and 8.0, to 4.0 and 2.1 respectively following sleep surgeries. Only two patients suffered from complications that required hospital admission, which were re-intubation for several days and post-tonsillectomy bleeding, which was controlled in the operating theatre with bipolar cautery.
Conclusions: Our results showed that MLS can be effective in treating surgical indicated OSA patients, even if the patients are obese. However, further prospective studies with larger sample size are warranted to investigate the effect of MLS on obesity.
Acknowledgements: Special acknowledgment to Dr. Abdulmohsen Al-Terki, the sleep surgeon in this study, for his effort and contribution to this study and abstract.

GENOMIC IMPRINTING IMPACTS ON SLEEP THROUGHOUT NEURONAL MODULATION OF LATERAL HYPOTHALAMUS IN MICE

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Introduction: Genomic imprinting is a parent-of-origin epigenetic phenomenon that is raising a considerable interest in sleep. In particular, paternally-expressed genes (PEG) tend to be distributed within hypothalamus, although the functional role of this epigenetic mechanism is largely unknown. Here we focused our investigation on the role of *Snord116*, a small nuclear RNA that is paternally expressed in lateral hypothalamus (LH). *Snord116*play a pivotal role in Prader-Willi syndrome (PWS), a neurodevelopmental imprinted disorder characterized by a REM sleep abnormalities and sleep intrusion during wakefulness.
Materials and methods: We studied mice carrying a paternal deletion of the *Snord116*gene ($PWS^{m+/p-}$) and wild-type littermate control ($PWS^{m+/p+}$). We recorded neuronal discharge within LH along with cortical EEG sleep. Thus we monitored the dynamic distribution of state-dependent neuronal activity during several sleep-wake cycles and following sleep deprivation. We paralleled the electrophysiological investigation with molecular analysis of the orexin (OX) and melanin-concentrating hormone (MCH) systems.
Results: $PWS^{m+/p-}$mice, compared to controls, showed an increase number of neurons in LH that respond to sleep. In addition, mutants presented also a lack of neuromodulation after SD, suggesting that *Snord116*deletion affects the capacity to accumulate sleep pressure. As a complement of the electrophysiological signatures, we observed a markedly reduction of OX-expressing neurons in the LH $PWS^{m+/p-}$mice compared to controls. MCH-expressing neurons were unchanged between the two groups of mice. In an effort to further investigate the imprinting mechanisms over the orexin system, we identified a link with *Peg3*, a paternally-expressed DNA binding element. In particular we report that Peg3 is able to bind and regulate the expression of orexin in LH.
Conclusions: Overall, these results suggest that paternally-expressed *Snord116*exerts an important role in the OX-neuronal formation and in the LH neuronal functions involved in sleep homeostasis. Based on our results we conclude that *Snord116*indirectly regulates orexin expression in the LH through Peg3-related processes. Moreover, our study suggests that paternal imprinting may represent a new epigenetic control mechanism of the orexinergic systems in sleep regulation.

Basic Research
Board #003 : Poster session 3
BRAIN ACTIVATION TIME-LOCKED TO SLEEP SPINDLES ASSOCIATED WITH HUMAN COGNITIVE ABILITIES

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Introduction: EEG studies have shown that inter-individual differences in the electrophysiological characteristics of spindles (e.g., density, amplitude, duration) are highly correlated with "Reasoning" abilities (i.e.,"fluid intelligence"; problem solving skills, the ability to employ logic, identify complex patterns), but not Short-Term Memory, or Verbal abilities. Simultaneous EEG-fMRIstudieshave revealed brain activations time-locked to spindles. However, the functional significance of the inter-individual differences in brain activations recruited during spindle events are unknown. Using simultaneous EEG-fMRI sleep recordings, we sought to identify, for the first time, the neuroanatomical function correlates of the well-established relationship between sleep spindles and Fluid Intelligence.

Materials and methods: Initial eligible (re; MRI-safe, no sleep disorders, non-shift workers, BMI< =25, BDI/BAI < 10 etc.) participants (35 in total) visited the sleep lab for an orientation session at least one week prior to the EEG-fMRI sleep recording night, and completed the Cambridge brain science (CBS) cognitive tests online at home after the orientation session. Participants were required to keep a regular sleep-wake cycle at least 7 days prior to and throughout participation in the study.Compliance with this schedule was assessed using both sleep diaries and wrist actigraphy. The experimental sleep session started between 21h00 and 24h00, during which time simultaneous EEG-fMRI was recorded while participants slept in the scanner. To ensure the absolute minimum amount of data required for EEG and fMRI analyses, and to ensure a minimum sleep duration, quality and continuity of sleep, participants were required to sleep for a period of at least 5 minutes of uninterrupted NREM sleep during the sleep session in the MRI scanner. Finally, 29 participants (M = 23.97, SD = 3.83, 17 female) who met all these criteria were included into the analyses, that slept on average for 44 minutes.

Results: Using simultaneous EEG-fMRI sleep recordings, the results of the present study support three main findings: (1) similar to previous studies, the electrophysiological spindle characteristics (e.g., amplitude) during NREM sleep were related to Reasoning but not Short Term Memory or Verbal abilities, (2) similar to previous studies, activations time-locked to spindles were observed in the thalamus, bilateral striatum, middle cingulate cortex, and cerebellum, and importantly, (3) Reasoning abilities, but not STM or Verbal abilities were correlated with spindle-related activations in a subset of these regions including the thalamus, bilateral putamen, medial frontal gyrus, middle cingulate cortex, and precuneus.

Conclusions: These results provide evidence that individuals with greater neural activation time-locked to spindle events have greater Reasoning abilities. Altogether, our results identified for the first time, that a subset of spontaneous spindle-related activations are correlated specifically with Reasoning abilities but are unrelated to other abilities such as STM and Verbal abilities. Thus, suggesting that the extent of spindle-related activations reflect an individual's capacity for reasoning.

SLEEP SPINDLE-DEPENDENT FUNCTIONAL CONNECTIVITY CORRELATES WITH COGNITIVE ABILITIES

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Introduction: EEG studies have shown that inter-individual differences in the electrophysiological properties of sleep spindles (e.g., density, amplitude, duration) are highly correlated with "Reasoning" abilities (i.e., "fluid intelligence"; problem solving skills; the ability to employ logic; identify complex patterns), but not "Short-Term Memory" (STM) or "Verbal" abilities. Previous simultaneous EEG-fMRI studies revealed brain activations time-locked to spindles, and demonstrated that a subset of these brain activations was specifically related to Reasoning abilities. However, the functional communication amongst brain regions related to spindles and their relationship to Reasoning abilities have yet to be investigated. Using simultaneous EEG-fMRI sleep recordings and Psychophysiological Interaction (PPI) analysis, we aim to explore the functional connectivity time-locked to spindles and its relationship to inter-individual differences in Reasoning, Verbal, and STM abilities.

Materials and methods: Initial eligible (re; MRI-safe, no sleep disorders, non-shift workers, BMI< =25, BDI/BAI < 10 etc.) participants (35 in total) visited the sleep lab for an orientation session at least one week prior to the EEG-fMRI sleep recording night, and completed the Cambridge brain science (CBS) cognitive tests online at home after the orientation session. Participants were required to keep a regular sleep-wake cycle at least 7 days prior to and throughout participation in the study.Compliance with this schedule was assessed using both sleep diaries and wrist actigraphy. The experimental sleep session started between 21h00 and 24h00, during which time simultaneous EEG-fMRI was recorded while participants slept in the scanner. To ensure the absolute minimum amount of data required for EEG and fMRI analyses, and to ensure a minimum sleep duration, quality and continuity of sleep, participants were required to sleep for a period of at least 5 minutes of uninterrupted NREM sleep during the sleep session in the MRI scanner. Finally, 29 participants (M = 23.97, SD = 3.83, 17 female) who met all these criteria were included into the analyses, that slept on average for 44 minutes. Based on previous literature, this investigation focused on the following regions of interest: 1) the thalamus; 2) anterior cingulate cortex (ACC); 2) the bilateral putamen, and, 3) the posterior cingulate cortex (PCC).

Results: (1) Sleep spindles during NREM sleep were found to induce brain connectivity within the thalamo-cortical-basal ganglia network, and the default mode network. (2) During the spindle events, the functional connectivity of the anterior cingulate cortex with the left putamen, and the functional connectivity of the thalamus with the MCC/PCC were exclusively related to individuals' Reasoning but not Verbal and STM abilities.

Conclusions: These results suggest that during spontaneous spindle events, the extent of communication between brain regions involved in spindle generation and other brain regions, such as the putamen and cingulate cortex, is related to our ability to identify complex patterns and relationships, and the use of logic, existing knowledge, skills, and experience to solve novel problems (i.e., individual differneces in "fluid intelligence").

FUNDAMENTAL SLEEP ARCHITECTURE IN MICE HOLDS THE POTENTIAL TO PREDICT HIGH-FEAR PHENOTYPE AFTER FEAR CONDITIONING

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Introduction: Posttraumatic stress disorder (PTSD) is a psychiatric disorder that may develop after exposure to traumatic events such as sexual assaults, crimes, car crashes or battle fields. However, it is still unclear why only about 10-20% of trauma victims develop the disease. Next to other behavioral, physiological and psychosomatic impairments, sleep disturbances constitute a hallmark symptom of PTSD. But impaired sleep has also been proposed to represent a core feature in disease development. First hints came from retrospective studies after the hurricane Andrew in 1992, indicating that impaired sleep before a trauma may interfere with fear memory processing after the trauma.

Materials and methods: To address this theory, we evaluated circadian sleep- and wake-behavior of C57BL/6J (BL6) mice prior to and following cued fear conditioning (FC), as well as after a fear retrieval (RET) session. Electroencephalogram (EEG) and electromyogram (EMG) activities were recorded chronically over several days and animals were assessed for freezing behavior.

Results: We performed k-means clustering based on freezing scores during FC and RET sessions, which allowed assignment of the animals into two subgroups of 'high freezers' and 'low freezers'. Behavioral divergence, especially in the inactive period of the animals was accompanied by dissimilarities in baseline sleep/wake patterns. High freezers displayed significantly lower amounts of non-rapid-eye-movement sleep (NREMS) and rapid-eye-movement sleep (REMS) and spent more time awake. Further analyses also revealed differences in REMS latency and spectral power.

Conclusions: Our findings suggest that differentiated alterations in baseline sleep might interfere with the formation and processing of fear memories and facilitate the development of a high-fear, PTSD-like phenotype in susceptible animals. Evaluation of such sleep alterations may have early diagnostic and potential prognostic values in anxiety disorders such as PTSD.

TOWARD A COMPLETE TAXONOMY OF RESTING STATE NETWORKS ACROSS WAKEFULNESS AND SLEEP: AN ASSESSMENT OF SPATIALLY DISTINCT RESTING STATE NETWORKS USING INDEPENDENT COMPONENT ANALYSIS

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Introduction: Resting state networks (RSNs) have been investigated under a wealth of different healthy and compromised conditions. In the healthy wakefulness state, RSNs are commonly grouped into ten "canonical" networks, which noticeably resemble the spatial organization of networks that support discrete cognitive functions. These same canonical RSNs have been consistently identified in non-healthy or non-wakefulness conditions, including sleep. What is particularly surprising is the seeming absence of additional, (i.e., non-canonical) RSNs in sleep, given the established connection between the canonical RSNs and cognitive function in wakefulness and given that sleep is a healthy alternate mode of the brain with unique functions from wakefulness, such as dreaming and memory consolidation. However, this negative finding could be a consequence of biased analysis methods used in prior studies, which searched exclusively for the canonical RSNs in sleep. The purpose of this study was to explicitly test the hypothesis that there are RSNs unique to sleep, beyond the canonical set of RSNs.
Materials and methods: 36 subjects were recruited for this study. Subjects slept (with no prior sleep deprivation), as their brain activity was recorded with simultaneous electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). Independent component analysis (ICA) was performed on both rapid eye movement (REM) and non-REM sleep stages (NREM; specifically NREM stages 2 and 3). The resulting independent components (ICs) were compared with spatial templates of the canonical RSNs (derived from a separate wakefulness study), using spatial correlation. Potentially new RSNs were operationalized as ICs with low spatial correlation (i.e., below a threshold of $r=0.2$) with the canonical set, yet which also had spatial and temporal (e.g., frequency-power) properties that were inconsistent with known fMRI blood oxygen level dependent (BOLD) artifacts.
Results: The results yielded, as far as we know, the largest set of EEG-fMRI data collected in a single study (for non-sleep deprived subjects or otherwise) that also included REM. Surprisingly, no unique RSNs were discovered in any individual sleep stage, nor in the combined sleep stage. All below-threshold ICs were positively identified as having either spatial or temporal properties that were consistent with BOLD artifacts.
Conclusions: This finding has important implications for both sleep and for RSNs. It indicates that: (1) the unique functions of sleep do not require the manifestation of any specialized RSNs; rather they are supported by much the same RSN architecture as wakefulness, and, (2) the repertoire of waking canonical RSNs is likely the complete set, suggesting they may constitute a complete taxonomy, and, (3) prior sleep studies which made use of wakefulness RSNs were warranted in doing so, despite not ever explicitly testing the assumption that wakefulness RSNs apply to sleep.

Basic Research
Board #032 : Poster session 2

RNA-SEQ ANALYSIS OF GALANINERGIC NEURONS FROM VENTROLATERAL PREOPTIC NULEUS IDENTIFIES EXPRESSION CHANGES BETWEEN SLEEP AND WAKE

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Introduction: Galanin neurons at ventrolateral preoptic nuleus (VLPO) have been hypothesized to be sleep-active neurons. Galanin neuron identification using immunoreactive labeling is difficult because galanin peptide is not located at the cell body, and using colchicine is known to induce artificial stimulus and cellular stress. Here we utilized Tg(Gal-EGFP)HX109Gsat mice that express eGFP (enhanced green fluorescent protein) under the control of galanin promoter to aid identification of galanin-expressing neurons in VLPO. With the use of laser capture microdissection (LCM), we specifically isolated galanin neurons and assessed expression changes in VLPO galanin cells between sleeping mice and mice kept awake using gentle handling.

Materials and methods: Fifty-four mice were separated into 9 groups (n=6 per condition) corresponding to baseline (Z0; lights-on), sleep or SD for 3, 6, 9, and 12 hours. Libraries were made using SMARTer Stranded Total RNAseq Kit and sequencing was done using Hi-Seq 4000. Differentially expressed genes (DEGs) between SD and sleep were identified using Limma Voom package. Functional analysis was performed using DAVID.

Results: We found 184 DEGs up-regulated by SD and 79 DEGs up-regulated by sleep (FDR< 5%). Heat shock proteins and UPR (unfolded protein binding) (*Hspa8*, *Hspa5*, and *Xbp1*) were among the most significantly SD up-regulated genes, and cold-induced RNA-binding proteins (*Rbm3* and *Cirbp*) were among the most significantly sleep up-regulated genes in galanin neurons. In addition, several groups of genes showed opposite directional changes compared to a recent RNAseq study performed on mPFC (medial prefrontal cortex), including genes involved in DNA damage/repair (*Mlh3* and *Herc2*) and nervous system development (*Epha4*, *Oprk1*, and *Srrm4*). Additionally, several circadian genes showed sleep/wake regulation, for example, *Dbp* and *Cry2* were up-regulated during sleep.

Conclusions: VLPO galanin neurons showed similar directional changes between sleep/wake in some groups of genes when compared to mPFC, such as heat shock/UPR genes (SD up-regulated) and cold-inducible RNA-binding proteins (sleep up-regulated), whereas opposite directional changes in others, such as DNA damage/repair and nervous system development, indicating mixed systematic and local neuronal activity guided mechanisms regulating gene expression in VLPO galanin neurons. There was a large amount of heterogeneity in the gene expression data among the LCM-isolated galanin samples. The heterogeneity could be partly due to the nature of the technique (pooling hundreds of dissected cells) and partly due to the diversity nature of galanin neurons in VLPO. A recent study identified other markers of sleep neurons in VLPO, i.e. *Tac1* and *Pdyn*. Our data showed controlling for the levels of Tac1 and Pdyn did not cause major changes in the identified differentially regulated genes.

Basic Research
Board #034 : Poster session 3

ADENOSINE RECEPTORS IN THE MEDIAN PREOPTIC NUCLEUS OF THE HYPOTHALAMUS AND MEDIAL SEPTUM INCREASE THERMAL HYPERALGESIA

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Introduction: Insufficient sleep and pain are public health epidemic problems that are reciprocally related, i.e., sleep loss worsens pain and pain disrupts sleep. However, the mechanisms by which sleep loss alters pain remain poorly understood. Neurons in the median preoptic nucleus of the hypothalamus (MnPO) project to several arousal- and pain-related regions, thus representing a potential key site for the regulation of this interaction. Adenosine neurotransmission in the MnPO regulates the sleep homeostatic response after prolonged wakefulness or sleep deprivation. In a recent study, we showed that pharmacologically blocking adenosine A_{2A} receptors within the MnPO prevented the increase in pain caused by sleep deprivation. Based on predictions from these data, we tested the hypothesis that pharmacologic stimulation of adenosine receptors in the MnPO increases pain-like behaviors in the rat.

Materials and Methods: Adult male, Sprague-Dawley rats (n=16) were implanted with guide cannulae for drug administration into the MnPO. After recovery and conditioning, microinjections (200 nL) of adenosine (1.34 µg; 2.5 nmol), adenosine and caffeine (same molar mass), and the adenosine A_{2A} receptor agonist CGS 21680 (1.07 µg; 2.5 nmol) were made in random order. Thirty minutes after microinjection, thermal hyperalgesia (Hargreaves' method), mechanical thresholds (von Frey) and the affective-motivational response to pain (mechanical conflict avoidance paradigm) were assessed. In addition, pain-like behaviors (paw licking, shaking, elevation) elicited by an injection of capsaicin into a hind paw were video-recorded and evaluated by an investigator blinded to the treatment condition (i.e., vehicle or adenosine injection into the MnPO). After the last experiment, brains were removed and processed for histological confirmation of the injection site.

Results: Relative to vehicle, administration of adenosine (Mean ± standard deviation: 6.13 ± 1.74 vs 5.10 ± 1.80 s; P < 0.0001) and CGS 21680 (6.36 ± 2.11 vs 4.92 ± 1.58 s; P < 0.0001) produced a significant increase in thermal hyperalgesia. Adenosine injection into the MnPO also significantly increased the duration of pain-like behaviors caused by capsaicin (29.63 ± 7.29 vs 55.12 ± 2.26 s; P = 0.004). Co-injection of adenosine and its antagonist, caffeine, blocked adenosine-induced thermal hyperalgesia (P = 0.098). In contrast to its effect on thermal nociception, adenosine or CGS 21680 did not induce mechanical hypersensitivity (P = 0.953) or alter aversion to noxious mechanical stimulation (P = 0.182). Histological analysis revealed that adenosine injection sites were localized to the MnPO and the medial septum (MS); there were no differences in pain behaviors between these sites.

Conclusions: These data suggest that adenosine A_{2A} receptors in the MnPO/MS selectively mediate thermal nociception, and support the interpretation that adenosine neurotransmission might contribute to regulate the relationship between sleep disruption and pain.

Basic Research
Board #029 : Poster session 1

CHANGES IN ELECTROENCEPHALOGRAPHIC SPECTRA ASSOCIATED WITH EYE CLOSURE IN A RESTING BAT

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Introduction: Eye closure state (i.e. open or closed) in combination with immobility is used to define sleep-wake state in behavioural studies. In bats, the degree to which eye closure state is correlated with brain state is unknown.

Materials and methods: Two Egyptian fruit bats (*Rousettus aegyptiacus*) were implanted with a wireless electrophysiological recording device (EEG and accelerometer with sampling rates of 242 Hz and 50 Hz respectively) under ketamine sedation. Two subcutaneous needle electrode channels were placed adjacent to the skull above either hemisphere. Spontaneous behaviour in a cage under dark conditions was recorded for 24 hours immediately following surgery using an infrared camera. Periods in which bats moved were rejected on the basis of accelerometer recordings as well as periods in which either one or both eyes were obscured. Behaviour was scored manually from the remaining video recordings as Eyes Open Rest (EOR) or Eyes Closed Rest (ECR). Periods in which one eye was closed were not scored. High frequency noise (>30 Hz) was present in a number of ECR periods. To provide a more direct comparison, a subset of 40 one-minute epochs in which high frequency noise was absent were isolated for each behaviour. EEG spectra were computed using Welch's method with Hamming windows (200 samples with 50% overlap) from which total power (0-120 Hz) was estimated. To address whether spectra from epochs within the same eye closure state are more similar than spectra from epochs in different eye closure states, intra- and inter-behavioural correlations between spectra were quantified using Pearson's correlation coefficient.

Results: Preliminary data from the left channel of one bat is presented. There was no statistically significant difference in total power between EOR and ECR epoch (p=0.74). Power was similar across behaviours at low (0.5-6 Hz, p=0.2) frequencies but power in the ECR spectra was significantly higher at mid-range (7-24 Hz, p< 0.01) frequencies and significantly lower at high (25-120Hz, p< 0.01) frequencies compared to EOR. Correlations between spectra were high across all combinations of epochs (mean=0.99). Post-hoc analysis of an ANOVA showed the mean ECR correlation was significantly higher than the inter-behavioural mean (p< 0.01) whereas the mean EOR correlation was significantly lower (p< 0.01). Mean ECR correlation was also found to be significantly higher than mean EOR correlation (p< 0.01).

Conclusions: There is no evidence to suggest a higher total EEG power in the ECR epochs compared to EOR as has been shown for sleep EEG when compared to waking EEG. Significantly different mid/high range frequencies suggest that the signals from the different behaviours do have distinct spectra. However, the mean inter-behavioural correlation is high and only significantly lower than one of the behaviours, which may be expected if there is some overlap in brain state (i.e. bats are awake in some eyes closed rest periods). Overall, there does appear to be a small difference in electrophysiology associated with eye closure state but there is currently insufficient evidence to relate this to sleep-wake state.

Basic Research
Board #178 : Poster session 1
LIGHT-INDUCED MELATONIN SUPPRESSION IN 3-4 YEAR-OLD CHILDREN

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Introduction: Although a robust literature has established that exposure to light at night suppresses melatonin production and delays circadian timing in adults, little is known about the light sensitivity of young children. The present study aims to establish preschool age children's sensitivity to light of varying intensities in the hour before bedtime.
Materials and methods: Healthy children (n=23, ages 3.0 - 4.9 years, 43% males), participated in a 10-day protocol. For 7 days, children followed a strict sleep schedule. On days 8-10, an in-home assessment was performed under dim-light conditions. On day 8, saliva samples were collected in 20-30 minute intervals throughout the evening until 1 hour past habitual bedtime. On day 9, children were exposed to a white light stimulus (ranging from 10lx to 5000lx) for 1-hour before habitual bedtime, and salivary melatonin was measured before, during, and after the exposure period. On day 10, children provided saliva samples in the evening for 2.5 hours past habitual bedtime. Phase angle of entrainment (onset of light exposure- time of melatonin onset on day 8) and percent melatonin suppression were computed. If melatonin onset on day 8 occurred after the clock time of light exposure on day 9, participants were excluded from analysis (n=4).
Results: During the 1-hour light exposure, salivary melatonin was suppressed between 69% and 94% in all participants, compared to the same period on day 8. Raw percent melatonin suppression did not demonstrate a dose-dependent relationship with light intensity. Rather, we observed a decrease in melatonin concentrations across all intensities.
Conclusions: These preliminary results suggest preschoolers are highly sensitive to a large range of light intensities, which may be mechanistically influenced by less mature ophthalmologic features of the eye. With young children's increased exposure to light-emitting devices before bed and the prevalence of nighttime settling difficulties, these findings may inform recommendations for parents on limiting evening light exposure.

THE RELATIONSHIP BETWEEN FASTING-INDUCED TORPOR, SLEEP AND WAKEFULNESS IN LABORATORY MICE

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Introduction: Torpor is a regulated and reversible state of metabolic suppression used by some animal species to conserve energy. It occurs in response to shortening of photoperiod (i.e. hibernation or seasonal torpor) or fasting. The relationship between torpor, sleep and wakefulness remains unclear. Both torpor and sleep are associated with immobility and reduced responsiveness, and it has been suggested that they are on a continuum neurophysiologically. However, animals emerging from seasonal daily torpor or hibernation immediately enter sleep with high slow-wave activity (SWA), indicating raised homeostatic sleep pressure. Fasting affects the timing, amount and quality of waking and sleep. Yet, how fasting-induced torpor affects brain activity and sleep-wake regulation has not been studied. We addressed this question in laboratory mice: a heterothermic species that readily enters torpor when fasted.

Materials and methods: adult, male C57BL/6J mice (n=6; male; 12 weeks old; mean weight 27.5g; fed ad-libitum; kept at 12:12 hour light-dark cycle and ambient temperature of 20-22°C throughout experiment) were implanted with chronic EEG electrodes (in the frontal and occipital cortices) and nuchal EMG wires. 9 days post-surgery the mice were recorded during baseline undisturbed with food ad-libitum, and subsequently underwent a restricted-feeding schedule where approximately 1.5g food was given daily at ZT6 (Zeitgeber time; ZT0=lights on, ZT12=lights off). Surface body temperature ($T_{surface}$) was measured continuously using thermal-imaging cameras. Vigilance states (wake, NREM or REM sleep) were scored offline in 4s epochs based upon EEG and EMG signals.

Results: Over the 5 days of restricted feeding, average body weight fell to 86.1 ± 2.3% (SD) of baseline (2.3 ± 0.4% per-day decrease). Daily maximum $T_{surface}$ decreased slightly, whilst minimum $T_{surface}$ dropped at 1.0 ± 0.4°C per day from 29.7 ± 0.5°C to 21.6 ± 0.3°C ($p=0.0002$). During torpor bouts, EEG amplitude decreased markedly compared with euthermia, yet typical EEG/EMG signatures of NREM sleep and wakefulness e.g. slow waves or transient EEG activation (corresponding to low and high EMG respectively) were clearly discernible. This enabled classification of vigilance states throughout the recordings. Overall, over each 24 h period as the daily duration of torpor increased, the amount of both REM and euthermic NREM sleep decreased, whilst wakefulness increased initially and then decreased from Day 3 onwards. Within torpor periods, compared with time-matched periods at baseline, there were decreases in the amounts of wake (from 47.6 ± 5.7 to 27.6 ± 8.4%; $p=0.0037$) and REM (from 8.1 ± 1.3 to 0.5 ± 0.2%; $p=0.0001$), and an increase in the amount of NREM-type activity (from 40.7 ± 4.5 to 65.4 ± 7.3%; $p=0.0001$).

Conclusions: Restricted feeding in mice results in the progressive occurrence of hypothermic torpor bouts, and concomitant decreases in the amounts of both REM and euthermic NREM sleep. Fasting-induced torpor in mice is entered via a transitional state that electrophysiologically resembles NREM sleep.

Basic Research
Board #036 : Poster session 3

DOPAMINE D_1 AND D_2 RECEPTORS MEDIATE ANALGESIC AND HYPNOTIC EFFECTS OF *L*-TETRAHYDROPALMATINE IN A MOUSE NEUROPATHIC PAIN MODEL

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Introduction: Levo-tetrahydropalmatine (*l*-THP), an active ingredient of *Corydalis yanhusuo*, has been reported to be a partial agonist for dopamine D_1 receptors (D_1R) and an antagonist for D_2R. Although it has been safely used clinically in China for decades as an analgesic with sedative/hypnotic properties, there are few studies that address the mechanisms by which *l*-THP exerts its beneficial effects in chronic pain-induced sleep disturbance
Materials and methods: A mouse model of chronic neuropathic pain induced by partial sciatic nerve ligation (PSNL) was employed. The antinociceptive and hypnotic effects of l-THP were evaluated by measurement of mechanical allodynia, thermal hyperalgesia, and electroencephalogram (EEG) recordings in PSNL mice. Pharmacological approaches and c-Fos expression were used to clarify the mechanisms of l-THP.
Results: Intraperitoneal injection of *l*-THP at 5 and 10 mg/kg not only significantly increased the mechanical threshold by 134.4% and174.8%, and prolonged the thermal latency by 49.4% and 69.2%, but also increased non-rapid eye movement sleep by 17.5% and 29.6%, and decreased sleep fragmentation in PSNL mice, compared with the vehicle control. Moreover, the antinociceptive effect of *l*-THP was prevented by D_1R antagonist SCH23390 or D_2R agonist quinpirole; meanwhile, the hypnotic effect of *l*-THP was blocked by quinpirole rather than by SCH23390. Immunohistochemistry demonstrated that *l*-THP inhibited c-Fos overexpression induced by PSNL in the cingulate cortex and the periaqueductal gray.
Conclusions: These findings indicated that l-THP exerted analgesic effects by agonism D1R and antagonism D2R, and the antagonism of D2R mediated the hypnotic effect of l-THP in PSNL mice.

CROSS-PARTICIPANT PREDICTION OF VIGILANCE STAGES THROUGH THE COMBINED USE OF WPLI AND WSMI EEG FUNCTIONAL CONNECTIVITY METRICS

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Introduction: Functional connectivity metrics represent a powerful tool to investigate brain inter-regional interactions in distinct behavioural states. The weighted Phase Lag Index (wPLI) and the weighted Symbolic Mutual Information (wSMI) have been specifically designed to minimise the impact of EEG volume conduction confounds. We recently demonstrated that they present a different sensitivity to linear and non-linear interaction dynamics. Here we investigated whether these two methods may unveil distinct functional differences across four stages of vigilance (wakefulness, NREM (N2/N3), REM sleep).
Methods: Twenty-four healthy participants (27±6yrs, 13F) underwent hd-EEG recordings (257 channels, 500Hz) during the night (11.30PM-7AM) and while awake in bed after sleep (8AM; 6min, eyes-closed). All recordings were pre-processed using standard procedures. Given that different amounts of data were available for each subject and sleep stage, a bootstrapping procedure (with replacement) was performed to obtain comparable numbers of data-segments across wakefulness (W), N2, N3 and REM-sleep. Specifically, for all conditions we extracted at each iteration (N=1000) 15 random 2s epochs. For each iteration, we computed the median power spectral density (PSD) across electrodes and the median connectivity (wPLI/wSMI) across all pairs of channels in delta, theta, alpha, sigma, beta, and gamma frequency bands. The subjects were divided into two equal-sized groups. A two-fold (i.e. training on group-1(2) and testing on group-2(1)) linear discriminant analysis (LDA) was applied to investigate the ability of power- and connectivity-based features obtained from one group to discriminate vigilance stages in the other group. The best features for each classifier were identified using a generalised ranking across forward- and backward-selection. Permutation tests (N=1000, shuffling of labels in training dataset) were performed to test for statistical significance.
Results: The maximum classification accuracy obtained with each single metric was 56.0% for PSD, 61.4% for wPLI and 63.8% for wSMI. The combination of two metrics increased accuracy to 71.1% for PSD+wPLI, 69.3% for PSD+wSMI, and 74.2% for wPLI+wSMI. The highest accuracy (78.3%) was obtained for the joint PSD+wPLI+wSMI classifier, for which the best features included alpha-wSMI, sigma-wPLI, and delta-wPLI. Follow-up statistical comparisons (paired non-parametric permutation tests; $p < 0.05$, Bonferroni correction) showed that both NREM (N2/N3) and REM-sleep were characterised by increased delta-wPLI (N2>N3>REM>W) and decreased alpha-wSMI (W>N3>N2>REM) with respect to W. For the classification of W vs. REM, alpha-wSMI alone achieved 87% accuracy. Sigma connectivity (wPLI/wSMI) was higher in N2/N3-sleep with respect to both W and REM-sleep (no differences between W and REM).
Discussion: The combined use of wPLI and wSMI connectivity metrics better describes changes in brain activity across vigilance stages compared to either individual connectivity approaches or power-based indices alone. The differences between sleep and wakefulness in delta- and alpha-connectivity are in line with previous observations in states of altered levels of consciousness, including in patients with disorders of consciousness and in anaesthesia. However, connectivity in these bands was also significantly different between wakefulness and REM-sleep, a stage typically characterised by vivid conscious experiences (dreams). In this light, these connectivity changes could mark disconnection/disengagement from the external environment rather than the current level of consciousness.

A ROLE FOR ASTROGLIAL CALCIUM ACTIVITY IN SLEEP AND SLEEP HOMEOSTASIS

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Introduction: Poor sleep can be caused by impaired sleep homeostasis which regulates sleep need as a function of prior wakefulness. The biological substrates of sleep homeostasis are incompletely understood. Therefore, determining the cellular and molecular basis of sleep homeostasis is necessary to understand causes of abnormal sleep. Astrocytes may play a central role. Astrocytes are found throughout the brain and modulate responses to sleep loss. Because many astroglial functions are mediated by intracellular calcium changes, we hypothesize that astroglial calcium dynamics contribute to the accumulation and discharge of sleep need.

Materials and Methods: Astroglial calcium signals were quantified during spontaneous sleep-wake behavior and in response to sleep deprivation (SD) in adult male C57Bl/6J mice expressing a genetically-encoded calcium indicator (GCaMP6f) selectively in frontal cortex astrocytes. Calcium activity was captured *in vivo* through a cranial window using a head-mounted epifluorescent microscope in freely-behaving mice (n=6) or two-photon microscopy in unanesthetized, head-restrained mice housed in an air-lifted cage (n=4). Calcium dynamics were simultaneously recorded with sleep-wake behavior as determined by electroencephalography (EEG) and electromyography (EMG). Mice underwent a counterbalanced design of 24h undisturbed baseline sleep and 6h SD via gentle handling followed by 18h recovery sleep. EEG/EMG were continuously recorded and imaging occurred at timepoints of high and low sleep need as determined by non-rapid eye movement (NREM) delta power (0-4.5 Hz).

To determine a role for astroglial calcium signaling in sleep homeostasis, we conditionally knocked out stromal interaction molecule 1 (STIM1) in astrocytes by crossing STIM1^fl/fl mice with GFAP-Cre/ERT2^Tg+/-;STIM1^fl/fl mice (GSTIM1). STIM1 mediates calcium influx after depletion of intracellular calcium stores. Adult male and female GSTIM1_controls (n=8; GFAP-Cre/ERT2^-/-; STIM1^fl/fl) and GSTIM1_mutants (n=9; GFAP-Cre/ERT2^Tg+/-; STIM1^fl/fl) were injected with tamoxifen (180 mg/kg; intraperitoneally) once per day for 5 days and implanted with EEG/EMG electrodes. Mice underwent 24h undisturbed baseline EEG/EMG recording followed by 6h SD via gentle handling and 18h recovery sleep.

Results: Astroglial calcium concentrations varied across sleep and wake. Calcium was at its highest concentrations during wakefulness and lower during NREM and REM sleep. SD led to an increase in astroglial calcium that decreased during recovery sleep. These SD-induced changes in calcium parallel changes in NREM delta power. Two-photon imaging also reveals that SD differentially impacts calcium dynamics in somata and processes. Inhibiting astroglial STIM1 function does not impact baseline sleep time, architecture, or EEG spectra. After 6h SD, however, the accumulation of NREM delta power is attenuated in GSTIM1_mutants. This effect is most pronounced for low NREM delta power (0-1.5 Hz). GSTIM1_mutants also sleep less during the 18h recovery period post-SD with the greatest difference seen at the beginning of the dark period.

Conclusions: Astroglial calcium activity 1) changes with arousal state, 2) tracks sleep need, 3) differs between astroglial somata and processes, and 4) is important for homeostatic responses to sleep deprivation. The studies presented here are the first to describe astroglial

calcium activity in conjunction with electroencephalographic determination of arousal state in freely-behaving mice and further support a role for astrocytes in sleep homeostasis.

Basic Research
Board #030 : Poster session 1

REM SLEEP DEFICITS PERSIST INTO ADULTHOOD AFTER EARLY LIFE SLEEP DISRUPTION IN PRAIRIE VOLES

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Introduction: In mammals, REM sleep duration is highest in the early postnatal period of life. This period of increased REM may be necessary to shape neural circuits that control the development of complex behaviors. Previous work in our laboratory has found that acute early life sleep disruption (ELSD -reduced REM sleep and fragmented NREM sleep) in the socially monogamous prairie vole leads to long lasting changes in both social behavior and expression of the calcium binding protein parvalbumin in the brain, post-mortem. We hypothesized that some of these later life deficits could be due to a persistent disruption of sleep-wake behavior lasting well beyond the acute period of experimentally induced sleep disruption.

Materials and methods: We conducted 24 hours of home cage tethered EEG/EMG recordings in adult male and female prairie voles that had previously undergone ELSD or Control conditions as juveniles. Time spent in each vigilance state, transitions between states, and normalized power in the theta (8-10 Hz) and gamma (30-80 Hz) frequency bands during each state were compared between groups.

Results: We found that, as adults, ELSD prairie voles continued to have lower REM sleep duration than Controls but all other sleep parameters were unchanged. Power spectral analysis on the EEG signal indicated that ELSD voles also had lower theta power and higher gamma power during both REM and Wake states, consistent with previously reported parvalbumin immunoreactivity in respective brain regions (hippocampus and neocortex). There was no change in theta or gamma power during NREM sleep.

Conclusions: The long term effects of ELSD on both REM sleep duration and electrical signatures in the brain during REM and Wake may underlie the behavioral deficits observed in these animals. We propose that the quality of sleep early in life is essential for shaping adult sleep patterns as well as behavior during Wake.

Basic Research
Board #034 : Poster session 2

INFLUENCE OF SKILLED REACHING TASK ON SLOW WAVES AND SLEEP SPINDLES IN RATS

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Introduction: Sleep following motor skill learning has known to enhance motor skill learning off-line in both animal and human studies. Here we trained adult rats in skilled reaching, which is known to induce long term synaptic facilitation in motor cortex, and measured sleep EEG in the motor cortex after the training to investigate the mechanism of sleep-dependent motor skill improvement.

Materials and methods: All the experimental procedures were performed in accordance with the Japanese Government Animal Protection and Management Law and were approved by the Institutional Animal Care and Use Committee of Tohoku University. All efforts were made to minimize animal suffering and to reduce the number of animals used. Long Evans rats (8-12 weeks, male, n=15) were used in this study. Screw electrodes were implanted in the bilateral motor cortices and somatosensory cortex. In addition, EMG electrodes were implanted in the neck muscle. The recording session started 1 week after the surgery. Recording was performed under a 12h light/dark cycle and freely-moving conditions without feeding restrictions. EEG, EMG, and activity (which was recorded by passive infrared motion sensor) were recorded. In addition, we developed an automated partial sleep deprivation apparatus to decrease NREM sleep and slow wave in NREM sleep and eliminate REM sleep.

Results: At first, we focused on the slow wave in NREM sleep. We found that significant increment of the slow wave power in the trained side of motor cortex relative to the untrained side was observed, but this asymmetry was no longer present after 180 min of sleep. In addition, we performed partial sleep deprivation experiment. We found that the partial sleep deprivation for 180 min after the training was found to extend the interhemispheric asymmetry of slow wave power. These suggest that skilled reaching task leads to interhemispheric slow wave asymmetry and the sleep contributes to recovery of the EEG asymmetry.

Density of spindle wave, which is typically observed in light NREM sleep, was known to increase during sleep following motor training and there are tight correlations between spindle wave and motor skill performance in human research. Therefore, we also investigated the relationship between the spindle wave and skill improvement. We found that there was a positive correlation tendency between the amplitude of sleep spindle wave for 30 min after the beginning of sleep and the motor skill performance improvement.

Conclusions: Because the slow wave increment in post-training sleep and the cross-correlation between spindle amplitude and the skill performance are reported in human studies, our findings suggest that mechanism of sleep-dependent motor skill improvement are common in rats and humans.

SHORT-TERM MEMORY DEFICITS IN THE SLEEP INBRED PANEL

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Introduction: Sleep is heritable and highly conserved across species, yet sleep duration varies from individual to individual. A shared genetic architecture between sleep duration and other evolutionarily important traits could explain this variability. Learning and memory are critical traits sharing a genetic architecture with sleep. We hypothesized that learning and memory would be altered in extreme long or short sleepers.

Materials and methods: We assessed short-term learning and memory by assaying the aversive phototaxis suppression behavior of flies from the Sleep Inbred Panel (SIP), a collection of 39 extreme long- and short-sleeping inbred lines of *Drosophila*. We also examined the response of long and short sleepers to enriched social conditions, a paradigm previously shown to increase day sleep as well as increase synaptic plasticity in the brain.

Results: Neither long nor short sleepers had appreciable memory acquisition in contrast to a moderate-sleeping control. While moderate-sleeping control flies had the expected increase in day sleep and quantifiable increases in synaptic terminals of the accessory medulla of the brain under enriched social conditions, flies of the Sleep Inbred Panel did not display these changes.

Conclusion: Our results suggest that both extreme long and short sleeping flies have learning and memory defects, a pattern also observed in studies of cognitive impairment in humans. The SIP thus emerges as an important model for the relationship between sleep and learning and memory.

Funding: This research was funded by the Intramural Research Program of the NIH, the National Heart Lung and Blood Institute.

UNIFORM MANIFOLD APPROXIMATION AND PROJECTION FOR FEATURE SELECTION ON SLEEP STAGING DATA

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Introduction: Sleep plays an important role in human physical and mental health and thus being able to measure its effectiveness is an important subject. A common method to assess sleep quality is through the analysis of sleep stages, which can be challenging to measure without access to electroencephalogram (EEG). One approach to facilitate sleep stage inference is by uncovering vital signs (i.e. cardiac and respiration) features related to each sleep stages. The purpose of this study is to apply unsupervised learning techniques for dimensionality reduction to understand the importance of cardiorespiratory and movement features on sleep stages. The uniform manifold approximation and projection (UMAP) algorithm was used, as this novel manifold learning technique for dimension reduction better preserves the global structure of the data and has superior run time performance than alternatives such as t-SNE and PCA [1].

Materials and methods: 12 nights of healthy subjects' data were collected from publicly available databases CAP and ISRUC. We then extracted 127 statistical features from the subjects' electrocardiogram (ECG), periodic leg movement and pressure-based airflow signals on 30s epoch basis. The UMAP was applied on the obtained statistical features, followed by the use of an ensemble of decision trees to comprehend the contributions of said features on sleep stages. Two sample Kolmogorov-Smirnov (KS) test was performed for each pair of sleep stages under the null hypothesis that the samples were drawn from the same distribution. The p-values were calculated, and top features were selected in decreasing order of p-values. Afterwards, UMAP algorithm was implemented for dimension reduction on unlabelled data with the top 20 features. An analysis was performed involving the tuning of the UMAP hyperparameters on the clusters found in lower embedded space against the labels of the sleep stages awake, rapid-eye-movement (REM) sleep, non-rem (NREM) light and deep sleep. We tested the UMAP implementation with various distance metrics and discovered that results bode well with Canberra distance. Further, we performed feature importance with random forest classification on the clusters identified in lower embedded space of UMAP with all sleep stages.

Results: UMAP significantly separates the wake stage from all other sleep stages, with the maximum of the respiration waveform frequency playing an important role. The separation of REM sleep and deep sleep with Canberra distance also displayed promising results, with the low frequency band of heart rate variability contributing to it most significantly. Other features of importance for sleep stage classification were the median coefficient variation of peak sequence, root mean square of successive difference of peaks, root mean square of tidal volume from respiration and total frequency power derived from heart rate variability.

Conclusion: We applied UMAP with different sleep stages for dimensionality reduction and found that the results are prominent for some sleep stages than others. We were able to identify that the most important features to discern awake phase, as well as REM sleep and deep sleep originate from the cardiorespiratory features.

References: [1] McInnes,I., Healy,J., UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction; arxiv:1802.03426 (2018)

AN AUTOMATED RANDOM FOREST ALGORITHM FOR SLEEP STAGING USING ADVANCED CARDIORESPIRATORY AND MOVEMENT FEATURES

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Introduction: Sleep disorders are a widely underestimated phenomena and the information of sleep stages plays an important role in understanding them better. An accepted way to analyze sleep is through its segmentation in different stages by the appearance of brain activity patterns and other physiological signs, as defined by the American Academy of Sleep Medicine (AASM). Sleep staging is commonly conducted in clinical settings using electroencephalogram (EEG), which could impair study results by disturbing patients' sleep habits. The aim of this study the development of a non-invasive method for accurate sleep stage classfication through the use of cardiorespiratory signals and body movements.

Materials and methods: We used the machine learning algorithm balanced random forest to classify sleep into four stages - awake, light sleep, deep sleep and rapid eye movement (REM) sleep - based on vital signals, namely cardiac, respiration and movement data. We trained our algorithm with 209 nights of anonymized clinical patients data with no diagnostic information, obtained from the Swiss Epilepsy Center at Klinik Lengg (Zurich), and used after approval from Cantonal Swiss Ethics Commission, Zurich (Swissethics BASEC Nr. 2018-01982). We extracted 122 advanced statistical features in the time and frequency space from cardiorespiratory and movement signals for 149439 epochs of length 30 seconds. These features were used as inputs to the classifiers. The test accuracy of our algorithm was evaluated using stratified 5-fold cross validation.

Results: The non-linear variant of random forests was the best-performing algorithm, obtaining 61.46% ± 0.19% accuracy for sleep stage classification using cardiorespiratoy and movement features, compared to 53.87% ± 0.26% accuracy obtained when using only features derived from body movement. The model yielded an F-score of 0.62, 0.69, 0.48, 0.41 for awake, light sleep, deep sleep and REM sleep respectively. We compared the accuracy of our models to a linear algorithm - linear discriminant analysis (LDA) - and showed that the balanced random forest had a 6.21% increase in performance.

Conclusions: Random forest models trained with cardiorespiratory and movement features provide an accurate, long-term and fully automated solution for affordable sleep quality assessment.

THE HUMAN K-COMPLEX: INSIGHTS FROM COMBINED SCALP-INTRACRANIAL EEG RECORDINGS

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Introduction: Sleep spindles and K-complexes (KCs) are the hallmark of N2 sleep. While the functional significance of spindles is comparatively well investigated, there is still ongoing debate about the role of the KC: It is unclear whether it is a cortical response to an arousing stimulus (either external or internal) or whether it has sleep-promoting properties. Invasive intracranial (iEEG) recordings from patients with drug-resistant epilepsy offer a unique opportunity to study directly human brain physiology. To better understand the function of the KC, we aimed to (i) investigate the intracerebral correlates of spontaneous scalp KCs, and (ii) compare the intracerebral activity of scalp KCs associated or not with microarousals.

Materials and methods: We selected whole-night recordings from adults with drug-resistant focal epilepsy who underwent combined intracranial-scalp EEG for presurgical evaluation at the Montreal Neurological Institute between 2010–2018. KCs were visually marked in the scalp and categorized according to the presence of microarousals: (i) Pre-microarousal KCs; (ii) KCs during an ongoing microarousal; and (iii) KCs without microarousal. Power in different spectral bands was computed to compare physiological iEEG activity at the time of scalp KCs relative to the background, as well as compare microarousal subcategories.

Results: A total of 1,198 scalp KCs selected from 40 subjects were analyzed, resulting in 32,504 intracranial KC segments across 992 channels. Fifty percent of KCs were without microarousal, 30% were pre-microarousal, and 20% occurred during microarousals. All scalp KCs were accompanied by widespread cortical increases in delta band power (0.3–4 Hz) relative to the background: the highest percentages were observed in the parietal (60–65%) and frontal cortices (52–58%). Compared to KCs without microarousal, pre-microarousal KCs were accompanied by increases (66%) in beta band power (16–30 Hz) in the motor cortex, and this increased beta power was present before the peak of the KC. In addition, spatial distribution of spectral power changes following each KC without microarousal revealed that certain brain regions were associated with increases in delta power (25–62%) or decreases in alpha/beta power (11-24%), suggesting a sleep-promoting pattern, whereas others were accompanied by increases of higher frequencies (12–27%), suggesting an arousal-related pattern.

Conclusions: This study shows that KCs can be generated across widespread cortical areas. Interestingly, the motor cortex shows awake-like EEG activity before the onset of KCs followed by microarousals. Our findings also suggest a dual role for the KC, with region-dependent sleep-promoting and arousal-related responses.

HEARTBEAT-RELATED RESPONSES OF FRONTAL CORTICAL NEURONS IN THE SLEEP-WAKE CYCLE IN CATS

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Introduction: The visceral theory of sleep (Pigarev, 2013) assumes that the cerebral cortex switch to the analysis of interoceptive information coming from visceral organs during sleep. This was first confirmed in gastrointestinal tract researches, when cortical responses related to its activity were actually detected in visual cortical areas during sleep. Moreover, we found some sleep-related responses for cardiac activity on iEEG and local field potentials (LFPs), which appeared in normal sleep in frontal and insular cortical region. This study aimed to explore heartbeat-related activitation of single neurons in frontal cortex regions during sleep-wake cycle.

Materials and methods: In two adult cats, LFP and neuronal firing were recorded with transcranial intracerebral bipolar microelectrodes from frontal cortex. Electrodes' placement was selected according to pre-existing assumptions about the possible whereabouts of cortical areas related to heart activity. ECG was recorded with two electrodes located in the stomach and on the cat´s head. We recorded iEEG, breath rhythm and eye movements as well, to identify the sleep phases. Our analysis included 2-5 hours records, with periods of wake, normal NREM and REM sleep. The processing and statistical analysis were made with Spike2 CED, including special self-made scripts.

Results: In 20 records, we marked out over 120 single neurons. Heartbeat-related responses as changes of neuronal firing were found in 32,4%, in frontal cortex of both hemispheres. This connection between neuronal firing and cardiac activity appeared during slow-wave sleep but was not observed in wakefulness.

Conclusions: Now we see that information related to cardiac activity reaches cerebral cortex during sleep indeed. Our results confirm that cerebral cortex becomes visceral-analyzing during sleep, and this special brain-heart axis develops information in sleep in order to restore the somatic functionality of all the body organ systems.

ROLE OF SUBLATERODORSAL TEGMENTAL NUCLEUS GABA NEURONS IN SLEEP-WAKE CONTROL

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Introduction: The circuits that control REM sleep remain speculative. It is well documented that the sublaterodorsal tegmental nucleus (SLD) plays an important role in controlling REM sleep, but it is unclear which subtype(s) of SLD neurons are involved. We previously showed that glutamate neurons in the SLD play a central role in controlling both REM sleep and REM sleep atonia. But, other published work suggests that GABA neurons in the SLD may also be involved (Lu et al. Nature, 2006). Here, we used optogenetic strategies to determine if GABA SLD neurons function to control REM sleep.

Materials and methods: To test the role of GABA SLD neurons in REM sleep control, we optically manipulated their activity by driving AAV-mediated expression of eArch3.0 (an inhibitory opsin) or ChETA (an excitatory opsin) in the SLD of vGAT-Cre mice (n=10). Then, we bilaterally implanted optic fibers above the injection site to deliver optical stimuli and implanted EEG/EMG electrodes to record electro-cortical and muscle activity for sleep-wake identification.

Results: First, we showed that the opsins were preferentially expressed in the GABA neurons in the SLD. Second, we showed that optical inhibition of Arch-expressing GABA SLD neurons terminated REM sleep episodes by triggering rapid transitions into wakefulness ($p< 0.001$). Third, we also found that prolonged optical inhibition of GABA SLD neurons potently reinforced wakefulness ($p< 0.001$). Last, we showed that optical activation ChETA-expressing GABA SLD neurons decreased wakefulness ($p< 0.05$) by increasing the length of NREM sleep periods ($p< 0.005$).

Conclusions: Our results suggest that GABA SLD neurons function to sustain REM sleep by suppressing wakefulness. Our current and previous work, therefore suggest that both glutamate and GABA SLD neurons regulate REM sleep. We propose that a glutamate-GABA microcircuit contained within the SLD functions to regulate REM sleep.

RELATIONSHIP BETWEEN THE DISCOMFORT WITH MASTICATION AND THE AVERAGE DAILY SLEEPING TIME IN KOREAN GENERAL WOMEN: ANALYSIS BASED ON THE 2016 KOREA NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (KNHANES)

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Introduction: The purpose of this study was to investigate the relationship between the discomfort of mastication and the average daily sleep time in Korean adult women.
Materials and methods: The KNHANES, based on the National Health Promotion Act, investigates the health-related behaviors of the Korean populace, as well as chronic disease status and aspects of food and nutrition. The KNHANES was conducted every 3 years from 1998 to 2005, and yearly in the period 2007 to 2009. This study used raw data from the first year of the 7th KNHANES, conducted in 2016. Among the subjects who conducted the first year of the 7th Korea National Health and Nutrition Survey (KNHANES) in 2016, there were 2858 adult women who responded to the discomfort of mastication and sleep time. Out of a total of 8150 respondents, 5292 subjects were excluded. The results for weekday daily sleep time and the results for weekend daily sleep time were combined and integrated into average daily sleep time.
Results: There was no statistically significant difference in age, BMI, waist circumference, education level, and steady high-intensity exercise compared to women who were uncomfortable with mastication. There was no difference in the frequency of depressed mood, anxiety, irritability, and suicidal ideation. However, results were derived through independent t-test. women who felt the discomfort with mastication tended to have shorter average daily sleep time. The difference in sleep time was 7.64 minutes (p = 0.066).
Conclusions: In this study, we observed that general adult women in Korea, when the subjects felt the discomfort with mastication, average daily sleep time was shorter. This may be the basis for relationship between the disorders of temporomandibular joint and mental health problem, especially in Korean adult women.
Acknowledgements: None.

VISCERAL COMPLEX OF CENTRAL SLEEP APNEA IN CATS

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Introduction: Central sleep apnea is absence of breathing during sleep caused by the command from breathing center to the thoracoabdominal muscles. In spite of wide spreading of this phenomenon among healthy and diseased people and some species of animals (mouse, rats, cats, dogs) its role in organisms is still unclear.
Materials and methods: In our studying in adult cats we used standard polysomnographic recording (EEG, ECG, EOG, airflow, respiration muscles registration) with some extra-channels: stomach and duodenum myoelectric activity, temperature of brain and body that allowed us to take a fresh view on this problem in context of the whole organism.
Results: We observed frequent cessations of breathing (for 9-13 seconds) during sleep generally perform in the transition states (switches between stages of sleep-wake cycle) during 3 years in three cats. Each of the central sleep apnea episodes accompanied with stereotypical complex of registered somatic and visceral reactions. Heart rate strongly increased before the start of apnea episodes, and diminished during the lack of respiration. All other visceral parameters demonstrated reduction of the activity levels. The main features of the apnea episodes were stable for all 3 years of studying.
Conclusions: Our exploration lets us to hypothesise that the Central Apnea most likely is coordinated physiological adaptive function important for the recovering of an organism.

Basic Research
Board #005 : Poster session 3

EFFECT OF THE SELECTIVE MELATONIN MT1 RECEPTOR PARTIAL AGONIST UCM871 IN THE ACTIVITY OF NORAPHINEPRINE NEURONS OF THE LOCUS COERULEUS DURING THE SLEEP/WAKE CYCLE

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Introduction: Melatonin is a neurohormone produced in a circadian rhythm in the pineal gland (Tan et al., 1999) which is involved in numerous physiological functions, including sleep and temperature regulation, via its G-protein coupled receptors MT_1 and MT_2 (Dubocovich and Markowska 2005). Different localizations of MT_1 and MT_2 receptors have been found, suggesting a selective functional specificity (Lacoste et al., 2015). The Locus Coeruleus (LC) may contain the critical wakefulness-promoting neurons that control the sleep-wake switch by discharging at highest rates during wakefulness (W), at lower rates during non-rapid eye movement (NREM) sleep, and exhibiting complete cessation of discharge during rapid eye movement (REM) sleep. However, the activity of MT_1 in the LC is poorly understood due to the lack of receptor-selective compounds. Here we investigate the role of the first selective MT_1 receptor partial agonist ($pK_i=8.93$) N-(2-{Methyl-[3-(4-phenylbutoxy)phenyl]amino}ethyl)acetamide (UCM871; Rivara et al., 2007) in the sleep-wake cycle, and the activity of the noradrenergic (NE) neurons in the LC over a 24-hour period.

Materials and methods: To assess the effects of UCM871 on the sleep-wake cycle, electroencephalograms (EEG) were recorded in free-moving rats (n=7-11) for a period of 24 h (from 6 PM to 6 PM), within which a subcutaneous injection of vehicle (veh) or UCM871 (7, 14 and 21 mg/kg) was administrated every 4 hours. To assess the localization and the distribution of MT_1 receptors in LC-NE neurons, we used immunohistochemistry (IHC) and immunofluorescence (IF) labeling with receptor-specific antibodies. Given the role of the NE neurons of LC in sleep activity, *in-vivo* single unit extracellular recordings of NE neurons were performed following the administration of veh or UCM871 (3.5, 7, 10 and 14 mg/kg, i.v.) during the day and the night.

Results: Rats treated with UCM871 at 14 mg/kg s.c. exhibited an increase in the duration (min) of REM sleep compared to the control group (veh: 96.6±7.0; UCM871: 119.7±5.1, p< 0.05) over 24 hours. Remarkably, UCM871 (14 mg/kg) increased REM sleep only during the light phase (veh: 41.17±3.9; UCM871: 60.3±4.2, p< 0.05) with no effect during the dark phase at the same dosage. Furthermore, IHC and IF results showed an expression of MT_1 receptors in LC-NE neurons with a higher co-localization with tyrosine hydroxylase (a marker of NE) in the dark phase than in the light phase. Finally, electrophysiology recording showed that LC-NE neurons' activity decreased in both phases with the administration of UCM871. However, the decrease was more pronounced (p< 0.01) during the dark phase at 10 mg/kg (71.3±10.3 %) and 14 mg/kg (80.5±9.9%) than the decrease during the light phase at the same dosage (10 mg/kg: 43.9±17.9%; 14 mg/kg: 47.0±23.1%).

Conclusions: These results show that MT_1 receptors play an important role in REM sleep and in adrenergic function, but in a distinct manner. While MT_1 activation in LC by UCM871 is pronounced in the dark than in the light phase, the effect in the REM sleep is higher during the light phase.

FIRST DEMONSTRATION THAT DIFFERENT NEURONS ARE ACTIVATED DURING PARADOXICAL (REM) SLEEP AND WAKING USING THE TRAP MICE METHOD

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Introduction: Paradoxical sleep (PS, or REM sleep) is characterized by cortical activation close to waking (W) paradoxically associated with muscle atonia. Based on cFos expression as a marker for neuronal activation, we recently showed that only a few limbic and cortical structures such as the dentate gyrus (DG), claustrum (CLA) lateral part of supramammillary nucleus (SuML), medial entorhinal (mENT) and retrosplenial (RSP) cortices are activated during PS in contrast to W during which most cortical structures are activated [1]. Our objective in the present study is to further determine whether the same or different neurons are activated during PS and W, and during two successive W-W or PS-PS periods.

Materials and methods: We used transgenic TRAP2 mice expressing tamoxifen-dependent CreER recombinase under cFos promoter [2]. CreER can only undergo recombination when 4-OHT (an active metabolite of tamoxifen) is present, resulting in a permanent Cre-dependent reporter gene (mCherry) expression in cFos labeled neurons. We examined 3 groups of mice: W-W group (open field for 2h), PSR-PSR group (2h PS recovery following 48h of selective PS deprivation), and a W-PSR group. All mice were injected with 4-OHT 2h after the beginning of W or PSR and perfused one week later 2h after W or PSR. Automatic PS deprivation was realized by the system we developed [3].

Results: In all groups, a large number of mCherry+ and Fos+ neurons were counted in the ACA, mENT, RSP and the DG. In the W-W and PSR-PSR groups, many mCherry+ neurons were Fos+ (double-labeled) excepting in the DG. In the W-PSR group, only a few neurons were double-stained in all regions. In PSR-PSR group, many double-labeled neurons were also observed in PS-generating structures such as the SLD and SuML. Finally, in all groups of animals, high percentage of neurons were double-stained in the suprachiasmatic nucleus (SCN) indicating that the activity of SCN neurons depends on circadian time rather than on vigilance states.

Conclusions: Our results first indicate that in structures generating circadian rhythms or PS, the same neurons are reactivated twice validating the TRAP method. They further indicate that W and PS are completely different states since different populations of neurons are activated during W or PS in particular in the cortical structures involved in learning and memory. These results open the avenue for the identification of the function of PS.

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OREXIN-A AMELIORATES LASTING BEHAVIORAL AND SLEEP DISTURBANCES PRODUCED BY EARLY POSTNATAL DYSFUNCTIONING OF BRAIN MUSCARINIC CHOLINERGIC SYSTEM

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Introduction: Orexin/Hypocretin-producing neurons are involved in the strengthening of arousal and wakefulness state. Despite the multiplicity of systems involved in retention of wakefulness this condition becomes unstable if brain Orexinergic system is deficient. Suppression of wakefulness is considered as one of the main reasons for sleep disorders and depression. Data from preclinical and clinical studies allow us to assume that Orexins may be involved in pathophysiology of depression. It was shown by us that early postnatal dysfunctioning of brain muscarinic cholinergic system (MChS) has lasting effects on general behavior and sleep-wakefulness cycle (SWC) in adult age rats and disturbances produced by this procedure are similar to sleep disorders in patients with major depressive disease.Study investigated in adult rats the effects of Orexin-A/Hypocretin-1 on the disturbances in general behavior and SWC produced by early postnatal dysfunctioning of MChS.

Materials and methods: Early postnatal dysfunctioning of MChS was produced by subcutaneous injection of Scopolamine (30 mg/kg,) two times daily, in rat pups (n=10) from postnatal day 7 to 28. Control rat pups (n=5) received the same volume of saline from postnatal day 7 to 28. Experiments were started in adult age, 2-3 month after discontinuation of drugs receipt. Surgery with implantations of stainless steel screws, for epidural EEG registration and microinjection cannulas (Plastics one) were made under general anesthesia. Two doses of Orexins (10µg/µl and/or 25µg/µl) were injected in lateral ventricle by special cannulas and Hamilton Syringe. After post-surgery recovery EEG registration of SWC was started immediately after microinjection of Orexin-A lasted continuously during 5 h daily for three consecutive days. Statistical processing was made by Students' t test.

Results: Direct ICV Microinjections of Orexin-A produces sharp decrease of locomotor activity, significant diminution of exploratory behavior, enhancement in the rate of food intake. Significant disturancees were found in SWC: reduction in the incidence and total time of active wakefulness; increase in the incidence and total time of passive wakefulness and light slow-wave sleep; increase in deep slow-wave sleep incidence and in the number of awakenings, indicating to the deterioration of sleep quality. Incidence and total time of REM sleep were sharply increased. These changes are very similar with sleep disorders, characteristic MDD.

ICV microinjection of Orexin-A (10 and/or 25µg/µl) dose-dependently ameliorates described sleep disturbances. Effects are manifested in the enhancement and stabilization of wakefulness, suppressed by postnatal dysfunctioning of MChS, in an increase in the latency of REM sleep, reduced as a result postnatal dysfunctioning of MChS and removal of REM sleep that develops very frequently as lasting effect of postnatal dysfunctioning of MChS.

Conclusions: Elevation of the level of Orexin-A in CSF ameliorates lasting behavioral and sleep-wakefulness disturbances produced by early postnatal dysfunctioning of MChS.

EVENING ACTIVITIES AND SLEEP IN LATE ADOLESCENCE - ECOLOGICAL AMBULATORY ASSESSMENT APPROACH

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Introduction: Increasing number of adolescents use technological devices before bedtime (Gradisar et al., 2013; Hale et al., 2018) and some research has shown this to been associated with decrease in sleep quality (Woods & Scott, 2014). Daily total sleep time usually decreases in late adolescence due to early school start times and increased academic demands, though the need of total sleep time stays stable (Crowley, Wolfson, Tarokh & Carskadon, 2018). This may happen because bedtime autonomy increases and adolescents have more autonomy also in their evening activities (Tashjian, Mullins, & Galván, 2019). Systematic reviews have shown an adverse association between screen-based digital media and sleep health (Carskadon, 2011; Crowley et al., 2018; LeBourgeois et al., 2017). The underlying mechanisms of these associations are likely to result from time spent on screens which displace time from other activities, psychological stimulation based on media content and/or the effects of light emitted from devices affecting circadian timing, sleep physiology and alertness. The aim of this study was to investigate how socio-psychological stimulation in the evening is related to adolescents' bedtime, sleep quality and sleep duration. More precisely, the aim was to investigate how different activities in the evening are associated with self-reported (subjective) and objectively measured bedtime and sleep duration and self-reported sleep quality using ecological ambulatory assessment (EMA) approach.

Materials and Methods: Data was collected from adolescents (N=149, female 68 %, aged 17-18) from a big city in Finland during spring 2018. During ten consecutive days participants answered short questionnaires using mobile phones (data points N=1471). Every evening participants reflected how stressed they felt themselves at the moment and every morning they reflected their previous evening and what they did 30 minutes before going to bed, time they went to bed and how well they slept. Open ended answers were categorized as *cognitive* (eg. studying), *relaxing* (eg. getting ready to sleep), *active ICT use* (eg. chatting), *passive ICT use* (watching videos/TV) and *other* (eg. travel). During the study period participants wore activity bracelets on their wrist (giving a MET value every 30 seconds). Research questions were approached using linear regression analysis and the comparison category in the analysis was category *relaxing*.

Results: The correlation between self-reported and objectively measured bedtime was .711 (p< .01). Results showed that participants who reported cognitive activities in the evening reported also worse sleep quality, later bedtime and shorter sleep duration compared to those who did relaxing activities in the evening. Stress in the evening was also negatively associated with self-reported sleep quality.

Conclusions: School demands and stress may play a large role in sleep problems compared to ICT use. ICT use is not always psychologically arousing and in the future studies the content of the activities should be addressed instead of screen time. EMA approach is a good way to study the real-life situations and behavioral patterns adolescents' experience.

EFFECTS OF HABENULAR STIMULATION FREQUENCIES ON OBSTRUCTIVE SLEEP APNEA INDUCED BY STIMULATION OF INSULAR CORTEX

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Introduction: To investigate the effects of high-frequency stimulation of the habenula (Hb) on obstructive sleep apnea (OSA) induced by stimulation of the insular cortex. **Materials and methods:** After OSA was induced by stimulating the insular cortex (Ic) with concentric stimulating electrodes at 100 Hz in rats, the Hb was stimulated at different frequencies (50 Hz, 120 Hz, 130 Hz, and 280 Hz). The changes of apnea events and electromyography (EMG) of the genioglossus were compared before and after stimulation of the Hb.
Results: With stimulation of the Ic at 100 Hz, apnea events were successfully induced with disappearance of EMG of the genioglossus. After stimulation of the Hb at 130 Hz, apnea events disappeared with significantly increased genioglossal EMG.However, such a change failed to be found at the stimulation frequencies of 50 Hz, 120 Hz, and 280 Hz.
Conclusion: Stimulation of the Hb at the frequency of 130 Hz could effectively inhibit OSA events induced by stimulation of the Ic.**Acknowledgements:** THe authors thank Professor Shao Wang for assistance with
the experiments, who passed away 2 years ago; he provided constructive advice to conceive the study. e authors are grateful to all the participators of the Department of
Physiology Lab and the Center of Medical Laboratory of Jilin Medical University. The study was supported by the National Natural Science Foundation of China (816700
80) and the National College Students Innovation and Entrepreneurship Training Program (201613706024).

Basic Research
Board #041 : Poster session 2
STUDY OF ASSOCIATION BETWEEN BODY MASS INDEX AND SLEEP QUALITY AMONG INDIAN STUDENTS

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Introduction: The prevalence of overweight, indicated by Body Mass Index (BMI: 23-24.9 kg/m2), pre-obese (25-29.9 kg/ m2) and obesity (>30 kg/m2) has increased in recent years. There has been a change in sleeping patterns (reduction in number of hours of sleep, quality of sleep, delay in onset of night time sleep) with the increase in BMI in Asian population, but studies are limited.

Materials and methods: Study included 230 college students from 18 to 24 years of which 171 were males. They were screened for major diseases and psychological problems. Subjects having sleep disorders who are under medication were excluded. Sleep patterns, latency, duration, habitual sleep efficiency, sleep disturbances and daytime dysfunction were assessed using Pittsburgh Sleep Quality Index (PSQI). Permission to use PSQI questionnaire was obtained from concern authority (Daniel J Buysse, Professor of Psychiatry and clinical Translational sciences, University of Pittsburgh School of Medicine).

Results: Among participants 103 (44.8%) had a BMI >23 kg/m2. Among these participants 41(17.8%) were classified as overweight (23-24.9 kg/m2) and 48 (20.9%) were pre-obese (25-29.9 kg/m2), whereas only 14 (6.1%) participants were obese (>30 kg/m2) based on Asian criteria . Most of the participants 110 (47.8%) were in normal category (18.5-22.9 kg/ m2).

Among all the participants, 74(32.2%) participants experienced poor sleep quality (>5PSQI< 8), and only 15 (6.5%) participants experienced extremely poor sleep quality (PSQI>8) . In this study 23.9% of participants reported taking more than 30 minutes to fall asleep after going to bed, 92.2% of participants reported with >85% of habitual sleep efficiency (percent of the time asleep after going to bed until get up from asleep) and only around 7.8% reported less than 85% of habitual sleep efficiency. Around 78.7% reported sleep disturbances less than once a week and around 11.7% reported sleep disturbances once or twice a week. Most of the participants reported day time dysfunction which may be due to poor sleep quality in night. 50% reported daytime dysfunction once in a week. Around 14.3% participants reported sleep duration of < 5 hours, 35.7% participants reported sleep duration of 5-6 hours, 44.3% participants reported sleep duration of 6-7 hours, however only 5.7% participants reported >7 hours that is the recommended sleep duration for adults. No participants has taken any sleep medication in last 1 month of the study. The relation between code (BMI) and various parameters was studied using Likelihood Ratio. Among all the studied 7 components, sleep latency and sleep disturbance component were significant (p< 0.05) . Association between BMI code with sleep latency was significant, p=0.038 . Association between BMI and sleep disturbance was highly significant, p=0.003.

Conclusions: Among all the studied 7 components, association of BMI code as per Asian criteria with sleep latency and sleep disturbance component were significant. The awareness about sleep habits is needed for good sleep quality.

ANALYSIS OF NIGHTTIME SLEEP FRAGMENTATION OF ACTIGRAPHY REST/ACTIVITY PATTERNS IN HEALTHY, YOUNG SEDENTARY NAPPERS

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Introduction: The effects of napping on the quality of sleep have been investigated with mixed results. The discrepancy in the literature may be explained by a difference in napping behaviors (duration, frequency or proximity to bedtime), daytime activity levels and methodological differences. Our aims were: 1) To assess sleep fragmentation of rest-activity patterns in nappers utilizing a novel algorithm, 2) To determine if napping behaviours contribute to sleep disruption, and 3) To determine if activity levels influence sleep quality.
Material and methods: This is a retrospective analysis whereby the data was taken from an existing study(Mograss et al., 2017). Screening questionnaires were completed on sleep habits, physical activity, medical and psychological history. A total of 62 healthy, sedentary adults (23.5 ± 4.2yrs) were divided into 3 groups: NoNaps, n=20/8 days, n=20; Moderate 1-2 naps/8 days, n=21; Frequent 3^+/8days, n=21. Actigraphy sleep including naps were reviewed on the diary and confirmed. We used a algorithm (kRA) which quantifies sleep fragmentation using a probabilistic state transition model (Lim et al., 2011). The kRA provides a measure of the probability of transitioning from a rest to active state. Actigraphy derive sleep variables include (total sleep time,TST; sleep latency,SOL; sleep efficiency,SE; awakenings,AWK; wake after sleep onset,WASO; activity levels, ActivL). ANOVAs were used to determine: 1) *nap frequency* Groups (no naps, moderate, frequent) x (kRA) and sleep variables, and 2) Daytime *activity levels* Groups (light=145-274 cpm, moderate=274-597 cpm) x (kRA) and sleep variables. Independent t-tests were used to determine 1) differences in nap duration Groups (short< 60min, long>60min)x (kRA) and sleep variables. 2) Nap proximity Groups (< 7hrs, $\geq$7hrs)x (kRA) and sleep variables. Pearson correlations were performed between the kRA and sleep variables.
Results: ANOVAs revealed a significant group effect on kRA ($p< 0.01$). Post-hoc Tukey HSD comparison indicated that frequent nappers (M±SD 0.0589 ± 0.01) had a significantly higher kRA than moderate nappers (0.0484 ± 0.01, $p< 0.01$, $d=0.96$) and non-nappers ($0.0497\pm.01$, $p< 0.02$, $d=0.83$). Moderate nappers did not significantly differ from non-nappers ($p=0.96$). We failed to find a significant difference on the sleep variables (TST, WASO, SE, SOL, AWK, ActivL), p's>0.05. Nap duration did not result in significant differences in the sleep variables or kRA metric (t-tests p's>0.10). Late evening naps with a proximity of < 7hrs vs. $\geq$7hrs to the bedtime, significantly increased TST, WASO, SOL, and AWK (t-tests p's≤0.02) but not SE or kRA (p's>0.15). ActivL did not result in differences in sleep variables or kRA (p's>0.14). Pearson correlations revealed negative associations between kRA and TST ($r = -0.32$, $p=0.01$), SE ($r = -0.32$, $p=0.01$). As awakenings and WASO increased there was an increase in kRA ($r=0.53$, $r=036$ p's < 0.01, respectively).
Conclusion: Frequent napping may result in increased sleep fragmentation. Evening naps closer to bedtime resulted in longer sleep durations and poorer quality sleep reflected in longer sleep onsets, increased awakenings without a change in sleep efficiency. The length of a nap did not appear to affect sleep in our analysis.

HOMER AND DMGLURA INTERACTIONS PROMOTE SLEEP IN *DROSOPHILA*

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Introduction: Homer proteins mediate plasticity and signaling at the postsynaptic density of neurons and are necessary for sleep and synaptic remodeling during sleep. We have previously shown that genetic loss of Homer in *Drosophila melanogaster* results in a short and fragmented sleep phenotype [1] and recent studies indicate that Homer signaling is required for synaptic downscaling during sleep in rodents [2]. However, the mechanism through which Homer signaling affects sleep currently remains an open question. At the synapse, Homer proteins act as adaptor proteins to mammalian group I metabotropic glutamate receptors (mGluRs), which may bear functional relevance to sleep regulation. Unlike mammalian systems, the *Drosophila* animal model contains only one Homer and one mGluR subtype, known as DmGluRA. This confers a technical advantage for identifying a possible role for the interaction of these proteins sleep regulation. Therefore, in this study, we investigated the role of Homer and Homer/mGluR interactions in *Drosophila melanogaster.*

Materials and methods: Wildtype, mutant, and transgenic flies in the following study are in the white Canton-Special (wCS10) genetic background strain (unless otherwise noted). The *DmGluRA^{PPGTRF}* mutation was generated on a *w1118* background using CRISPR/Cas9-mediated homology directed repair. *Drosophila* sleep was recorded by video and analyzed as previously described [3]. Homer-DmGluRA protein interactions were assessed by co-immunoprecipitation assays and Western blotting. Student's t tests were used to compare sleep between genotypes with Holm-Sidak correction for multiple comparisons.

Results: Homer knockdown in neurons significantly reduced the amount of sleep in the fly, leading to a reduction of approximately a third of the daily sleep amount observed in parental controls. Co-immunoprecipitation assays demonstrate that Homer proteins physically associates with *Drosophila* DmGluRA. CRISPR/Cas9-mediated genetic deletion of the putative conserved Homer/DmGluRA binding site in *Drosophila* significantly reduced the association between Homer and DmGluRA proteins and also reduced total sleep amount.

Conclusions: The results of this study demonstrate that Homer signaling in neurons is required to promote sleep and provide the first evidence that Homer and mGluR interactions - which were previously considered a primarily mammalian phenomenon - are conserved in *Drosophila melanogaster*. Finally, the changes in sleep observed in the Homer/DmGluRA binding mutant suggest that coupling of Homer to DmGluRA is critical for Homer to promote sleep.

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SUVN-G3031, A HISTAMINE H3 RECEPTOR INVERSE AGONIST PRODUCES WAKE PROMOTING AND ANTI-CATAPLECTIC EFFECTS IN HYPOCRETIN-2-SAPORIN LESIONED RATS

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Introduction: SUVN-G3031 is a potent and selective H3 receptor inverse agonist with hKi of 8.7 nM at H3R and more than 100-fold selectivity against related GPCRs. SUVN-G3031 exhibited desired pharmacokinetic properties and brain penetration in preclinical species. SUVN-G3031 blocked R-α-methylhistamine induced water intake and increased tele-methylhistamine levels in brain and cerebrospinal fluid. Acute oral administration of SUVN-G3031 produced significant increase in acetylcholine, histamine, dopamine and norepinephrine levels in the cortex. SUVN-G3031 produced wake promoting effects in male Wistar rats and C57BL/6J mice. SUVN-G3031 was evaluated in Phase 1 clinical studies (US IND) and is being developed for the treatment of sleep related disorders. It showed desirable pharmacokinetic profile with safety and tolerability in healthy human volunteers.
Materials and methods: In the present study, effects of SUVN-G3031 on sleep/wake profile were evaluated in rats lesioned with neurotoxin hypocretin-2-saporin in lateral hypothalamus. EEG signals were acquired using telemetric device implanted intraperitoneally.
Results: Rats lesioned with hypocretin-2-saporin in lateral hypothalamus produced narcoleptic-like behavior. SUVN-G3031 produced significant increase in wakefulness with concomitant decrease in rapid eye movement (REM) sleep in rats lesioned with hypocretin-2-saporin. Treatment with SUVN-G3031 decreased the DREM episodes indicative of anti-cataplectic effect in rodents.
Conclusions: Results from the current study provide a strong preclinical basis for potential utility of SUVN-G3031 in the treatment of sleep related disorders like narcolepsy with and without cataplexy. Phase 2 POC study for the treatment of narcolepsy is currently being planned in USA.
Acknowledgements: None

GENETIC IDENTIFICATION OF CHOLINERGIC MECHANISMS CONTROLLING SLEEP AND WAKEFULNESS

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Introduction: Acetylcholine is the oldest neurotransmitter ever found and known to have an essential function especially to wakefulness and REM sleep. We previously showed that genetic inhibition of basal forebrain cholinergic neurons (BFCN) in mice lead to the sever short sleep phenotype especially during dark phase, which is active period for mice (Niwa et al. 2018). We also identified that this phenotype is well reproduced by the double knock-out (DKO) of Chrm1 (M1) and Chrm3 (M3) genes (Niwa et al. 2018). However, this phenotype is quite strange considering the well-known cholinergic function to wakefulness. To further investigate why genetic disruption of BFCN to M1/3 pathway results in the severe short sleep phenotype during dark phase, we generated M3 conditional knock-out mice and examined which cre driver lines can reproduce the phenotype.
Materials and methods: Chrm3 flox mice, several cre driver mice, EEG/EMG measurement and analysis
Results: We successfully generated and examined M3 flox/flox mice with or without 6 different cre lines. Among them, we found that one cre line reproduced the short sleep phenotype during dark phase. Surprisingly, we also found that another cre line produced a trend of the opposite phenotype, which is more amount of sleep during dark phase.
Conclusions: These results suggest that cholinergic regulation of wakefulness via M3 is not mono- but multi-layered cellular mechanism.

A SHORT DEVICE-BASED QUESTIONNAIRE 'SLEEPHUBS CHECK-UP' TO ENGAGE THE GENERAL POPULATION IN UNDERSTANDING MORE ABOUT THEIR SLEEP

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Introduction: There is an ever-increasing availability and usage of consumer sleep technology (CST) and treatments for sleep disorders, for example, CBT-I as solutions to the perceived increased levels of sleepiness in some western societies. The increased number of people complaining of poor sleep puts a strain on health services where many doctors have neither the time or experience to deal with sleep problems. While it seems that we are good at offering potential solutions to the perceived problem of poor sleep, sleep questionnaires have historically not been written from the general public point of view, and often not easily accessible. There appears little in the way of engagement and screening for the general population to see if they have a sleep problem, and if they do whether that problem is amenable to treatment with CST/CBT-I. The SleepHubs Check-up (SHC) is a 4-6 question device-based questionnaire designed for use by the layman as it is quick and easy to complete and focuses on three categories commonly associated with poor sleep: daytime sleepiness, snoring, and insomnia. Based on the results of the SHC, individuals are assigned into one of three categories: Probable good sleeper - no need to worry further, Possible reasonable sleeper but room for some improvement, CST/CBT-I of possible benefit, possible sleep health issue, clinically relevant, further investigation required.

Materials and methods: We randomly recruited one hundred adults as a pilot study to engage in answering questions as part of the SleepHubs Check-up. The questions used took their inspiration from the Screen for Sleep Disorders in Brodkey et.al 1997[1]. We modified the wording and added a few supplemental questions to improve the accuracy of the screen. The responses to the questions were automatically scored and individually weighted and these scores compared with the scoring mechanism of the Insomnia severity Index (ISI), Stop Bang and OSA probability based on the MAP index (MAPI).

Results: One hundred adults (55% female) with an average age of 43 years and average BMI of 26.4 Kg/m^2 were recruited. Statistical analysis showed a positive correlation (>80%) between SHC and probability of Insomnia using the Insomnia severity Index (ISI) when applying Pearsons correlation coefficient. Additionally, the SHC score accurately identified individuals at risk of OSA when compared to Stop Bang and MAPI scores.

Conclusion: The SleepHubs Check-up assignment and categorisation criteria has shown to be effective and it is proposed could act as an instrument for use in both research and as a screening tool for clinicians in the health care environment enabling quick identification and assignment of individuals that may have a sleep issue.

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PHYSICAL EXERCISE MODIFIES THE MORPHOLOGY OF SLEEP δ-WAVES: AN ENVELOPE ANALYSIS

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Introduction: It is believed that exercise has positive influences on sleep (decreased sleep onset latency and wake, increased slow wave sleep (SWS), and improvements in subjective sleep, etc.) (*Sleep Med Rev* 4: 387, 2000). However, there are several studies which fail to observe a clear increase in SWS after exercise, and some previous studies reported a decrease in SWS after exercise (*Acta Physiol Scand* 574:14, 1988). To get an insight into the effects of exercise on sleep architecture, present study adopted envelope analysis (*NeuroImage* 172: 575, 2018). Deep sleep (N3) is characterized by high amplitude, continuous delta waves. These morphological features can be followed using envelope analysis allowing the inference of sleep stability. This approach provides information beyond the standardized scoring of sleep.

Materials and methods: Nine healthy young men without sleep disorders participated a randomized-crossover intervention study (age 23.8 ± 0.7 yr; weight 66.62 ± 2.2 kg; BMI 22.8 ± 0.6 kg/m^2). The trials with and without exercise (60 min at 60% VO_2 max on a treadmill, beginning at 6 hours before bedtime) were separated by a washout period of a week. Temperature and humidity were maintained at 25℃ and 55%, respectively. The subjects went to bed at their habitual bedtime and slept for 8 hours with PSG recording. The experiment was preceded by an adaptation night.

Results: Amount of SWS decreased (control trial: 101.6 ± 7.6 min vs. exercise trial: 90.8 ± 6.8 min, $P = 0.007$), rather than increase, after exercise compared to control trial. REM sleep latency (control trial: 107.2 ± 15.4 min vs. exercise trial: 79.6 ± 8.2 min, $P < 0.05$) also shortened in exercise trial. Scatterplot delta band amplitude against CVE showed distinct distribution between sleep after a single bout of exercise and sedentary control. Sleep after exercise showed distinct distribution of epochs located in high amplitude (> 2.3) and low CVE values (< 1.3); exercise increased stability of delta waves. During sleep after exercise, the time course of CVE was significantly lower than that of control during the first half of sleep (control trial: 1.50 ± 0.03 vs. exercise trial: 1.44 ± 0.03, $P = 0.005$). Delta power during 30 minutes after sleep onset was significantly greater (control trial: 192.47 ± 24.70 μV^2 vs. exercise trial: 239.23 ± 32.12 μV^2, $P = 0.027$). Delta power density over entire sleeping period was significantly higher in the exercise trial compared to control trial (control trial: 89.17 ± 1.28% vs. exercise trial: 91.28 ± 0.95%, $P = 0.048$). In addition to conventional sleep scoring, envelope analysis provides different approach to evaluate the impact of exercise on SWS quality.

Conclusions: Exercise did not change the conventional sleep parameters such as an amount of SWS, wakefulness, etc. However, physical exercise favors the appearance of high amplitude continuous delta waves associated with N3. Additional information with the envelope analysis provides insight into the effects of exercise on sleep.

NIGHT-SHIFT WORK INCREASES COLD PAIN PERCEPTION

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Introduction: Although night-shift work (NSW) is associated with a higher risk for several physical and mental disorders, the impact of NSW on pain perception is still unclear. This study investigates the impact of NSW on cold pain perception considering the impact of mood and sleepiness.

Materials and methods: Quantitative sensory testing (QST) was performed in healthy night-shift workers. Cold pain threshold as well as tonic cold pain was assessed after one habitual night (T1), after a 12-hour NSW (T2) and after one recovery night (T3). Sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI) before T1, sleepiness with the Stanford Sleepiness Scale (SSS) and mood with a German short version of the Profile of Mood States (ASTS) at T1, T2 and T3. Depending on the distribution of the data, ANOVAs or Friedman tests as well as t- or Wilcoxon tests were performed.

Results: Nineteen healthy shift-workers (13 females; 29.7 ± 7.5 years old; 8.1 ± 6.6 years in shift work, PSQI: 4.7 ± 2.2) were included. Tonic cold pain showed a significant difference between T1 (48.2 ± 27.5 mm), T2 (61.7 ± 26.6 mm; effect size: Cohen´s d.=.49; percent change 28%), and T3 (52.1 ± 28.7 mm) on a 0 to 100 Visual Analog Scale (p-value = .007). Cold pain threshold changed from 11.0 ± 7.9 C (T1) to 14.5 ± 8.8 C (T2) (p-value = .04), however, an ANOVA comparing T1, T2, and T3 was not significant (p-value = .095). Sleepiness (SSS) and mood (ASTS) changed significantly between T1, T2 and T3 (p-values < 0.01). The change of mood but not of sleepiness correlated with the difference in tonic cold pain from T1 to T2 (R: 0.53; R2: 0.29; p-value = .022).

Conclusion: NSW increases cold pain perception. The same tonic cold pain stimulus is rated 28% more painful after NSW and normalizes after a recovery night. Increases in cold pain perception due to NSW appear to be more strongly related to changes in mood as compared to changes in sleepiness.

ANTIBACTERIAL ACTIVITY OF INHIBITORS OF MONOAMINES RE-UPTAKE DEPENDS FROM THEIR ANTI-DEPRESSIVE EFFICACY

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Introduction: Unlimited uses of antimicrobial agents, frequently applied arbitrarily, contributed to the development of "antibiotic resistance" and new infectious diseases. As a result, effectiveness of wide range of antibiotics gradually decreases and their side effects increase. Therefore searching for non-antibiotic agents with antimicrobial activity, antidepressants among them, is very topical. No less important is the question whether the antimicrobial activity of antidepressants can be dependent on their effectiveness in restoring of sleep disturbances in animal models of depression. Problem is important because antidepressants are supposed to restore disturbances characteristic for MDD - sleep disorders among them, and effective drugs mustn't additionally worsen sleep and general condition of depressive patients.The aim was to study antibacterial action of tricyclic, non-selective and selective, antidepressants and possible dependence of antimicrobial activity to their anti-depressive efficacy on sleep disturbances in animal models of depression.

Materials and methods: Wild white rat pups (n=5 in each group) received subcutaneous injection of Melipramin (group I) and/or Fluoxetine (group II), 30 mg/kg, two times daily, from postnatal day 7 to 28. Control rat pups received saline with the same procedure. Experiments were started 8-12 weeks after end of treatment. Surgery was made under general anesthesia. Baseline sleep registration in each control rats was made three consecutive days, 10.00 - 20.00 h. In experimental groups EEG registration of SWC, with the same duration as in controls, was started immediately after intraperitoneal injection of Melipramin and /or Fluoxetine (10 mg/kg, 15 mg/kg). Escherichia coli, Bacillus subtilis, Staphylococcus aureus and Mycobacterium phlei were used as test cultures. Melipramine, (0.01; 0.1 and 1 g/L) and Fluoxetine (0.01; 0.1 and 1 g/L) were used for the studying of antibacterial spectrum.
Statistical processing of obtained results was made by Students' t-test.

Results: In rat pups, exposed postnatally to the antidepressants, SWC was disturbed significantly in adult age. Single dose Melipramin produced additional significant undesirable changes manifested in the worsening of sleep quality and whole inhibition of REM sleep during 4-5 h after drug injection. Sleep disorders alike to depression developed in recovery period (24 h after drug injection) - sleep quality becomes worsened, sleep interruptions increases, REM sleep latency diminishes, but its incidence rise. Deteriorating influence of Fluoxetine on SWC was relatively weaker and short-term indicating to higher anti-depressive efficacy of the drug.Only Fluoxetine exerted dose-dependent suppressive action on growth-development of microbial test-objects with different quality of antimicrobial activity for different test-objects. Overall, antimicrobial activity was dependent on anti-depressive efficacy of used antidepressants.

Conclusions: Antimicrobial activity of Melipramin and/or Fluoxetine on growth-development of Escherichia coli, Bacillus subtilis, Staphylococcus aureus and Mycobacterium phlei depends on their anti-depressive efficacy on sleep disturbances which has been only revealed by the selective inhibitor of serotonin re-uptake, Fluoxetine.

BEDROOM DESIGN ORIENTATION AND SLEEP ELECTROENCEPHALOGRAPHY SIGNALS

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Introduction: Orientation is a significant factor in architectural design that may affect well-being. Body direction does not change during sleeping, and sleeping is sensitive and affected by environmental factors. **Aims:** This neuroarchitecture study aimed to assess the effects of bed orientation on sleep quality to enhance bedroom design.
Materials and methods: To do so, the effects of earth´s electromagnetic field (EMF) on sleep electroencephalography (EEG) signals were evaluated using signal processing techniques. In this cross-sectional study, a total of 21 healthy volunteer participants slept for two consecutive naps, at two rooms with identical interior design and different bed orientations, toward and against earth´s EMF in a sleep clinic. Statistical Analysis: In this experiment, discrete wavelet transform extracted five subfrequencies of EEG data as delta, theta, alpha, beta1, and beta2. In addition, the energy signals were computed by measurement of wave frequencies. The mean total sleep time was 1.63 h in North-South (N-S) earth´s EMF orientation and 1.38 h in the other direction.
Results: t-test results showed significant changes in delta, theta, and alpha frequencies in terms of bed orientation. There was a significant result in the alpha energy ratio over the whole signal energy. Furthermore, there were increases in the average energy of delta, theta, and alpha bands in N-S versus East-West (E-W) bed directions.
Conclusions: This study indicated that sleep in N-S direction could be more beneficial than E-W and the sleep EEG signals can be sensitive to earth´s EMF. The results show the importance of considering orientation in bedroom design and its benefits on inhabitants´ well-being.

SLEEP SPINDLES ARE RESILIENT TO EXTENSIVE WHITE MATTER DETERIORATION

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Introduction: Sleep spindles are an essential part of NREM sleep, notably involved in sleep regulation, cognition, learning, and memory. These oscillatory waves depend on the complex interaction between the thalamus and the cortex, which is supported by a structural backbone of thalamo-cortical white matter tracts. It is still largely unknown if the brain can properly produce sleep spindles when it underwent extensive white matter deterioration. We hypothesized that damage to cerebral white matter, including thalamo-cortical tracts, affects sleep spindle generation and morphology.

Methods: We tested this hypothesis with traumatic brain injury, a unique human model of severe white matter deterioration. Widespread and significant white matter damage is the signature of chronic moderate to severe traumatic brain injury. We included 23 brain-injured subjects (30.5 ± 11.1 years old; 17m/6f) and 27 healthy controls of similar age and sex. Sleep spindles were extracted with an automatic detection algorithm on a full-night of polysomnography. We measured their density, duration, amplitude, and oscillation frequency as well as the sigma-band power in the N2 and N3 stages of NREM sleep. White matter deterioration was quantified using high-precision diffusion-weighted MRI. We used four diffusion metrics, namely the fractional anisotropy, as well as the mean, axial, and radial diffusivities that we extracted with probabilistic tractography in the thalamocortical tracts in addition to a whole brain voxel-wise approach. We performed between-group comparisons and intra-group correlations with all sleep spindles and white matter properties.

Results: Surprisingly, although extensive white matter damage across the brain including all thalamo-cortical tracts was evident in the brain-injured group, sleep spindles remained completely undisrupted when compared to the healthy control group. In general, sleep spindles were not associated with the degree of white matter deterioration in the brain-injured group, except that worse white matter integrity correlated with lower spindle oscillation frequency. Sleep spindles were also not associated with the inter-individual variability in white matter for the healthy control group.

Conclusions: This study highlight the resilience of sleep spindles, as they appear to remain normal even in a model of extensive white matter damage. We show here that even with such a severe traumatic event, the brain has the ability to conserve normal sleep spindles.

HOW MUCH SLEEP DOES AN ELITE ATHLETE NEED?

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Introduction: Elite athletes typically report obtaining less than the recommended target of eight hours of sleep per night, but little is known about how much sleep they need each night to feel rested. The aim of this study was to identify the subjective sleep need of elite athletes and to compare it with an objective measurement of habitual sleep duration.
Materials and methods: A total of 175 elite athletes from 12 sports wore an activity monitor and completed a sleep diary for a minimum of four nights during a normal phase of training. The data from the activity monitor and sleep diary were used to calculate habitual sleep duration for each athlete. Sleep need was assessed prior to data collection with the question 'how many hours of sleep do you need to feel rested?'. Sleep deficit was then calculated for each athlete by subtracting habitual sleep duration from sleep need. Paired t-tests were conducted to detect a difference between sleep need and sleep duration.
Results: On average, athletes' subjective sleep need was 8.3±0.9h and their mean habitual sleep duration was 6.7±0.8h. There was a significant difference between sleep duration and sleep need [$t(168) = -19.2$, $P < 0.0001$]; and this difference was observed in most sports (basketball, road cycling, rugby union, track cycling, triathlon, Australian Rules football, soccer, cricket, swimming) but not all (mountain biking, race walking). The mean sleep deficit (i.e., discrepancy between sleep need and sleep duration) was 1.6±1.0h. Only 3% of athletes met their required sleep need.
Conclusions: A majority of elite athletes fall short of their sleep need by one hour or more. Insufficient or inadequate sleep, defined here as a failure to meet a required sleep need on a regular basis, could have important consequences for an elite athlete, particularly in terms of their ability to train effectively and/or compete at their best.

Basic Research
Board #048 : Poster session 3
REM SLEEP AND CATAPLEXY REGULATION IN *HCRT* AND SEROTONIN TRANSPORTER KNOCKOUT MICE

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Background: Cataplexy is a major symptom of narcolepsy and is defined as a sudden loss of muscle tone during wakefulness while consciousness is preserved. It is a dynamic, multi-phased process which involves different brain regions before, during and after its occurrence. In narcolepsy patients night-time sleep is fragmented and sleep onset REM episodes prematurley occur. Monoaminergic neuronal populations that are important wake-promoting systems play also an important role in the pathophysiology of narcolepsy with cataplexy. In this work we sought to understand if the modulation of the serotonergic transmission can influence cataplexy occurrence in mice and carefully investigated the distribution of both cataplexy and REM sleep in five mice genotypes: *wt*, *Hcrt$^{KO/KO}$*, *5HTT$^{KO/KO}$*, *5HTT^{KO+}/ Hcrt$^{KO/KO}$* and *DKO* (double knockout).

Methods: the mice were implanted with EEG electrodes and EMBLA™ hardware was used for signal acquisition and Somnologica-3™ (Medcare) software for data analysis. High resolution camera also was used to record animal's behavior during different vigilance states.

Result: No cataplexy attacks were expected in *5HTT$^{KO/KO}$* and *wt* mice but EEG signal tracking showed that, while *Hcrt$^{KO/KO}$* and *5HTT^{KO+}/ Hcrt$^{KO/KO}$* exhibit higher number of cataplexies per hour both in baseline and recovery periods [(BS: 0.55 ± 0.14) and (BS: 0.44 ± 0.06) respectively], *DKO* mice show dramatic decrease in cataplexy numbers (BS: 0.13 ± 0.02). Time spend in cataplexy also was reduced both in baseline and recovery conditions: (BS: 0.64 ± 0.17) and (BS: 0.54 ± 0.09, minutes) respectively for *Hcrt$^{KO/KO}$* and *5HTT^{KO+}/ Hcrt$^{KO/KO}$* mice versus (BS: 0.28 ± 0.06) for *DKO* mice. All genotypes displyed normal pattern and amount of vigilance states. Prominent differences was only observed in REM sleep. REM sleep amount was significantly increased, as previously reported, in genotypes having null *5HTT* alleles compare to other genotypes, notably in baseline light period, which is the normal sleep time for mice (*5HTT$^{KO/KO}$*: 6.54 ± 0.08; *DKO*: 6.71 ± 0.22 vs *wt*: 4.97±0.00; *Hcrt$^{KO/KO}$*: 4.96 ± 0.23; *5HTT^{KO+}/ Hcrt$^{KO/KO}$*: 5.61 ± 0.27. minutes). During the night, the increase in REM sleep was found in mice without intact HCRT system (*Hcrt$^{KO/KO}$*: 3.38 ± 0.29; *5HTT^{KO+}/ Hcrt$^{KO/KO}$*: 3.14 ± 0.14; *DKO*: 4.88 ± 0.13 vs *wt*: 1.89 ± 0.00 and *5HTT$^{KO/KO}$*: 1.95 ± 0.33. minutes), although longer REM bouts (>2 minutes) still remain in *5HTT* null mice. When the animals were homeostatically challenged with sleep deprivation, during recovery dark period *wt* mice were the only to show REM dissipation, while the other four genotypes still showed increased REM sleep need with the maximum level in DKO mice (DKO: 6.33 ± 0.15 vs wt:1.77± 0.00; HTTKO: 3.38 ± 0.76; OXKO: 3.73 ± 0.28; 5HTTKO+/ OXKO: 3.94 ± 0.11. minutes). Therefore, REM sleep pressure is persistent in the presence (*5HTT$^{KO/KO}$*) and absence (*DKO*) of HCRT.

Conclusion: These findings indicate that serotonergic and orexinergic systems are major players in the regulation of REM sleep and cataplexy, respectively.

FACTOR STRUCTURE OF THE PITTSBURGH SLEEP QUALITY INDEX IN CHINESE ADOLESCENTS

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Introduction: The Pittsburgh Sleep Quality Index (PSQI) has been widely used to assess subjective sleep disturbance in various populations. However, validation of the PSQI single-factor scoring has not been carried out for the Chinese adolescents, approximately 14.8% of the total population in China. This study aimed to evaluate the PSQI's factor structure, reliability and convergent validity in Chinese adolescents.

Materials and Methods: The present study recruited 23,616 students (10,936 males, 46.3%) with an average age of 16.02 (SD = 1.03) years from 34 Chinese regular public secondary schools. Participants completed the PSQI, Center for Epidemiologic Studies-Depression Scale (CES-D), and Revised Child Manifest Anxiety Scale (RCMAS). Using a cross-validation approach, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed on polychoric correlations of PSQI component scores with independent random-split subsamples respectively. We also evaluated the convergent validity of the PSQI with CES-D and RCMAS.

Results: The internal reliability of PSQI components was acceptable (Cronbach's α = 0.78). The results of EFA yielded both a single-factor model (35.78% of total variance explained) and a two-factor model (49.60% of total variance explained) in which one is the sleep efficiency factor and the other is the sleep quality factor. The results of CFA yielded acceptable model fit for the two-factor model, χ^2 = 298.58, df = 10, p < 0.0001; SRMR = 0.055; RMSEA = 0.061 (90% CI = 0.055-0.067); CFI = 0.983; TLI = 0.963; whereas the single-factor model was rejected given its unacceptable factor loading (< 0.32) for the component of sleep efficiency. The PSQI global score was positively correlated with depression (CES-D; r = 0.49, p < 0.0001) and anxiety (RCMAS; r = 0.48, p < 0.0001), demonstrating good convergent validity with emotional problems.

Conclusions: The findings validate the two-factor structure for the PSQI in a large adolescent sample, suggesting that a two-factor score could be applied to the Chinese adolescent population.

DETERMINING THE IDEAL MATTRESS FIRMNESS BASED ON ANTHROPOMETRIC MEASUREMENTS

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Introduction: Mattresses need to provide enough support to keep spinal alignment close to a neutral posture, whilst minimising muscle activity and providing optimum pressure relief. There is limited evidence to suggest that a 'one size fits all' mattress provides the appropriate support for individuals with diverse body shapes, so a greater understanding of how different mattresses affect the human body is key. By having a more objective approach to choosing a mattress an individual may have an improved quality of sleep.

Materials and methods: A ten-camera infrared movement analysis system recorded the movement of retro-reflective markers placed on the Upper-Mid Thoracic, Mid-Lower Thoracic, Lower Thoracic-Upper Lumbar, Upper-Lower Lumbar and Lower Lumbar-Pelvic areas of the spine. A static image of the spine was taken in a standing position and was used to define each individual's neutral posture. Deviations away from this neutral position were assessed under three different conditions in side lying. Three visually identical mattresses were tested, internally each mattress contained a different firmness of spring unit (soft, medium, firm) with an identical gel foam comfort layer. In addition, height, weight, shoulder width and hip circumference measurements were taken to determine differences in body types.

Results: Spinal alignment was assessed on 59 healthy participants and no significant differences were seen between the different mattress configurations. However, further analysis showed significant differences in spinal alignment between the different mattress conditions within different body shape subgroups. Subgroups were defined using body weight, height, BMI, shoulder width and hip circumference. Those with a higher body weight had a more neutral spinal alignment when on a firmer mattress, whereas those with a lower body weight were better suited to a softer mattress. Shorter people were better aligned on a softer mattress, and a medium mattress kept the spine in a more neutral position amongst taller people. There were no differentiating factors between shoulder width or BMI groups. However, those with a larger hip circumference had significantly greater spinal deviations when on a softer mattress, implying that a softer mattress should be avoided by this subgroup.

Conclusions: This study suggests that a 'one size fits all' approach to mattresses may not be appropriate. Contrasting body types need different levels of support to improve overall spinal alignment, allowing the inter-vertebral disc to re-hydrate, and spinal muscles to relax throughout the night. The use of simple anthropometric measurements could make the selection of the most appropriate mattress easier for the general public.

Basic Research
Board #094 : Poster session 1
INTERPLAY BETWEEN SOCIAL MEDIA USE, SLEEP QUALITY AND MENTAL HEALTH OUTCOMES IN YOUTH: A SYSTEMATIC REVIEW

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Introduction: Social media applications have become increasingly prominent in everyday life, especially among youth. Numerous observational studies and reviews have explored, separately, the relation between social media use and sleep quality, and with common mental health outcomes (anxiety, depression, and stress) in child and adult populations. However, a comprehensive review addressing how social media, sleep quality, and mental health all interact in adolescents and young adults has been lacking in the literature. This systematic review aims to provide a more comprehensive assessment of these relationships among youth.

Materials and methods: We searched Medline, PsycINFO, EMBASE, and Scopus databases for observational studies from 1990 to the present. Studies were included if they assessed active social media use, as well as both sleep quality and common mental health outcomes (anxiety, depression and stress). Studies using validated measures for all three variables, (e.g. the Pittsburgh Sleep Quality Index, the Beck Depression Inventory and other verified questionnaires and surveys) were included in the review. Inclusion criteria also consisted of studies examining young adult populations ranging from 16-25 years old, with the inclusion of subjects ranging from 12-30 years old. Use of passive social media (e.g. watching TV) and assessment of sleep disorders (insomnia) were not included in the review. Psychiatric mental disorders, including self-harm and eating disorders and/or other rare mental disorders were excluded. We qualitatively synthesized data from included studies, and risk of bias was assessed using CLARITY tools.

Results: Two hundred fifty-eight studies involving social media use, sleep, and mental health were identified, 33 of which met the inclusion criteria. Twenty-eight cross-sectional studies and five prospective cohort studies consisting of 228,079 participants aged 11-29 years old were included. Among cross-sectional studies, 67% (n=20) reported significant associations between excessive social media use and negative mental health outcomes. Significant associations between poor sleep quality and excess social media use and negative mental health outcomes were found in 57% (n=17) and 40% (n=12) of cross-sectional studies, respectively. Across longitudinal studies, social media use frequency was a risk factor for both mental health (40%, n=2), and poor sleep outcomes at follow up (80%, n=4). Sixty percent (n=3) of cohort studies showed sleep quality to be a mediator between social media use and negative mental health outcomes in adolescents.

Conclusions: The current review corroborates the interplay between social media use, sleep quality, and mental health in youth. Prospective studies suggest poor sleep quality may be an important mediator between excessive social media use and anxiety/depression. However, cross-sectional studies are more equivocal regarding the directionality between the variables. Given the massive exposure to social media among youth and the potential public health implications of sleep problems, including poor mental health outcomes, this issue warrants further investigation to clarify the directionality and strength of such associations, using larger, well-designed cohort studies.

Basic Research
Board #045 : Poster session 2
A NOVEL ANTI-MICROBIAL PEPTIDE, NEMURI INDUCES SLEEP IN DROSOPHILA

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Sleep has been postulated to be controlled by the balance between opposing networks that facilitate wakefulness and sleep. Previous genetic screenings carried out in *Drosophila* have identified many genetic factors that modulate wakefulness and sleep. However, these factors are permissive for sleep rather than instructive; their loss reduces sleep, but their increase is insufficient to increase sleep.

In order to identify genetic factors that induce sleep, we carried out an unbiased and genome-wide gain of function genetic screen. Through a screen of over 12,000 lines designed to over-express genes in neurons, we discovered a novel gene, "*nemuri*" that induced sleep in *Drosophila*. Pan-neuronal expression of *nemuri* increased the length and depth of sleep. *nemuri* expression also increased with stress such as sleep deprivation or bacterial infection. We showed that *nemuri* encodes a secreted peptide molecule, suggesting that Nemuri acts non-cell-autonomously to promote sleep. Moreover, we found that Nemuri had anti-microbial peptide activity *in vitro* and *in vivo*. *nemuri* knock-out mutants showed increased arousability during daily sleep, attenuated recovery sleep after sleep deprivation, and reduced infection-induced sleep. We propose that Nemuri is a sleep-promoting factor particularly important for conditions of high sleep need, such as sickness, and provides a link between sleep and immune function.

AUTONOMIC ACTIVATION AT BEDTIME PREDICTS SUBSEQUENT SPINDLE DENSITY

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Introduction: Heart Rate Variability (HRV) is a marker of the autonomic nervous system (ANS) activity and represents the ability of the heart to respond to environmental as well as internal stimuli. Recently HRV during the short pre-sleep onset period has been suggested as predictor of the subsequent sleep quality. Sleep spindles, brief electroencephalogram oscillations (10-16 Hz) characteristic of the N2 NREM sleep stage, represent an index of sleep stability associated with the overall sleep quality. Their sleep-preserving function might consist in filtering the transmission of sensory information to the cortex. This study aimed at assessing whether the ANS activity in the pre-sleep onset period predicts sleep spindles features, that may influence sleep quality.

Materials and Methods: All subjects (n=49, 21 females, age: 27.40±11.31) underwent a night of polysomnographic recordings at home. Sleep Efficiency (SE, time asleep/time in bed) was computer and adopted as objective sleep quality proxy. The slow (10-13 Hz) and the fast (13-16 Hz) spindles were automatically detected from N2 NREM sleep stage on central (C3, C4) and frontal (F3, F4) electrodes. For each spindle parameter (amplitude, duration, intensity, density) a weighted average was calculated between homologous electrodes. Time and frequency domain analysis of HRV were conducted on the electrocardiogram (ECG) signal characteristics of the 5 minutes before the sleep onset. The parameter extracted were SDNN (standard deviation of normal to normal RR intervals), RMSSD (root mean square of successive RR differences), pNN50 (percentage of successive RR that differ by more than 50 ms), and the low (LF) and high (HF) frequency spectral component. The LF/HF and the SDNN/RMSSD ratios were computed. Correlations were studied with linear regression and mediation analyses.

Results: HRV parameters are associated to both SE (SDNN/RMMSD: R=-0.320, p=0.030; LF: R=-0.483, p=0.000; HF: R=0.518, p=0.000; LF/HF: R=-0.533, p=0.000; pNN50: R=0.393, p=0.007) and fast spindles density (SDNN/RMMSD: R=-0.262, p=0.001; LF: R=-0.272, p=0.009; HF: R=0.278, p=0.007; LF/HF: R=-0.294, p=0.004; pNN50: R=0.418, p=0.000). Fast spindles density is correlated with SE (R=0.271, p=0.009) but mediation analysis showed that there is not a significant indirect effect of HRV on the SE through the fast spindles density.

Conclusion: The pre-sleep onset HRV is able to predict the SE but this association is not mediated by the fast sleep spindles density. Therefore, ANS activity does affect concurrently and independently fast spindles density and SE.

Basic Research
Board #049 : Poster session 3

RISK FACTORS FOR COMPLICATIONS OF ENDOSCOPIC SINUS SURGERY FOR CHRONIC RHINOSINUSITIS.

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Bckground: Patients undergoing endoscopic sinus surgery (ESS) are at risk of complications because of the close proximity of the sinuses to the orbit and anterior skull base. The aim of this study was to evaluate the complications of ESS and to identify patient characteristics that were risk factors for the complications.

Methods: We conducted a prospective study of 306 patients who underwent ESS for chronic rhinosinusitis. Patients completed preoperative examinations that included computed tomography, endoscopic observation for nasal polyps, and tests for comorbidities including asthma and vascular disease. Perioperative complications were evaluated based on information provided by the surgeons. Multivariate analysis was performed to identify patient characteristics that were risk factors for complications.

Results: Overall, perioperative complications occurred in 21 patients (5.8%). A major complication, cerebrospinal fluid leakage, occurred in one patient (0.1%). Minor complications occurred in 20 patients (5.7%), with the most common being intraoperative hemorrhage (n = 18). Multivariate analysis indicated that presence of asthma and the total polyp score correlated significantly with the occurrence of complications.

Conclusion: The risk factors for perioperative complications were asthma and the polyp score. We conclude that the surgeon should confirm whether the patient has lower airway disease, especially asthma, before operating. The surgeon should also determine the grade of nasal polyps.

Basic Research
Board #046 : Poster session 2
BROKEN SLEEP PREDICTS HARDENED BLOOD VESSELS

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Introduction: Disturbed sleep is linked to atherosclerosis in humans. However, the underlying mechanisms are unknown. Sleep loss has independently been linked to inflammation, specifically of white blood cells, and has independently been confirmed as a mechanism underlying atherosclerosis. Aligning these findings, and building on seminal rodent work (McAlpine et al. 2019), here we test the hypothesis that one novel mechanistic pathway by which sleep disruption increasing atherosclerosis severity is through the mediating step of raised inflammatory-related white blood-cells activity, specifically atherosclerotic-associated neutrophils and monocytes.

Materials and methods: 1630 participants (752 males, mean ± SD age = 68.5 ± 9.2 years) from the Multi-Ethnic Study of Atherosclerosis (MESA Exam 5, Bild et al., 2002) underwent overnight polysomnography (PSG) and seven days of wrist actigraphy recording. White blood cell counts were assayed using blood draws. Atherosclerosis was assessed using Coronary Artery Calcification (CAC) imaging to obtain a standard Agatston score (Agatston et al., 1990).

Results: Levels of sleep fragmentation positively and significantly predicted CAC score. The impact of actigraphy-measure sleep fragmentation across a week on CAC scores was significantly mediated through the raised level of neutrophils. This same intermediary mechanism was replicated when using single-night PSG sleep recordings, wherein sleep fragmentation predicted increasing CAC scores through the mediating influence of raised neutrophil count and raised monocyte count. Furthermore, these sleep-related associations remained significant when accounting for other common cardiovascular disease risk factors (age, sex, ethnicity, BMI, sleep apnea, and insomnia).

Conclusion: Together, such findings support a novel mechanistic framework whereby sleep disruption in humans increases atherosclerosis risk through the intermediary step of raised inflammatory-related white blood-cell activity, notably neutrophils and monocytes. That the mediation effects remained significant after controlling for other risk factors and sleep apnea and insomnia indicates that the impact of sleep fragmentation on atherosclerosis is somewhat generalizable. Conversely, our results intimate that improving sleep quality may offer a novel, modifiable and thus preventative strategy for lowering inflammatory status and thus atherosclerosis risk. More broadly, these data should help inform public-health guidelines that focus on societal sleep health, one benefit of which may be the reduction of atherosclerotic burden.

INVESTIGATING THE ROLE OF TWO SUBCORTICAL VASOACTIVE INTESTINAL PEPTIDE-CONTAINING CELL POPULATIONS IN SLEEP-WAKE CONTROL

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Introduction: A role for vasoactive intestinal peptide (VIP) in promoting rapid eye movement (REM) sleep has been suggested, but the anatomical location of the neurons that release VIP to promote REM sleep has not been identified. Here, we investigated the role of VIP-containing cell groups in the ventromedial preoptic area (VMPO^{VIP}), and the suprachiasmatic nucleus (SCN^{VIP}), in sleep-wake regulation. The VMPO has previously been implicated in thermoregulation and the febrile response (processes with mechanistic links to sleep-wake), whereas SCN^{VIP} cells have been previously implicated in REM sleep control, albeit indirectly using constitutive knockout mice.

Materials and methods: We first investigated the native firing activity of the VMPO^{VIP} and SCN^{VIP} cell groups, over repeated sleep-wake cycles, using *in vivo* fiber photometry in *VIP-ires-Cre* mice. We next examined the afferent and efferent profile of these cell groups using conditional retrograde (pseudotyped modified rabies) and anterograde (adeno-associated viral vector-based) tracers. We finally utilized a chemogenetic strategy to selectively activate VMPO^{VIP} and SCN^{VIP} cells while monitoring electroencephalogram/electromyogram activity, in order to determine their role in sleep-wake control.

Results: We found that VMPO^{VIP} cells were predominantly and strikingly REM-active, that they received many synaptic inputs from surrounding hypothalamic regions (including the ventromedial hypothalamus, dorsomedial hypothalamus and the arcuate nucleus), and that they targeted established sleep-wake nodes, such as the ventrolateral preoptic nucleus, tuberomammillary nucleus, lateral hypothalamus and ventrolateral periaqueductal gray area. To our surprise, chemogenetic activation of the VMPO^{VIP} cell population had little effect upon all measures of sleep-wake analysed. In a parallel series of experiments on SCN^{VIP} cells, we found that SCN^{VIP} cells exhibited little state specific variation in their activity patterns, but, and in contrast to VMPO^{VIP} cells, were preferentially activated by a light pulse. We also found that SCN^{VIP} cells, again unlike VMPO^{VIP} cells, receive a substantive input from the retina and from the intergeniculate leaflet of the thalamus. However, chemogenetic activation of SCN^{VIP} cells was without effect upon sleep-wake.

Conclusions: We conclude that the 1) functional roles, and 2) outflow from and modulatory input to the VMPO^{VIP} and SCN^{VIP} cell populations are distinct. Our finding of a REM-active activity profile of the VMPO^{VIP} cells further suggests that these neurons may play a functional role in generating certain cardinal features of REM sleep (for example, suspension of thermoregulation during REM sleep), which is an active focus of on-going research in our laboratory.

THE EFFECT OF ACUTE INTERMITTENT HYPERCAPNIC HYPOXIA ON CEREBRAL NEUROVACULAR COUPLING IN HEALTHY HUMANS

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Introduction: The physiological responses of healthy humans exposed to acute intermittent hypercapnic hypoxia (IH) are comparable to those of obstructive sleep apnea patients exposed to chronic IH during nocturnal apneas. These include increases in central sympathetic outflow, daytime blood pressure and decreases in cognition. Such deterioration of neurocognitive function has been attributed to an impairment of cerebral neurovascular coupling (NVC). The matching of cerebral oxygen supply to metabolic demand, and its impairment may contribute to reductions in neurocognitive function following IH. Previous reports suggest reduced cerebrovascular reactivity following IH, however, it is unknown if IH alters cerebral NVC. We tested the hypothesis that acute IH exposure evokes similar loss of NVC in healthy young men and women.
Methods: NVC was assessed in 18 humans (8 female; tested 0-5 days in early follicular phase of menstruation, age = 22±1 years, mean±SEM) before and after 40-minutes of IH. Eight men served as a time-matched control group. Dynamic end-tidal forcing was used to control end-tidal O_2 ($P_{ET}O_2$) and CO_2 ($P_{ET}CO_2$) at baseline levels throughout NVC assessment and to administer 40-minutes of IH. Each minute of IH was comprised of 40-seconds hypercapnic hypoxia (nadir S_PO_2 = 83.4±1.0%, peak $P_{ET}CO_2$ = +3.2±0.3 mmHg above baseline) and 20-seconds of normoxic recovery. Beat-by-beat mean arterial pressure (MAP; finger-pulse-photoplethysmography), middle (MCA_V) and posterior (PCA_V) cerebral artery blood velocity (transcranial Doppler) were measured continuously throughout the protocol. Cerebrovascular conductance was calculated as the quotient of MCA_V or PCA_V and MAP (MCA_{CVC} and PCA_{CVC} respectively). The peak PCA_V response to 5 repeated cycles of 30-seconds eyes-open with standardized visual stimulation (flashing checkerboard) followed by 30-seconds eyes-closed determined NVC. The MCA_V response permitted comparison in regional cerebral blood supply. NVC was quantified as the peak absolute and percent increase (relative to eyes-closed) during visual stimulation averaged over 5-cycles.
Results: Resting MAP was augmented following IH exposure (77.9±1.2 vs. 82.7±1.3 mmHg, P< 0.01). Females had higher resting MAP compared to males at baseline (81.0±1.4 vs. 75.4±1.2 mmHg respectively, P=0.055) and following IH (88.3±1.8 vs. 78.1±1.3 mmHg respectively, P< 0.01). Additionally, females had a larger increase in resting MAP following IH compared to males (sex-by-time interaction: P=0.02). Following IH, PCA_V (-1.6±0.7 cm/s), MCA_{CVC} (-0.057±0.018 mmHg/cm/s), and PCA_{CVC} (-0.046±0.010 mmHg/cm/s) were reduced (all P< 0.05) while MCA_V was unchanged. Additionally, PCA_V, MCA_{CVC} and PCA_{CVC} did not differ between sex. The absolute peak PCA_V or MCA_V response to visual stimulation were not altered by IH. The percent relative PCA_V and MCA_V response during visual stimulation were similar following IH, however, there were significant increases in the percent relative response for PCA_{CVC} (+4.5±1.5%, P< 0.01) and MCA_{CVC} (+4.1±1.2%, P< 0.01) which did not differ between sex (P=0.3 and P=0.4, respectively). Time-matched controls showed no difference in MAP or NVC responses following 40-minutes of room air breathing.
Conclusions: Our data show in young healthy humans, (1) NVC is improved following acute IH, (2) NVC is similar between sexes before and following acute IH and (3) MAP responses to acute IH differ between sexes.

PROTECTIVE EFFECT OF ADIPONECTIN ON GENIOGLOSSUS IN MITOPHAGY IMPAIRED BY CHRONIC INTERMITTENT HYPOXIA

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Introduction: Obstructive sleep apnea (OSA) has a component of oxidative stress characterized by chronic intermittent hypoxia (CIH), with a pathogenesis similar to ischemia/reperfusion injuries. Mitochondrial impairment resulting from hypoxia is eliminated by mitophagy to avoid cell apoptosis. Disturbances of mitophagy induced by CIH in cardiomyocytes resulted in cell apoptosis and could be improved by adiponectin (Ad). Dysfunction of the genioglossus muscle is important in the pathogenesis of OSA. However, there have been no reports regarding either the effect of CIH or Ad on genioglossal mitophagy. Therefore, this project was designed to explore the differential effects of CIH and Ad on mitophagy in the genioglossus.

Materials and methods: 150 male SD rats were randomly divided into 3 groups (normal control (NC), CIH, and CIH+Ad groups), with 50 rats in each group observed for 5 weeks. At the end of every week, 10 rats from each group were evaluated for comparison of serum Ad levels, contractile function of the genioglossus, mitochondrial structure and function, and mitophagy and cell apoptosis in the genioglossus. Statistical analyses were performed using SPSS; differences among groups were compared using a one-way analysis of variance (ANOVA).

Results: 1) The CIH group was significantly different from the NC group as follows: During the first three weeks it was observed that serum Ad levels decreased; however, all of the reactive oxygen species (ROS), relative protein and mRNA of mitophagy, autophagy biomarker LC3-II, and autophagosomes increased, while during the last two weeks all parameters decreased. Specifically, serum Ad levels (mean±SD) for the NC group: 2184.05±55.38(baseline), 2187.95±30.11(Wk1), 2193.00±42.23(Wk2), 2196.08±39.56(Wk3), 2183.94±35.85(Wk4) and 2182.88±33.24(Wk5); the CIH group: 2197.14±43.33(Baseline), 1985.72±28.24(Wk1), 1810.78±46.67(Wk2), 1629.78±55.99(Wk3), 1425.27±62.04(Wk4) and 1226.97±79.79(Wk5); the CIH+Ad group: 2196.91±47.02(Baseline), 2112.75±74.29(Wk1), 2038.39±26.25(Wk2), 1958.56±86.98(Wk3), 1849.91±89.28(Wk4) and 1794.06±90.57(Wk5). All of the differences were significant (P value< 0.01) in the 3 groups in the end of every week. Compared to CIH group, all parameters were partially improved in CIH+Ad group in the last two weeks, but still less than NC group. 2) There were no differences among the 3 groups in mitochondrial structure by electron microscope, mitochondrial function-associated mRNA, the activity of mitochondrial enzymes and content of ATP in genioglossus during the first three weeks. Also, no change in apoptosis was observed through testing Caspase-9, Caspase-12, Caspase-3 and scanning apoptotic cells at the same time. Additionally, genioglossus contractile properties did not show significant differences. However, damaged mitochondrial structures were growing during the last two weeks; mitochondrial function-associated mRNA, the activity of mitochondrial enzymes and content of ATP in genioglossus were lessening in the CIH group compared to NC group. Exacerbation of apoptosis and dysfunction of genioglossus contractile properties were also detected in the last two weeks. Meanwhile, it was observed that all of the damage was partially alleviated in the CIH+Ad group, but still more than the NC group.

Conclusions: Disturbances of genioglossus mitophagy could be related to damaged mitochondrial structure, impaired mitochondrial function, and decreased genioglossus contractile properties in rats induced by CIH. The damage could be alleviated by

supplementation of exogenous Ad via increasing mitophagy.

GEOGRAPHIC VARIATION IN SHORT SLEEP DURATION AND SLEEP QUALITY: A MULTILEVEL ANALYSIS USING THE 2015-2017 CANADIAN COMMUNITY HEALTH SURVEY

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Introduction: Many children, adolescents, and adults do not sleep a sufficient number of hours per night, which may have negative effects on health. Although there has been a considerable amount of research conducted on the individual, social, and environmental determinants of sleep, there is a dearth of knowledge on geographic variation in sleep duration and quality, and about the effect of geographic location or 'place' on sleep, and how contextual factors may contribute to these geographic differences. The objective of this study was to assess if there is geographic variation in short sleep duration and sleep quality across communities, while controlling for individual demographics, socio-economic, and health factors.

Materials and methods: Data from the 2015, 2016, and 2017 cycles of the Canadian Community Health Survey were used in this cross-sectional study. In total, the sample consisted of 68,624 individuals (12 years and older) from six provinces (Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia), representing 93.04% of all Canadians. To assess the magnitude of geographic variation in self-reported short sleep and three binary indicators of quality of sleep (i.e., difficulty initiating and maintaining sleep, daytime sleepiness, and finding sleep refreshing), multi-level modeling techniques were used. Forward Sortation Areas (FSAs) were used as a proxy measure for a community. In the multi-level analysis, 1,214 unique FSAs were used. On average, there were 56.53 CCHS respondents per FSA with a median equal to 38.00 respondents.

Results: Overall, 45.38% of respondents engaged in short sleep, 47.27% had difficulty initiating and maintaining sleep, 29.44% had daytime sleepiness, and 60.76% found their sleep refreshing. Between community differences accounted for 4-6% of variation in sleep duration and sleep quality. After controlling for study demographics, socio-economic, and health factors, all variances remain statistically significant and did not have a substantial effect on the variance in the adjusted models. Self-reported general health and mental health had the strongest and most consistent effect on all sleep outcomes. Of particular note, those with poor overall health had 1.97 times greater difficulty initiating and maintaining sleep (95% CI 1.86 to 2.09), and those with poor mental health had 2.60 greater odds of difficulty initiating and maintaining sleep (95% CI 2.41 to 2.80).

Conclusions: The findings suggest that there is variability in short sleep duration and sleep quality in Canada and that this variation cannot be accounted by compositional effects related to differential distribution of demographic and socio-economic characteristics across communities. The presence of geographic variation, although not as pronounced as the variation across individuals, suggests that some community factors may play a role and warrant further investigation. Assessing how sleep varies across geographic areas can provide valuable information that can help target future health unit programs, services and strategies.

CHARACTERIZATION OF FUNCTIONAL CONNECTIVITY OF THE MU RHYTHM IN AUTISTIC CHILDREN. PRELIMINARY RESULTS

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Introduction: The heterogeneity of the clinical presentation of ASD with the increase in the prevalence and the complexity of the central symptoms, have motivated clinicians and researchers to investigate this disorder, which presents a challenge for translational science (Williams2014).

The measures of functional connectivity have become relevant in the study of ASD, in recent years, because differences in anatomical, functional and effective connectivity have been found consistently among people with high risk of ASD, people with ASD and controls. However, there is still no consensus regarding the significance of these differences in and their relation to the clinical presentation of ASD (Schwartz,2016).

We studied the connectivity during Mu rhythm due to the relationship that this sensorimotor rhythm has with the mirror neuron system (Pineda2005, Pineda2009, Arnstein2011).

Materials and methods: Participants: 15 children (male) with Diagnosis of mild to moderate ASD, and 15 controls.

Materials: Polysomnograph Cadwell brand, Brainstorm Software for EEG Analysis (Tadell, 2011).

Procedure: The polysomnographic records consisted of two nights. The first night of habituation, in which respiratory variables were recorded. The second night, the raw EEG was acquired from F3, F4, C3, C4, T3, T4, P3, P4, O1 and O2, with an average reference; at a sampling frequency of 400. Electrooculogram with two electrodes per eye, chin electromyogram, and bilateral tibial electromyogram.

The polysomnographic records were rated according to the rules of the AASM. Records were included in the study if they had at least 3 minutes of wakefulness at rest and that had at least three epochs (of 5 seconds) with Mu rhythm in wakefulness and REM sleep, respectively.

The recorded data were separated into 5 seconds epochs, that included Mu activity in wakefulness and in REM sleep.

The data were analyzed with the Brainstorm Software, to determine the connectivity by temporal correlations in averaged signals, and comparing subjects and controls.

Results: Autistic participants seem to have less connectivity than controls, during Mu in REM sleep and awake.

Behavior, Cognition and Dreaming
Board #038 : Poster session 1

MOTIVATIONAL INTERVIEWING IMPROVES CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) ADHERENCE IN PATIENT WITH ESTABLISHED CARDIOVASCULAR DISEASES

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Introduction and Objectives: Adherence to continuous positive airway pressure (CPAP) therapy for obstructive sleep apnoea (OSA) is poor in patient with cardiovascular (CV) disease. We assessed the effectiveness of a motivational interviewing (MI) intervention in addition to best practice standard care to improve adherence to CPAP therapy in people with low adherence to CPAP and established CV diseases.

Method: 118 adults (72% male) with established CV disease (secondary prevention or resistant hypertension or atrial fibrillation)with a new diagnosis of OSA and treated by CPAP treatment were recruited. Among the total cohort 63%, were considered non adherent (less than 2 hours of CPAP therapy at one month) . Participants were assigned to MI randomly and received 4 sessions of a motivational interviewing interventio . The primary outcome was the difference between the groups in objective CPAP adherence at 1-month, 2-month, 3-month after .

Results: The number of hours of CPAP use per night in the MI group at 3 months was 4.27 hr and was 3.02 hr in the control group (p = .005). This represents 41 % better adherence in the MI group relative to the control group. No difference were seen at an earlier stage.

Conclusions: MI is an effective intervention that improves CPAP adherence rates compared to standard care alone in patient with established CV disorders and OSA.

Behavior, Cognition and Dreaming
Board #039 : Poster session 1
SLEEP HABITS AND CIRCADIAN PREFERENCES IN ELEMENTARY SCHOOL CHILDREN IN MEXICO

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Introduction: Insufficient sleep in children has been associated with psychological and behavioral health alterations. In addition, sleep deprivation can lead to lower academic grades, sleepiness and moodiness. Mexico is one of several Latin-American countries were a double-shift school system (Morning Shift: a group of students attend at morning and leave at mid-day; Afternoon Shift: a group of students attend at mid-day and leave in the evening) are implemented in public schools. Furthermore, there is scarce information regarding sleep habits in elementary school children in Mexico, therefore, the main objective was to determine the differences between sleep habits and circadian preference in elementary school children attending a double-shift school system.

Materials and methods: The sample consisted of 400 elementary public school children in Reynosa, northeastern Mexico (183 girls and 217 boys; mean ± SD: 10.77 ± 0.70 years old, age range 10-12 years) attending a double-shift school system: 200 from the morning shift (MS, 82 girls and 118 boys) on a schedule from 07:30 to 12:30 and 200 in the afternoon shift (AS, 101 girls and 99 boys) on a schedule from 13:00 to 18:00. Students completed a sleep habits survey and the MESC as a measure of morningness-eveningness.

Results: No sex differences were found, on the other hand, those attending morning shift, on weekdays woke up earlier (MS: 06:07 ± 00:39; AS: 08:30 ± 01:49, $p < .001$, $\eta_p^2 = 0.24$) and had shorter sleep duration (MS: 8:06 ± 2:12; AS: 10:05 ± 1:47, $p < .001$, $\eta_p^2 = 0.08$), but on weekends, went to bed later (MS: 23:35 ± 02:11; AS: 23:18 ± 02:35, $p < .001$, $\eta_p^2 = 0.02$) and had more social jetlag (MS: 02:25 ± 01:56; AS: 01:00 ± 01:45, $p < .001$, $\eta_p^2 = 0.10$) than afternoon shift students. In regards with morningness-eveningness, MS had a total of 8 evening-type, 62 intermediate and 130 morning-type and in the AS, it had a total of 18 evening-type, 88 intermediate and 94 morning-type. Furthermore, on weekdays and weekends evening-types went to bed later (EV: 22:49 ± 01:59; MA: 21:55 ± 01:50, $p < .01$, $\eta_p^2 = 0.02$; EV: 00:10 ± 02:53; MA: 22:59 ± 02:20, $p < .001$, $\eta_p^2 = 0.05$, respectively) and on weekends woke up later (EV: 10:29 ± 01:51; MA: 09:08 ± 02:05, $p < .001$, $\eta_p^2 = 0.04$) and had more social jetlag (EV: 01:52 ± 02:37; MA: 01:36 ± 01:58, $p < .01$, $\eta_p^2 = 0.02$) than morning-types. No significant interaction effects were found.

Conclusions: Elementary school children who attended classes in the morning shift were not that sleep deprived. However, afternoon shift school children have a more optimal sleep duration. With respect to their circadian preference, evening-type tend to follow the expected direction, however, regardless of their chronotype, elementary school children were not sleep deprived, .

Behavior, Cognition and Dreaming
Board #048 : Poster session 2
MORNINGNESS-EVENINGNESS PREFERENCE AND SLEEP HABITS IN MEXICAN YOUNGER AND OLDER ADULTS

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Introduction: Chronotype is an individual difference trait that remains rather stable across shorter time spans. However, during lifespan development, people are on average early chronotypes during child age, turn towards eveningness in puberty, and slowly turn back to morningness again, and in old age most people are morning oriented again. Furthermore, there is scarce information regarding morningness-eveningness with and adult sample in Mexico, therefore, the main objective was to determine the differences between morningness-eveningness and sleep habits in younger and older adults.

Materials and methods: The sample consisted of 510 Mexicans, aged 18-77 years (mean ± SD: 27.79 ± 10.24) of which 228 (44.7%) were female and 282 (55.3%) male. Divided into 327 young adults (YA, 144 female and 183 male) between 18 and 30 years (21.36 ± 3.04) and 183 older adults (OA, 84 female and 99 male) between 31 and 77 years (40.38 ± 9.85). The samples were recruited from several cities from Mexico via an online procedure. Both young students and adult workers completed the rMEQ and a sleep habits survey.

Results: No sex differences were found, on the other hand, young adults, on weekdays went to bed later (YA: 23:58 ± 00:55; OA: 23:06 ± 00:54, $p < .001$, $\eta_p^2 = 0.07$) and had shorter sleep duration (YA: 6:49 ± 0:45; OA: 07:33 ± 0:57, $p < .001$, $\eta_p^2 = 0.08$), and on weekends, went to bed later (YA: 01:43 ± 01:23; OA: 00:41 ± 01:29, $p < .001$, $\eta_p^2 = 0.05$), woke up later (YA: 09:58 ± 01:28; OA: 08:47 ± 01:35, $p < .001$, $\eta_p^2 = 0.06$), and had more social jetlag (YA: 02:28 ± 01:09; OA: 01:51 ± 01:13, $p < .001$, $\eta_p^2 = 0.02$) than older adults. In regards with morningness-eveningness, for YA had a total of 212 evening-type, 81 intermediate and 34 morning-type and OA, it had a total of 65 evening-type, 84 intermediate and 34 morning-type. Furthermore, on weekdays and weekends evening-types went to bed later (EV: 00:10 ± 00:54; MA: 22:47 ± 00:35, $p < .001$, $\eta_p^2 = 0.31$; EV: 02:14 ± 01:09; MA: 23:40 ± 00:57, $p < .001$, $\eta_p^2 = 0.44$, respectively) and woke up later (EV: 06:54 ± 00:52; MA: 06:29 ± 00:37, $p < .001$, $\eta_p^2 = 0.06$; EV: 10:28 ± 01:17; MA: 07:54 ± 01:05, $p < .001$, $\eta_p^2 = 0.42$, respectively) and during weekdays had a shorter time in bed (EV: 6:44 ± 00:50; MA: 7:41 ± 00:46, $p < .001$, $\eta_p^2 = 0.17$) and had more social jetlag (EV: 02:49 ± 01:03; MA: 01:08 ± 00:59, $p < .001$, $\eta_p^2 = 0.28$) than morning-types. No significant interaction effects were found.

Conclusions: Young adults are more sleep deprived than older adults during weekdays. With respect to their circadian preference, evening-type tend to follow the expected direction, and also evening-types tend to be more sleep deprived during weekdays than morning-types.

NEURAL ACTIVATION OF PUTATIVE SLEEP-WAKE AFFECTING AND RELAXING PROMOTING ODORS

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Introduction: Odors have been shown to influence human mood and behavior. The aim of this study was to investigate the neural processing of fragrances reported to have relaxing impact.

Materials and methods: In this study we investigated the neural processing of two different complex fragrances, labeled B (Peppermint, Rosemary, Lavender) and C (Eucalyptus, Lemon, Peppermint, Basil) supposed to have relaxing, mood-enhancing and/or vigilance-increasing properties. Both odors were compared to phenethyl alcohol (PEA) in an fMRI paradigm with 23 healthy normosmic subjects (11 female). Karolinska Sleepiness Scale (KSS) was used as a vigilance measure and correlated moderately with subject´s amount of sleep (-.355, $p = .048$, one-sided).

During six fMRI sessions, all three odors were presented via olfactometer in a block design in bouts of 10 seconds interleaved with 18 seconds of odorless control air.

Results: In-session ratings revealed that odors B and C were more intense and less pleasant than the control odor (both at $p < 0.001$). While odor B was perceived as "neutral", odor C was perceived rather pleasant than neutral and the control was perceived as pleasant.

Both B and C resulted in a higher neural activation than the control odor. Compared to each other, odor B was related to enhanced activation in the amygdala, anterior cingulate cortex, inferior temporal cortex and fusiform cortex.

When presented to odor B, participants' sleepiness correlated to BOLD signals in the left and right middle frontal gyrus. When presented to odor C, sleepiness correlated to an activation in the left hippocampus while wakefulness was related to more activation in the middle orbital gyrus.

Conclusions: The results indicate that odors B and C influence areas associated with executive functioning (middle frontal and orbital gyrus) and memory (hippocampus), depending on participant´s sleepiness. If their impact is confirmed, mixture of adequate fragrances may be an interesting complement to traditional pharmacotherapy.

Acknowledgements: The study was founded by ThisWorks

NIGHTTIME PARENTAL INTERVENTIONS ARE RELATED TO THE SEVERITY OF MALE POSTPARTUM DEPRESSION

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Introduction: The incidence of postpartum depression (PPD) in mothers has been well-studied. There has been less focus on the incidence of PPD in fathers. Many studies also show an association between disrupted infant sleep, reported by parents, and maternal PPD. No studies to date have objectively recorded sleep and demonstrated a relationship to PPD in fathers. The Nanit camera system uses computer vision algorithms to analyze real time video sleep recordings and parental interventions. It is a valid and reliable automated system. This pilot study was designed to examine correlations between infant sleep, parental interventions and PPD in males.

Methods: 284 U.S. men (of 1,121 surveyed) with babies aged 3-6 months, all with female partners, were recruited from households using the Nanit infant sleep system. They completed the Edinburgh postnatal depression scale (EPDS), validated in men, and demographic questions. Their demographics and EPDS scores were compared to the video sleep metrics (total nighttime sleep, sleep onset, sleep efficiency, bedtime and wake up time) and parent interventions over two weeks.

Results: The average number of parental interventions per night for fathers with an EPDS score < 6 was 1.98 (low EPDS group, n=161), the number of interventions for fathers with a score >10 was 3.0 (high EPDS group, n=41), and the number of interventions for fathers with an EPDS score >14 (very high EPDS group, n=11) was 4.4. The average total nighttime sleep of infants of fathers in the low EPDS group was 9.2 hours per night versus 9.1 hours in the high EPDS group and 9.0 hours in the very high EPDS group. These differences were non-significant. Similar trends were seen in bedtimes between groups, with the average bedtime for the low EPDS group being 7:50pm, 8:16pm for the high EPDS group and 8:34pm in the very high EPDS group. Average sleep onset times were 6.05 minutes, 4.87 minutes and 3.41 minutes, and average sleep efficiencies were 87%, 87% and 88% for the three groups respectively. There were no significant differences for any of the video-recorded sleep metrics, likely because of small group sizes.

Conclusions: The number of parental interventions were related to the EPDS scores. Couples, where the father had a low EPDS score, were half as likely to visit their infants at night than those with a very high EPDS score, suggesting that infant sleep interventions are related to the occurrence of postpartum depression in fathers. This is the first study to show objective video sleep and parent intervention data in relation to male postpartum depression. Limitations of the study were: small group sizes and interventions that were carried out by both mothers and fathers. Nevertheless, the larger number of interventions indicates that sleep disruption is associated with depression. Future studies should focus on sleep and mother-father-baby interactions to more fully understand the impact of male PPD.

THE INCIDENCE OF MALE POSTPARTUM DEPRESSION IS RELATED TO INCOME AND AGE IN A SAMPLE OF AMERICAN FATHERS

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Introduction: There have been several studies showing evidence of male postpartum depression (PPD). Nanit has developed a camera system that uses computer vision to analyze infant sleep and the parental interventions that occur during the night. We are trying to understand if there is a need to help support new fathers in their transition to fatherhood through an app-based system of support. This study was designed to understand and highlight the incidence of PPD in new fathers in the United States.

Methods: 289 American men (of 1,121 requested) with babies aged 3-6 months, who all had female partners, were recruited from a group of households using the Nanit infant camera and sleep system. They completed the Edinburgh postnatal depression scale (EPDS) and demographic questions. Their demographics were compared to their EPDS scores.

Results: The respondents were 75% White, 9.3% Asian, 3.1% African American (12.5% Other). The percentage of respondents who described their place of residence as urban was 39.8%, suburban 53.6% and rural 6.6%. Ninety percent of respondents had a four year college degree or higher and 79.9% earned over $100,000 per year. The mean EPDS score for all respondents was 4.98. 14.5% (42/289) of respondents had an EPDS score of >10, indicating the likelihood of moderate to severe depression and 11/289 (3.8%) had an EPDS score of >14, indicating severe depression. The average EPDS score decreased steadily as income increased, with the average EPDS score for men who earned $25,000-$50,000 per year being 6.83 and the average EPDS score for men earning over $200,000 per year being 4.18 (Cohen's f=0.21). Fathers who were aged 45-54 had an average EPDS score of 3.0 which was significantly lower (p=0.04) than the average EPDS score of fathers aged 25-34 which was 5.3. There was no significant effect of place of residence, ethnicity or number of children on EPDS score.

Conclusions: This study revealed a relatively high rate of PPD in this selective upper middle class Caucasian group of fathers and a significant inverse relationship between income and EPDS score. EPDS scores also were significantly higher in younger fathers compared to older fathers. Future studies should include a larger and more diverse sample. One limitation of the study was that a male-specific depression scale was not administered. Men often exhibit symptoms of depression differently than women and whilst the EPDS is a validated tool for use in men, a logical next study would include depression scales that are designed for men. However, the study reinforces the premise that there are opportunities to help support fathers during the postpartum period.

THREE CONSECUTIVE NIGHTS OF RESTRICTED SLEEP: EFFECTS OF MORNING CAFFEINE CONSUMPTION ON MOOD, REACTION TIME AND SIMULATED DRIVING PERFORMANCE

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Introduction: Sleep is a fundamental biological requirement, essential for optimal health. Individuals unable to achieve adequate amounts of sleep may experience a range of negative behavioural and psychological consequences (e.g. increased daytime sleepiness, altered mood, reduced cognitive performance, driving impairment). Caffeinated products are often consumed as a popular countermeasure to reduce sleepiness, enhance mood, and improve cognitive functioning. However, the efficacy of caffeine to exert these effects after consecutive nights of restricted sleep is poorly understood, particularly in relation to performance on complex applied tasks (e.g. driving a motor vehicle). Therefore, the aim of this study was to investigate the effects of three consecutive nights of restricted sleep on subjective ratings of mood, cognitive function, and simulated driving performance and assess the ability of a morning dose of caffeine to attenuate any effects associated with sleep restriction.

Materials and Methods: Twenty healthy habitual caffeine consumers (11 females; age: 23.3±5.7 y; BMI: 22.3±3.5 kg·m^{-2}; caffeine intake: 204±89 mg·day^{-1}; Mean±SD) who had normal sleeping patterns (≥8 h sleep/night) participated in this double-blind, placebo-controlled, randomised study. Following one night of normal sleep (Day 0: ≥8 h time in bed (TIB)), participants underwent three consecutive nights of restricted sleep (Day 1, 2, 3: 5 h TIB). Participants received caffeine (200 mg; $n=10$) or placebo ($n=10$) capsules, together with a decaffeinated coffee and standardised breakfast each morning. All participants received caffeine (100 mg) capsules to consume in the afternoon of each trial day. On Day 0, 1 and 3, participants completed visual analog scales to measure subjective ratings of alertness, concentration and tiredness, before and 1 h after capsule administration. Cognitive function was examined 1 h after capsule administration using a computerised Choice Reaction Time (CRT) task. Response speed and accuracy were the outcome variables. Analysis of response speed was conducted using both traditional central tendency measures (comparing mean and variance) and *ex-Gaussian* distributional analysis. Driving performance was assessed using a 30 min simulated driving task. Lateral (standard deviation of lane position [SDLP] and total number of line crossings [LC]) and longitudinal (standard deviation of speed [SDSP]) measures of vehicular control were the outcome variables.

Results: Alertness and concentration significantly decreased, and tiredness increased across the three days of sleep restriction (all $p's< 0.001$). Caffeine only marginally alleviated these effects. No differences were observed between treatments or across trial days for response speed and accuracy on the CRT task, irrespective of the analytical approach employed. Likewise, no significant differences were observed between groups or across trial days for lateral (SDLP, LC) and longitudinal (SDSP) measures of simulated driving performance.

Conclusion: Overall, results from this study indicate that three consecutive days of sleep restriction may influence subjective ratings of alertness, concentration and tiredness, but does not appear to impact CRT or simulated driving performance. Caffeine may alleviate some of the negative subjective effects imposed by restricted sleep, but the efficacy of caffeine to attenuate performance changes in cognitive function and driving performance were unable to be observed in this study.

MULTI-LEVEL INTERVENTIONS TO PROMOTE HEALTHY SLEEP IN PRESCHOOL CHILDREN ATTENDING HEAD START: A COMPREHENSIVE & FEDERALLY FUNDED EARLY CHILDHOOD EDUCATION PROGRAM

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Introduction: Inadequate or poor-quality sleep in early childhood impairs social-emotional and cognitive function and increases obesity risk. Short sleep duration and behavioral sleep problems (BSPs) occur in 20%-50% of preschool-aged children (3-5 years). The United States´ Head Start early childhood education (ECE) program serves approximately 1 million vulnerable children annually. Head Start's approach to school readiness integrates child and family well-being, including health promotion, screening, and referral. We conducted a stepped-wedge cluster randomized controlled trial (RCT) in Head Start to test multi-component interventions' effects upon child sleep duration and difficulties, and parent knowledge and behaviors. Per trial design, outcomes data were collected at baseline, pre/post a randomly assigned early vs. later intervention roll-out during the 2018-2019 school year, and 1-year later. We present available valid baseline data for the Head Start Agencies (n=7) and their sites (n=23).

Materials and methods: We recruited English and Spanish speaking parents of 3-year-olds. Guided by the social-ecological model, interventions engaged and promoted sleep health for staff, parents, and children. The first intervention was the Early Childhood Sleep Education Program (ECSEP) trainings for parents and children created by Sweet Dreamzzz, Inc., followed by the Sleep Health Flipchart, which was delivered to families 1-on-1. Lastly, the agencies shared a seven-minute video across various platforms. The trial´s primary outcome measure is a 7-day sleep log, completed by parents for the index child. Secondary outcomes include the Tayside Children´s Sleep Habits Questionnaire (TCSQ) and Parent Knowledge/Attitude/Self-Efficacy/Beliefs (KASB). The Health Care Institute at the Anderson School of Management at UCLA provided a health literacy implementation platform and the Sleep Disorders Center at the University of Michigan provided sleep medicine expertise.

Results: Most children met National Sleep Foundation (NSF) guidelines: 267/340 (79%) children reportedly slept $\geq$ 10 hours on weeknights. Higher mean KASB scores were associated with bedtimes $\geq$8pm vs. < 8pm (116.8 [sd= 9.8] vs. 111.2 [sd= 12.6], p=.01) but not with bedtimes $\geq$9pm vs. < 9pm (112.3 [sd=13.2] vs. 111.4 [sd= 11.0], p=0.49). TCSQ (+) scores indicating problems falling/staying asleep were reported by 347/515 (67%)—though just 60/347 of such parents (17%) agreed that their child "has sleeping difficulties." Mean KASB scores were lower for parents reporting TCSQ (+) vs. TCSQ (-) sleep problem scores (110.5 [sd=12.6] vs. 115.3 [sd= 12.9], p=.00). Bedtimes before v. after 8pm, and before v after 9pm were both significantly associated with TCSQ (+) scores (p=.04 and p=.00), respectively.

Conclusions: The high rate of sleep problems and late bedtimes in preschoolers—despite many children meeting NSF guidelines- suggests the need for meaningful sleep education in ECE programs. Interventions aimed at increasing parent KASB may reduce child sleep problems and potentially lead to earlier bedtimes. Future analysis of longitudinal data will assess the effects of low health literacy strategies and materials for preschool-aged children and their families.

Community Center, and Yeled v'Yalda, Early Childhood Center

DOES COGNITIVE RESERVE IMPACT THE RELATIONSHIP BETWEEN SLEEP DISTURBANCE AND COGNITIVE PERFORMANCE: A META-ANALYSIS

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Introduction: Studies investigating the relationship between poor sleep and cognition in older adults have found mixed results, raising questions regarding the nature of the relationship in this population. The present study reviews the literature regarding a promising potential moderator that may explain this variability - specifically cognitive reserve.
Cognitive reserve refers to pre-existing and compensatory neural networks involved in cognition. Cognitive reserve theory proposes that having more efficient and flexible neural networks enables individuals to cope better with neuropathology. Cognitive reserve moderates the relationship between other forms of neuropathology (e.g., dementia-related brain changes) and cognitive performance, and may also change the expression of cognitive changes related to poor sleep

Materials and methods: A systematic literature search was conducted of published and unpublished studies, resulting in 8 papers that met inclusion criteria. Weighted random effects meta-analysis was used to synthesise data and calculate effect sizes. Data were meta-analysed in four cognitive domains: processing speed, executive function (EF), attention, and memory.

Results: Preliminary analysis revealed that cognitive reserve (CR) was a significant moderator of the effect of poor sleep on EF: Individuals with high CR who slept poorly were significantly less impaired on EF tasks than individuals with low CR who slept poorly. Both high and low CR groups were equally affected by poor sleep on memory and processing speed tasks. We found no main effects, nor interactions for the effects of sleep disturbance on attention.

Conclusions: The relationship between disturbed sleep and cognitive outcomes is complex and cognitive reserve is one of several important individual differences that are increasingly accounted for in the literature. Executive function tasks may be more sensitive to sleep disturbance and individuals with lower cognitive reserve are likely to be differentially affected on these tasks. **Acknowledgements:**

Behavior, Cognition and Dreaming
Board #042 : Poster session 1

NAP AND COGNITION IN KOREAN ADULTS: A POPULATION-BASED STUDY

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Introduction: The relationship between nap and cognition is not well-established. Prior research reported the positive and negative effect of nap on cognition. The purpose of this study is to investigate the relationship between nap and cognitive function in Korean adult population.

Materials and methods: A population-based nationwide cross-sectional survey was performed in 2018. A two-stage stratified random sample of Koreans aged 19 years or more were selected and evaluated by trained interviewer using questionnaires. Cognitive function was assessed with the Mail-In Cognitive Function Screening Instrument (MCFSI). The sleep habits on weekdays and weekends including night sleep and napping, subjective sleep requirements and accumulated sleep debt were assessed with the questionnaire. Sleep quality, daytime sleepiness, insomnia, and depression were assessed with the Pittsburg Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI), and Patient Health Questionnare-9 (PHQ-9), respectively. Multiple linear regression was applied to estimate independent association of factors with cognition.

Results: Among 2501 participants, excluding one due to incomplete response, a total of 2500 participants were included in the analysis. MCFSI score was 2.65±3.23 and nap was reported in 726 (29%) participants (nappers). Mean MCFSI score was higher in the nappers (3.44±3.61) compared with non-nappers (2.33±3.00, p< 0.001). In the multiple linear regression analysis, when compared with more than 12 years of education, 6 to 9 years of education (β=0.655, p=0.005) and less than 6 years of education (β=0.924, p=0.001) were significant independent positive contributing factor for MCFSI score. Dyslipidemia (β=0.710, p=0.001), PHQ-9 score (β=0.144, p< 0.001), ISI score (β=0.115, p< 0.001), ESS score (β=0.099, p< 0.001), PSQI score (β=0.072, p=0.022), and age (β=0.060, p< 0.001) were also significant independent positive contributing factor for MCFSI score. Nap and sleep duration were not significantly associated with MCFSI when adjusted for covariates.

Conclusions: Older age, lower level of education, depressive mood, insomnia, daytime sleepiness, and poor sleep quality were independently associated with worse cognitive function. Although nap and shorter sleep duration were associated with worse cognitive function in univariate analysis, results of multivariate analysis suggest that these association might be secondary to other factors.

Behavior, Cognition and Dreaming
Board #043 : Poster session 1

ASSOCIATION OF SNORING CAUSED BY ADENOID HYPERPLASIA WITH BEHAVIOURAL DISTURBANCES IN SCHOOL CHILDREN

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Introduction: Snoring among children due to adenoid hyperplasia may be associated with behavioural changes due to the resultant sleep disturbance. To assess this, the Rutter Children Behavioural questionnaire - the RCBQ (originally developed for screening emotional and behavioural disorders by teachers) was utilised to determine behavioural changes in school going children (age=4-15 years) with snoring.

Materials and methods: 32 children (4-15 years) were subjected to a modified RCBQ, of whom the first group of 11 were diagnosed snorers with adenoid hypertrophy and the second group of 21 were asymptomatic school going children. This RCBQ was used to assess and detect the presence of any behavioural changes in the children in both the groups. The original RCBQ, as described by Rutter in 1967 contained 26 questions of which only 18 questions were relatable and relevant to the local region and were utilised. The RCBQ´s original ordinal scale of scoring from 0 to 2 was used leading to a total score for each participant to be a minimum of zero and maximum of 36.

Results: The median (IQR) age of the children in snoring group (n= 11) was 8.0 (11.0) and the median (IQR) age of the children in non-snoring group (n= 21) of children was 8.0 (5.0). Though there was no statistically significant difference in the age of both the groups (p value = 0.938, Mann Whitney U test), we found a statistically significant difference in total score of the modified RCBQ between the snoring and non-snoring group of children (p value = < 0.001, Mann Whitney U test).

Conclusions: This study shows that in children with snoring due to adenoid hypertrophy there exists a significant increase in behavioural effects such as restlessness, irritability, thumb sucking, disobedience and a lack of concentration. These behavioural effects may be detrimental to the child's development and thus may be considered as an indication for early surgical management of snoring and open mouth breathing in children with adenoid hyperplasia.

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Behavior, Cognition and Dreaming
Board #054 : Poster session 3
INFLUENCE OF ETHNICITY AND SOCIAL STATUS ON STRESS AND SLEEP

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Introduction: Sleep has been shown to facilitate the emotional processing of life events1, and disruptions to sleep can impair emotional processing (REF). Stress is one factor known to negatively impact physiological and self-reported sleep quality. Self-reported stress levels due to discrimination have been shown to significantly differ among ethnicities, with Caucasian Americans reporting lower stress levels compared to Asian Americans, Latino Americans, and African Americans. Furthermore, sleep quality differs across ethnicities, in particular ethnic minorities, and those with self-reported lower socioeconomic status, reporting lower sleep quality.
The aim of this analysis was to explore the influence of ethnicity, social interaction, and perceived social status on stress and sleep.
Materials and methods: Survey data was collected as part of a questionnaire administered to 945 college-age participants (Asian= 461, Latino= 359, White= 125) prior to their participation in research studies. Stress and sleep were measured using the Perceived Stress Scale (PSS) and the Pittsburgh Sleep Quality Index (PSQI), Social contact and subjective social status were measured using the Social Ties Scale (STS) and the MacArthur Scale of Subjective Social Status (MSS).
Results: Subjects identifying as Asians reported higher stress levels and worse sleep quality compared to those identifying as Latino or White. PSQI was significantly predicted by PSS ($p < 0.001$) and Ethnicity ($p=0.029328$). PSS was significantly predicted by PSQI ($p < 0.001$), Ethnicity($p= 0.00022$), and MSS ($p= 0.00290$). An interaction of Ethnicity and PSQI (LatinoxSleep, AsianxSleep, and WhitexSleep) also predicted PSS.
Conclusions: Ethnicity and perceived social status are predictors of sleep and stress. These results contribute to the literature on the influence of sociocultural factors on stress and sleep.

EFFECTS OF SLEEP DEPRIVATION ON FUNCTIONAL CONNECTIVITY DURING A PSYCHOMOTOR VIGILANCE TASK

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Objectives: Sleep deprivation (SD) is associated with a range of adverse cognitive outcomes including impaired cognitive functioning and vigilance, resulting in decreased workplace productivity and increased risk of motor vehicle accidents (1). However, the mechanisms of brain activity underlying the impact of sleep deprivation on cognition remains unclear. The default mode network (DMN) consists of brain regions that are activated at rest and deactivated in response to task (2), and previous studies have reported a reduction in functional connectivity in the DMN during cognitive tasks after sleep deprivation (3). This study aims to investigate both the effects of total SD and recovery nap on performance and functional connectivity during a psychomotor vigilance task.
Methods: 19 healthy young adults (mean age=21.15, 12 females) were scanned using simultaneous EEG-fMRI (3T GE with high-density EGI system; TR=2.5 seconds) during a psychomotor vigilance task (PVT) in the following three states: non-SD, total SD, and after a one-hour recovery nap. Functional MRI data preprocessing (smoothing, registration, estimation of confounds) was performed using the *fmriprep* pipeline (4). The volumetric data was then projected onto the cortical surface space and divided into 100 cortical parcels. Functional connectivity between these parcels, as well as within & between 7 Functional Networks (5) was estimated using Pearson correlations. Paired sample t-tests were used to compare the functional connectivity between the different states and false discovery rate correction for multiple comparisons was applied (p value threshold< 0.05). Repeated measures ANOVAs and post-hoc t-tests were used to compare the accuracy and reaction time at the PVT (6) between the three different states.
Results: When comparing the SD to non-SD state, there was a significant decrease in accuracy (t=-3.3, p< 0.01) and reaction time (t=3.0, p< 0.01) on the PVT. There were overall significant increases in connectivity between and within most networks, especially within the DMN (t=3.9, p< 0.01). After the recovery nap, there was an improvement in both accuracy (t=3.2, p< 0.01) and reaction time (t=4.6, p< 0.001) indicating recovery in performance. Moreover, there was an overall decrease in functional connectivity, which was significant only within the visual network (t=-4.6, p< 0.01).
Conclusions: SD had a negative impact on vigilance performances, which partially improved after a recovery nap. The overall increase in connectivity between and within the 7 networks suggests less segregation of networks following total SD. However, the overall decrease in connectivity after a one-hour recovery nap opportunity indicates more segregation of networks. Future studies will investigate the impact of SD on different cognitive tasks and connectivity during nap to further improve our understanding of the neural recovery mechanism of sleep.

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DREAMS OF INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT: REFLECTED IN DREAM REPORTS?

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Introduction: Previous research has identified a continuity between waking-day thoughts and dream content, such that dreams often incorporate imagery of waking-day learning. Some leading theories postulate that cognitive capacity is a fundamental dimension of dream formation, as demonstrated in studies of dreams in development notably by Foulkes (1982). However, there is a lack of studies examining how cognitive impairment affects dreaming. Here, we sought to determine whether mild cognitive impairment (MCI) is reflected in dreams.

Materials and methods: Data was collected from a sample of healthy older adults (HOA) and older adults with mild cognitive impairment (MCI) at the Bruyère Research Institute in Ottawa, Canada. MCI diagnosis was made by a physician. Participants also completed the California Verbal Learning Task (CVLT). For collection of dreams, participants were given sleep and dream journals to take home over the course of one month during which they reported their dreams with specific instruction to complete them by themselves. The journals also included a day-diary for recording significant waking-day events. Up to two dreams per participant were analyzed. Dreams were transcribed for analysis of words and characters. Dream content was analyzed using the Hall & Van de Castle method of content analysis.

Results: Our results indicated no difference in the length of dream reports between the two groups. Despite this, the complexity of dream reports (i.e. length of words used) was correlated with performance on the MoCA, such that individuals with poorer cognitive performance tended to use less complex words to describe their dreams ($r = 0.417$, $n = 50$, $p < 0.01$). Similarly, a multiple regression analysis revealed that CVLT scores also significantly predicted the complexity of dream reports, accounting for 30.6% of the variance in number of characters per word in dream reports ($r^2 = 0.306$). We also found no significant differences between HOA and MCI for any of the Hall & Van de Castle categories.

Conclusions: Our results demonstrate that MCI may be reflected in the way that dreams are reported by older adults suffering from the initial signs of cognitive decline. Whether this reflects deficiencies in offline processing, or if participants simply have more difficulty describing their dreams while awake, is unknown. We found no significant differences among the Hall & Van de Castle categories of content analysis. This is perhaps not surprising, since the Hall & Van de Castle method does not include measures of cognitive capacity or dream themes relating to their impairment (i.e. themes of forgetfulness). Further analyses of the data sample will be required in order to more directly assess cognitive factors in the dream reports. Fogel et al. (2018) demonstrated, using a computer-linguistic approach, that incorporation of task-related imagery in dreams positively correlates with reasoning and verbal abilities. It will be an important step to determine whether, in the same fashion, cognitive impairments is reflected in the manner in which waking-day events from the day-journals were incorporated into dreaming in our sample.

Behavior, Cognition and Dreaming
Board #198 : Poster session 3

SLEEP AND EARLY COGNITIVE DEVELOPMENT IN CHILDREN WITH AND WITHOUT DOWN SYNDROME

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Introduction: In typically developing (TD) children, poor sleep contributes to cognitive difficulties. Down syndrome (DS) is the most common developmental disorder and is characterised by mild to moderate cognitive impairment with a particular weakness in expressive language and relatively good visuospatial skills. Children with DS have severe sleep problems, particularly sleep-disordered breathing. This study explores, for the first time, associations between sleep and early cognitive development in pre-schoolers with DS.
Materials and methods: Twenty-two children with DS and 22 TD children aged 2 to < 5 years attended Coventry University with a parent to complete the Mullen Scales of Early Learning, which assess gross motor, fine motor, visual reception, and expressive and receptive language skills. They also underwent home cardiorespiratory polygraphy. Parents completed questionnaires on sleep, language and behaviour.
Results: Children with DS performed less well on each Mullen scale relative to TD children. Developmental trajectories indicated delayed and slower learning for fine motor, visual reception and expressive language skills in DS. Receptive language was delayed but showed a typical trajectory. In TD children, there were clear associations between better sleep and improved language and behaviour. Findings were mixed for children with DS, likely because multiple factors in this complex syndrome mask or mediate associations between sleep and cognitive development.
Conclusions: Receptive language should be recognised as a relative skill in DS that could aid learning in other areas. We recommend that sleep problems be screened and treated as even mild disruptions may prompt poorer cognition and behaviour.
Acknowledgements: We are extremely grateful to the children and families who patiently helped with our research, and to the Down's Syndrome Association and parent groups who advertised the study. Research expenses were funded by Coventry University and we thank Benedict Carlin, who assisted with the majority of test sessions whilst completing his BSc psychology degree.

THE EFFECT OF 12-HOUR EMT SHIFTS ON MEDICAL STUDENT FATIGUE, EMPATHY AND BURNOUT

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Introduction: Extensive research has demonstrated that fatigue has a detrimental effect on cognitive performance. Extended work shifts, shift work, and fatigue have also been shown to adversely affect mood, leading to increased frustration and a tendency to blame others for problems. Empathy can also be affected by fatigue, which has been shown to decrease both emotional and cognitive empathy. Empathy in healthcare workers is a desirable trait, as it is associated with increased patient recovery rates, increased patient satisfaction, and decreased use of pain medication following surgeries. However, extended and rotating shifts may alter empathy in physicians and medical students and ultimately affect patient outcomes. In addition, fatigue and declining empathy levels are associated with higher levels of burnout, especially in healthcare workers.

Materials and methods: This study was designed to assess the effect of 12-hour shifts (both day and night) on empathy in medical students. First and second year medical students were tested prior to and immediately following a 12-hour Emergency Medical Technician/Ambulance shift using the Stanford Sleepiness Scale to assess perceived fatigue and the Toronto Empathy Questionnaire to assess empathy. Results were compared both within subjects (pre and post) and between subjects (day versus night shifts) to determine if 12-hour shifts and fatigue affected empathy scores. Burnout was assessed using the Maslach Burnout Inventory following each shift to determine if fatigue, empathy and shift influenced medical student burnout.

Results: Based upon preliminary results, working a 12-hour night shift produced more fatigue and more pronounced decreases in empathy than working the 12-hour day shift. Both shifts resulted in a decrease in empathy scores across the 12-hour period. The effect of fatigue on burnout depended upon gender and time of shift, with females exhibiting increased rates of burnout, especially the emotional exhaustion component.

Conclusions: This research may be used to help target fatigue countermeasures for those working extended and rotating shifts to decrease the likelihood of burnout and declines in empathy in medical professionals. Future research is addressing how physiological fatigue relates to burnout and empathy in medical students, physicians, nurses, and emergency medical technicians.

COMPARATIVE EFFECTS OF SLEEP DEPRIVATION AND ALCOHOL ON DRIVING SIMULATOR PERFORMANCE

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Introduction: Sleep deprivation and alcohol can have similar deleterious effects on cognitive performance. However, there are strong individual differences in performance during exposure to sleep deprivation or alcohol. Our first objective was to assess the dose-equivalent effects of extended wakefulness and breath-alcohol concentration (BrAC) on driving simulator performance. Our second objective was to assess whether individual differences in driving performance were reproducible across exposures to sleep deprivation versus alcohol.

Materials and methods: Healthy men (n = 40, aged 21-40 years) were recruited from the general population to take part in a within-participant, randomized crossover study. During separate study visits spaced at least 2 weeks apart, participants completed a 3-day laboratory protocol that included a 25-h period of sustained wakefulness (starting from 0700). In the alcohol study condition, participants were given small oral doses of alcohol every ~30 min during the daytime (from 1100 to 1900) in order to increase their BrAC gradually from 0.00 to 0.08 g/210L. In the non-alcohol condition, participants were given non-alcoholic drinks over the same time period. Participants completed a 16-min driving simulator test every 2 h (York Urban Driving Simulator 6), with performance assessed using the standard deviation of lane position (SDLP) of the vehicle. Dose-response curves were constructed to determine values for extended wakefulness that resulted in performance decrements equivalent to a BrAC of 0.05 or 0.08 g/210L. To assess stability of individual differences across conditions, intraclass correlation coefficients (ICC) were determined using variance components analysis, taking into account baseline individual differences in SDLP.

Results: Staying awake for about 19 h impaired driving performance to a similar degree as a BrAC of 0.05 g/210L. Staying awake for about 21 h was equivalent to a BrAC of 0.08 g/210L. Individual differences in SDLP during extended wakefulness were reproducible across study visits (ICC = 0.65, P < 0.001). In contrast, individual differences in performance in response to sleep deprivation did not associate with differences in response to alcohol administered during the daytime (ICC = 0.08, P = 0.32).

Conclusions: Extended wakefulness resulted in driving performance impairments comparable to alcohol intoxication. Individual differences in driving performance were stable and reproducible across multiple exposures to sleep deprivation. However, individual differences in performance vulnerability to sleep deprivation did not associate with vulnerability to effects of alcohol without sleep deprivation. Our results suggest that different biobehavioral mechanisms may underlie driving impairment during exposure to sleep deprivation versus alcohol.

Behavior, Cognition and Dreaming
Board #051 : Poster session 2
CUMULATIVE PARTIAL SLEEP DEPRIVATION DOES NOT IMPAIR SIMULATED DRIVING PERFORMANCE: A DOUBLE-BLIND RANDOMIZED PLACEBO-CONTROLLED EXPERIMENT

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Introduction: Road traffic injuries are the eighth leading cause of death worldwide. Insufficient sleep increases the odds of a driver being in a road traffic crash. Partial sleep deprivation, where sleep is restricted to 2-6 hours per night, impairs driving performance. Previous research on the impact of sleep deprivation on driving behavior have not included a placebo control and did not blind participants or researchers. Effect sizes may have been overestimated by researchers who assumed that the proportion of change accounted for by a placebo effect was part of the impact of sleep deprivation, and thus overestimated the latter.Additionally, the impact of cumulative partial sleep deprivation such as restriction sleep by one hour per night over six nights on driving behavior has not been examined. This is a critical omission given that 23% of adults sleep at least one hour per night less than what they consider optimal on a regular basis.
The goal of the present study was to address these gaps by comparing the impact of a one-hour reduction in sleep duration per night for six nights and a placebo condition on driving simulator performance.
Materials and methods: Ninety-eight healthy participants stratified by age (18-25, 30-34) and sex (48 women and 50 men) were randomly allocated to undergo six nights of either one-hour nightly sleep restriction or exposure to a lamp with no known therapeutic effects during daylight (placebo condition). Participants and research assistants were blinded. Compliance with experimental sleep conditions was confirmed by actigraphy. Subjective sleepiness was measured with a visual analogue scale at baseline and following both experimental conditions. Driving performance (as lane position variability) and driving speed were measured using a driving simulator at baseline and following experimental conditions. The driving simulator consisted of a car seat in front of three screens with a steering wheel and accelerator and brake pedals. Participants were instructed to drive normally through five scenarios: an urban scenario, a suburban scenario driving in a straight line with intersections, a rural highway, and a curved road with one lane in each direction where oncoming vehicles passed at random intervals or at regular intervals.Sleep, sleepiness, and driving measures were analyzed with a mixed two-way ANOVA where time (baseline and experimental sessions) was the within-subject variable and condition (sleep deprivation versus placebo) was the between-subject variable.
Results: In participants in the sleep deprivation condition, between baseline and experimental weeks, sleep duration was reduced by 68 minutes. There were no changes in sleep duration for the placebo condition. Regardless of condition, subjective sleepiness increased between baseline and experimental sessions. Cumulative partial sleep deprivation, compared to the placebo control, did not impair driving performance and did not increase speed.
Conclusions: The experimental manipulation of sleep duration was successful such that subjective sleepiness increased in both conditions while sleep duration was only reduced in the sleep deprivation condition. One hour per night for six nights of cumulative partial sleep deprivation did not impair driving simulator performance.

THE RELATIONSHIP BETWEEN SLEEP AND COGNITIVE PERFORMANCE IN ADOLESCENTS

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Introduction: Adolescence is a period of development that is marked by changes in sleep/wake patterns and in cognition. Maturational changes paired with environmental demands, such as early school start times and late bedtimes, have resulted in high schoolers being at risk for inadequate sleep. A plethora of studies have demonstrated that sleep duration is associated with cognitive functioning in children and adolescents. However, the characterization of a good sleep encompasses both the amount of sleep as well as the subjective experience of falling asleep easily in bed and sleeping throughout the night. The aim of the current study is to examine the association between executive functioning and subjective as well as objective measures sleep in adolescents. It was hypothesized that sleep quality and quantity would be associated with executive functioning including attention, shifting, inhibition, processing speed, and working memory.
Materials and methods: 29 typically developing adolescents **(**19 girls, 10 boys) (M_{age} = 15.03 years ± 0.19) had their sleep recorded at home using actigraphy (AW) for seven consecutive nights and completed the Pittsburgh Sleep Quality Index (PSQI). The NIH Toolbox Cognition Battery was used to measure processing speed (pattern comparison test), set-shifting (dimensional change card sort test), working memory (list sorting test), and inhibition/attention (flanker test).
Results: Objectively measured sleep duration was positively correlated with scores on the dimensional card sort test (r = .53, p < .05) and bedtimes were negatively correlated with performance on the list sorting test (r = -.59, p < .05). Objectively measured time spent awake in bed was positively correlated with scores on pattern comparison test (r = .51, p < .05), and performance on the dimensional card sort test was positively associated with both subjective (r = .58, p < .01) and objective (r = 49, p < .05) measures of time spent in bed.
Conclusions: In a sample of typically-developing adolescents, sleep quantity and quality were both negatively associated with the shifting component of executive function. In addition, our results showed a negative relationship between later bedtimes and working memory, as well as between time spent awake in bed and processing speed.

ASSOCIATION OF SLEEP SPINDLE CHARACTERISTICS WITH EXECUTIVE FUNCTIONING IN HEALTHY SEDENTARY MIDDLE-AGED AND OLDER ADULTS

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Introduction: Sleep spindles are defining characteristics of NREM stage-2 sleep. Sleep spindle characteristics have been associated with memory consolidation and more recently with reasoning abilities, and have been used as marker of progressive cognitive decline in clinical populations. In this study, we sought to investigate i) the relationship between sleep spindle characteristics and cognitive functions, ii) the associations between spindle characteristics and scores on the Montreal Cognitive Assessment (MoCA), and iii) differences in spindles characteristics between carriers of the well-known risk allele for Alzheimer's Disease, the apolipoprotein ε4 (APOE ε4) allele, and non-carriers.

Materials and methods: 63 participants (mean age ± SD = 68.0±5.6, 30 females) underwent one night of in-home polysomnography (PSG) and cognitive testing in separate sessions, and consented to genetic testing. A novel computerized algorithm was used to score PSG data and sleep spindle characteristics were obtained through EEG spectral analysis. A Principal Component Analysis (PCA) was conducted to reduce the number of analyzed cognitive variables and generate factors based on the communalities between the original variables. Multiple linear regression analyses were employed to investigate the relationship between spindle characteristics and both cognitive measures, and MoCA scores. Independent samples t-tests were conducted to test for differences in spindles characteristics between carriers (APOE ε4+) *and non-carriers (APOE* ε4-)*.* All statistics were two-tailed and significance was set at $p < 0.05$.

Results: We used a Montecarlo simulation to establish the number of factors to retain and based on it we forced the PCA to generated 3 cognitive factors which explained 64.8% of the total variance. Factor 1, which explained the largest amount of variance (39.4 %), consisted of outcomes of primary executive functions (processing speed, inhibition and verbal fluency). After controlling for age, body mass index (BMI), apnea-hypopnea index (AHI) and periodic limb movements (PLMI), the primary executive functions factor was significantly associated with sleep spindle density (b= 0.363, $p = 0.015$), and frequency (b= 0.345, $p = 0.025$). There was also a statistically significant positive association between MoCA and spindle frequency (b= 0.325, $p= 0.019$) after controlling for age, BMI, AHI and PLMI. No differences in spindles characteristics were found between *APOE* ε4+ and *APOE* ε4-.

Conclusions: Some spindle characteristics were associated with cognitive performance and MoCa scores in our sample of healthy middle-aged and older adults. Longitudinal studies are necessary to assess the ability of spindle characteristics to predict future cognitive status.

Behavior, Cognition and Dreaming
Board #057 : Poster session 3

COGNITIVE PHENOTYPES OF PATIENTS WITH TEMPORAL LOBE EPILEPSY: SLEEP MAY HAVE ITS OWN ROLE TO PLAY

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Introduction: Cognitive disturbances, specifically memory impairment, are common and well documented among patients with medically refractory temporal lobe epilepsy. A recently published study showed that cognitive phenotype of patients with temporal lobe epilepsy (TLE), can be distinguished, based on their memory and language dysfunction. Additionally, disturbed sleep and poor sleep architecture has been shown to be common in this population. The aim of this study is to determine the cognitive phenotype among TLE patients and evaluate its association with clinical and polysomnographic parameters of sleep.

Materials and methods: Consecutive patients with medically refractory temporal lobe epilepsy were enrolled from Department of Neurology, All India Institute of Medical Sciences, New Delhi between Dec 2017 to May 2018. All patients underwent detailed clinical evaluation and neuropsychological testing for executive function (trail making test, stroop colour word test), memory (Wechsler Memory Scale) and language (Western aphasia battery). Each participant was classified into four groups based on their cognitive phenotype which was determined by language or memory impairment. Group 1 patients had both memory and language impairment, Group 2 had only memory impairment, Group 3 had only language impairment and Group 4 was comprised by patients with no language or memory impairment. Overnight polysomnography was conducted, sleep spindle characteristics (frequency, amplitude, density and associations) were scored automatically and manually by a sleep technologist and reviewed by the Sleep physician. Sleep spindle density (SD) and sleep spindles associated with K complex density (SD-K) was calculated as number of events per minute.

Results: A total of 100 patients (68 males; mean age of 26.9 ± 8.4 years were enrolled in this study. Almost all (98%) patients were found to have executive dysfunction. Cognitive phenotype distribution showed 28 patients in group 1, 47 in group 2, 11 in group 3 and 14 in group 4. On clinical epilepsy and sleep evaluation no significant difference was found among the groups except self-reported total sleep time (9.1 ± 2.1 vs 8.4 ± 1.1 vs 7.9 ± 0.7 vs 8.1 ± 2.4 respectively, $p = 0.04$) was significantly more among group 1 patients. On polysomnography evaluation SD-K (0.6 ± 0.5 vs 1.1 ± 0.3 vs 1.7 ± 0.5 vs 1.9 ± 0.7 respectively, $p = < 0.001$).

Conclusions: Density of sleep spindles associated with K complexes is lowest among temporal lobe epilepsy patients with both memory and language impairment, and significantly lower among those with only memory impairment compared to those with only language impairment. These findings may provide insights into the role of specific sleep features associated with different cognitive phenotypes of temporal lobe epilepsy.

THE EFFECT OF SLEEP DEPRIVATION ON EMOTIONAL FACIAL VERSUS NONFACIAL STIMULI PROCESSING IN YOUNG ADULTS WITH ADHD

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Introduction: The present study sought to investigate whether young adults with ADHD have more difficulty processing emotional facial versus nonfacial (shape) stimuli compared with young adults without ADHD, and whether such a difference worsens following sleep deprivation.

Materials and methods: Thirty young men (M= 25.6) with (n=14) or without (n=16) a diagnosis of ADHD were included in this study. The participants were instructed to sleep 7h or more each night for one week, and their sleep quality was monitored via actigraph. Subsequently, the participants were kept awake in a controlled environment for 30 hours. The participants completed a Visual Oddball Task. Photographs of faces of 3 different male individuals and 3 different geometric shapes (circle, triangle, and square) were used as stimuli. Facial expressions were neutral (nontarget) or angry (target). Geometric shapes were "empty" (nontarget) or with a black cross at the middle of the shape (target). Participants were seated in a comfortable chair in a dimly lit room at a distance of 80 cm from a 19-in. computer screen. They were instructed to focus their gaze on the stimuli to be presented at the center of the screen and to point out as quickly as possible (without compromising accuracy) the occurrence of a "target" (deviant) stimulus by pressing the spacebar. Omission errors were measured (i.e., forgot to press the spacebar when a deviant stimulus appeared).

Results: Differences between ADHD and control groups were assessed for target (facial emotional, and shape) omissions. A significant Time × ADHD interaction was found for emotional facial stimuli omissions [$F_{(1, 28)} = 5.37$, $p < 0.05$]. At the onset of the experiment there were no differences in omission errors between the participants with ADHD and those without ADHD. Following sleep deprivation, however, the ADHD group had more omission errors compared with the control group [$t_{(1, 29)} = 5.36$, $p < 0.05$]. Regarding neutral shape target stimuli, results showed a main effect for time [$F_{(1, 28)} = 7.81$, $p < 0.01$] such that all participants (ADHD and control) had more omission errors after sleep deprivation.

Conclusion: Among young adults with ADHD, sleep deprivation may hinder the processing of facial stimuli.

Behavior, Cognition and Dreaming
Board #058 : Poster session 3

PRESLEEP CORTISOL LEVEL ASSOCIATES WITH HIGHER CORTICAL AROUSAL IN REM AND NREM SLEEP

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Introduction: Towards the late evening hours, an effective regulation of emotions becomes more challenging with increasing sleepiness. Paradoxically, feelings of stress and anxiety may increase in these hours. Presleep hyperarousal refers to elevated state of vigilance before the sleep onset. The hyperarousal may manifest as somatic or cognitive arousal, or both. Somatic hyperarousal refers to physiologic state of arousal that can imply heightened autonomic nervous system activity and/or hormonal, such as increased hypothalamic-pituitary-adrenal (HPA) axis activity. Cognitive arousal may refer to heightened subjective experience of stress and increased rumination of worries.
In this study, we use human, generally healthy adolescent community cohort, to study the effects of presleep arousal as measured from repeated samples of evening cortisol, on REM sleep continuity and REM and NREM sleep EEG power spectrum. We hypothesized to find a positive association with evening cortisol and high EEG frequencies specifically during REM sleep. In addition, based on the compensatory mechanisms of REM sleep, we hypothesized to find similar increase in the continuity of REM periods as observed in mice models.

Materials and methods: 154 adolescents were from an urban community-based cohort. Five samples of saliva were collected using swabs (Salivette; Sarstedt, Nümbrecht, Germany) from a mean time of 18:20 to bedtime (mean 23:00). Participants underwent overnight polysomnography (PSG) in their own home.

Results: An increasing cortisol level towards the bedtime associated with higher EEG power at all frequency ranges in frontal locations, the highest association being for beta1 frequency. In central locations, the associations were more emphasized for beta1 and beta2 frequencies.Those with frontal beta1 power belonging to the highest 80th percentile displayed higher overall evening cortisol level than those below the cutoff, and their trajectory of cortisol first declined, but towards the bedtime it increased, whereas in others it continued steadily declining over the evening hours. Higher overall cortisol level in the evening was associated with less fragmented REM.

Conclusions: Physiological arousal at bedtime affects sleep EEG powers and lowers sleep quality in this respect. However, there was a compensatory mechanism, as the REM sleep was more continuous along a higher physiological arousal level in the evening, replicating thus evidence from animal models.
Acknowledgements: -

Behavior, Cognition and Dreaming
Board #202 : Poster session 3

THE RELATIONSHIP BETWEEN MACHINE LEARNING DERIVED SLEEP PARAMETERS, AND EMOTIONAL AND BEHAVIOURAL PROBLEMS IN 3- AND 5-YEAR OLD CHILDREN

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Introduction: Subjective reports of sleep duration have been associated with childhood behavioral problems. In contrast, accelerometer-based sleep duration has not been associated with behaviour problems among preschool children. Applying machine learning (ML) techniques to accelerometer data may provide insights into underlying sleep stages. We examined associations between ML-derived sleep states (patterns) and behaviour problems.

Materials and methods: Children from the CHILD cohort Edmonton site with sleep and behaviour data at 3-years (n=330) and 5-years (n=304) were included in this analysis. Parent-reported behaviour problems, including externalizing (aggressive and attention problems), internalizing (depression and anxiety) and total behaviour problems, were assessed by the Child Behavior Checklist (CBCL); higher scores represent increased behavior problems. Parents were instructed to have their child wear the accelerometer on their non-dominant wrist 24-hours/day for at least 1 day. Total sleep duration (hours/day) was calculated from the accelerometer data.

Analysis: The Hidden Markov Model physical activity R-package (HMMpa) was used for ML analysis of the accelerometer raw data. HMM was used to discover the number of hidden states (i.e. the number of hidden sleep categories) using the 60-second epoch vector magnitude (VM) and sleep pattern transitions. HMM was then used to link each epoch VM count to an HMM-identified sleep state. The average time every participant spent in each HMM-states was estimated and expressed in hours/day. Generalized Estimating Equation (GEE) model analyzed associations between sleep (total sleep duration, ML-sleep states) and behaviour problems.

Results: Average total sleep duration was 10.8±0.78 hours/day and 10.4±0.57 hours/day at age 3 and 5 respectively. Four hidden sleep states were identified at three years and six hidden sleep states at five years. HMM-1 for both ages had zero VM. The rest of the hidden states, with some degree of movement detected by VM, were merged together and represented by HMM-mov. Children spent an average of 8.2±0.85 hours/day in HMM-1 and 1.2±1.4 hours/day in HMM-mov at age three. At age five, children spent an average of 8.2±0.6 hours/day in HMM-1 and 0.78±1.04 hours/day in HMM-mov.
Surprisingly, each hour of sleep was associated with a 0.66-point higher total behavior score (95%CI: 0.30, 1.30, p=0.04) and 1.15-point higher externalizing score (95%CI: 0.38, 1.92, p=0.003). However, we found differences in behavior symptoms by HMM sleep states. Each hour in HMM-1 was associated with a 0.76-point lower internalizing score (95%CI: -1.35, -0.17, p=0.01). In contrast, each hour in the HMM-mov state was associated with a 0.38-point higher total behavior score (95%CI: 0.02, 0.75, p=0.039) and 0.59-point higher externalizing score (95%CI: 0.18, 1.0, p=0.005).

Conclusions: Children who have prolonged time in sleep with no movement were more

likely to have lower behavioural problems, and children with prolonged sleep-movement period have more behavioural problems. Continued efforts to validate and compare the ML-sleep states with polysomnography are needed.

EVALUATING MINDFUL ATTENTION AWARENESS AS A PREDICTOR OF SLEEP QUALITY IN HEALTHY YOUNG ADULTS

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Introduction: The psychological construct of mindfulness is defined as a receptive state of mind involving non-judgmental observation of one's thoughts, feelings, and surroundings, and has been linked to sleep quality: low levels of mindfulness have been associated with insomnia in middle-aged adults, and interventions to increase mindfulness have improved self-reported sleep quality in middle-aged and older adults undergoing treatment for medical conditions including cancers (e.g., Black et al., 2015; Martirez & Zeidler, 2015). In the present study, we examined whether these relationships between mindfulness and sleep quality also exist in a sample of young adult university students without any diagnosed sleep disorders (N = 76, mean age 21 years; 64% female).

Materials and methods: Participants completed a questionnaire battery including the Pittsburgh Sleep Quality Index (PSQI), the Mindful Attention Awareness Scale (MAAS), the Perceived Stress Scale, and the Beck Depression Inventory.

Results: Using total PSQI score as an index, self-reported sleep quality in the sample ranged from minimal to marked disturbance (min 2, max 16; mean 6.8, STD 3.4). Mindful attention did not correlate with total PSQI score, but did negatively associate with scoring on PSQI questions pertaining to daytime alertness and energy (PSQI component 7, $r = -0.28$, $p = 0.014$). Mindful attention correlated negatively with perceived stress ($r = -0.42$, $p < 0.001$) and depressive symptoms ($r = -0.46$, $p < 0.001$), which themselves were strong predictors of total PSQI score.

Conclusions: Our observations suggest that mindful attention may not be directly relevant to sleep quality in healthy young adults, in contrast to other populations. However, mindful attention in this sample is nonetheless associated with stress levels and mood states, which are well-established predictors of sleep quality. These findings may imply that mindfulness-based interventions to improve sleep quality may not be as valuable in younger adults, in comparison to interventions designed to address stress level or mood.

COMMUNICATING SLEEP HEALTH WITH A VIGILANCE TOOLBOX: REVIEW OF BASEBALL TAG AS A VIGILANCE ASSESSMENT AND TEAM-BUILDING ACTIVITY

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Introduction: Hand-eye coordination (HEC; the process of associating visual information with motor movements) is an essential skill for athletes. Sleep deprivation causes vigilance fluctuations (the ability to sustain attention), which may affect HEC and gross motor skills, and increases injury risk. In 2018, high-school students at the Vancouver Summer Sleep School created a "Sleep Health Communication Concept" in order to disseminate knowledge among youth with "Vigilance-Games"; "Baseball Tag" was created to communicate the relationship between sleep deprivation and HEC. We investigated the suitability of "Baseball Tag" as a knowledge dissemination concept.

Materials and methods: A. A literature review was conducted on Medline to identify how sleep affects hand-eye coordination in the context of baseball batting (search phrase): ["athletic performance" OR "hand-eye coordination" OR "eye-hand" OR "batting"] AND ["baseball" OR "sleep"].

B. "Baseball Tag", as initially suggested, was played by 12 lab-members (in two teams) at a pilot-run. The offensive team batted while the defensive team pitched and tagged offensive players. For assessing fatigue, the Karolinska Sleepiness Scale (KSS) and selfies were used; for assessing gross motor movement when batting, video recordings were used. For assessing HEC, batting percentage was measured and recorded in a digital survey tool (Qualtrics) on participants' mobile devices.

C. A Strength-Weakness-Opportunity-Threat (SWOT) analysis was conducted for the original game and the adapted game.

Results: A. 8/604 articles focusing on methodologies were reviewed. Results show that batting accuracy can be calculated through (i) batting percentage, (ii) ball-to-bat contact point and (iii) average velocity of bat swing. The ball can be delivered to the batter via (i) a mechanical pitcher, (ii) manual pitching or (iii) a batting tee.

B. Self-experience and participant feedback revealed that Baseball Tag was a time-consuming, but fun team-building exercise. KSS scores were similar pre- and post-game. Although selfies were encouraged, they were not collected for data analysis. Video recording was unoperational due to location constraints. The game was adapted by separating batting and game stations: (1) the batting station focuses on data collection, as participants hit a baseball on a batting tee, and HEC and gross motor movements will be captured through batting percentage and lateral/frontal video recordings, respectively; (2) the game station focuses only on team-building through tagging others 'out'.

C. Original game - S: single station; W: time-consuming, low quantitative data; O: promotes team-building; T: large space required. Adapted game - S: reduced game time, consistent quantitative data; W: affected by previous batting experience; O: promotes team-building; T: space.

Conclusions: Based on feedback and the SWOT-analysis, "Baseball Tag" is suitable as a team-building icebreaker in a knowledge dissemination setting. Unlike individual-based testing, "Baseball Tag" creates an interactive environment that enables reflection on

vigilance and performance while engaging in a fun activity. The adapted version allows both group-bonding and collection of large quantitative data. "Baseball Tag", as part of a "Vigilance Toolbox", opens the discussion on how to communicate injury/accident prevention to young people in an appealing way.

Behavior, Cognition and Dreaming
Board #048 : Poster session 1

THE ATTENTION IMPROVEMENT AFTER LIGHT TREATMENT IN CIRCADIAN REARRANGEMENT

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Introduction: Sun light of some wave length regulate human circadian rhythm by manipulate the secretion of melatonin. Attention is the most common neurocognitive function affected in sleep disorders, including circadian disorders. The hypotheses of this study is the attention will improve after light therapy in the circadian disorders.

Materials and methods: In this study, patients with delayed sleep phase will be invited to join the study. The patient will undergo four periods of study. The first period, baseline period, patients will stay in his usual sleep-wake schedule for 7 days. Then, in 2nd period, pre-light therapy period, patients will be wake up one hour earlier than his usual schedule without expose to any light. Then, light therapy period, patients wake up one hour before his regular schedule and light therapy (10000 Lux in 50 cm distance) for 30 minutes was done for 14 days. And then, post-light therapy period, the attention and cognitive function without light therapy will be observed for another 7 days. Sleep logs and actigraphy is recorded for the whole 4 period, 35 days. Psychomotor vigilance task (PVT), Epworth Sleepiness Scale (ESS) and Insomnia severity index (ISI) are evaluated upon wake-up on the 7th day of the baseline period, the 1st and 7th days of light therapy free period, the 7th and 14th days of light therapy period and the 7th day the maintenance period.

Results: From September, 2016 through November 2017, 10 subjects completed this study. The average reaction time of the pointer PVT attention test was faster in intervention group (p-value< 0.05) especially in post-light therapy period. A decreasing trend in insomnia severity and continuous improvement effect on sleep quality was noted during and up to 7days post-light therapy (p-value< 0.05). The result of ESS showed no significant statistical difference after intervention (p-value>0.05), but this is acceptable as somnolence is not a definite symptom of sleep disorder.

Conclusions: In conclusion, light therapy do improve wake-up neurocognitive function especially attention and sleep quality after circadian changes.

EFFECTS OF ACUTE CAFFEINE CONSUMPTION FOLLOWING SLEEP LOSS ON COGNITIVE, PHYSICAL AND OCCUPATIONAL PERFORMANCE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Caffeine is widely used to counteract performance impairments that occur following sleep restriction or deprivation. However, the efficacy of caffeine to attenuate performance decrements may depend on factors such as caffeine dose, timing of administration, habitual caffeine use, type and complexity of performance task and the amount of sleep lost. The aim of this study was to systematically review and meta-analyse published literature examining the effects of acute caffeine consumption on cognitive, physical and occupational performance in sleep deprived/restricted individuals.

Materials and methods: Electronic databases (PubMed (MEDLINE), Web of Science (via Thomas Reuters) and Scopus were searched to identify studies that measured cognitive, physical or occupational performance following either *sleep restriction* (≤6 h sleep within 24 h) or *deprivation* (≥24 h wakefulness) under control (placebo) and intervention (caffeine) conditions. Studies were eligible for inclusion if performance was assessed within 6 h of caffeine consumption and excluded if the effect of caffeine could not be isolated or if performance data were not adequately reported. Individual effect estimates (EEs) were calculated as Hedges' g for independent groups; if a study repeated the same performance test within a 6 h period (and no additional caffeine was administered between tests) the resulting Hedges' g values were combined into a single EE. Random effects meta-analyses were performed to determine intervention efficacy. Statistical significance was attained if the 95% CI did not include zero. Heterogeneity was assessed using the I^2 index.

Results: 4351 records (excluding duplicates) were screened and 59 publications were reviewed. These publications provided 228 EEs on cognitive performance outcomes. Mean caffeine intake was 341±174 mg (range: 80-600) and total time awake was 32±13 h (range: 18-86). The cognitive domains assessed were attention, executive function, information processing, memory and reaction time; 'speed' and 'accuracy' data were handled separately within each domain. Simulated driving performance, an applied cognitive skill, was also examined. Caffeine decreased (i.e. improved) response time (43 EEs; g=0.71; 95% CIs 0.56,0.85; I^2=48%) and number of lapses (22 EEs; g=0.73; 95% CIs 0.50,0.95; I^2=60%) on attention tests, decreased response time (18 EEs; g=0.69; 95% CIs 0.20,1.18; I^2=88%) and increased accuracy (17 EEs; g=0.47; 95% CIs 0.14,0.81; I^2=78%) on executive function tests, decreased response speed on reaction time tests (12 EEs; g=1.12; 95% CIs 0.75,1.48; I^2=74%), decreased response time (10 EEs; g=2.12; 95% CIs 1.11,3.12; I^2=95%) and increased accuracy (32 EEs; g=0.49; 95% CIs 0.39,0.60; I^2=22%) on information processing tests, and enhanced lateral (23 EEs; g=1.62; 95% CIs 1.28,1.96; I^2=70%) and longitudinal (12 EEs; g=1.62; 95% CIs 1.14,2.10; I^2=66%) vehicular control on simulated driving tests. No other performance outcomes were appropriate for meta-analysis. However, studies typically indicated a benefit of caffeine on memory (5 publications, 25 EEs), physical (13 publications, 41 EEs) and occupational (8 publications, 35 EEs) performance, although, the magnitude of effect and performance tests employed were heterogenous.

Conclusion: Results indicate that in situations where individuals experience inadequate sleep, the ingestion of caffeine is an effective strategy to enhance cognitive and physical

function.

SLEEP AND THE RELATIONSHIP BETWEEN STRESS REACTIVITY AND PROCESSING SPEED IN EARLY CHILDHOOD

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Introduction: During early childhood, sleep impacts the development of the cognitive, behavioral and stress systems that allow children to optimally process and react to everyday challenges. We have previously shown that experimental sleep restriction in young children reduces the cortisol awakening response, predicts self-regulation strategies, and moderates the association between response inhibition and behavioral self-regulation strategies. The aim of this study was to extend these findings by focusing on interactions between processing speed, a basic fundament underlying the cognitive skills associated with self-regulation, physiological stress reactivity, and sleep. We hypothesized that in 4-year-old-children stress reactivity would be associated with processing speed and that sleep would moderate this relationship.

Materials and methods: Healthy children ($n = 17$; 4.75 ± 0.1 years; 10 female) maintained an individualized sleep schedule for ≥ 5 days before baseline and acute sleep restriction (3 h bedtime delay) conditions. Under each condition, behavioral assessments that induced high cognitive load were administered in the late morning to mirror the time when children are in preschool. As part of this assessment, processing speed was measured as the latency to respond during a simple reaction time task. Salivary cortisol samples ($n = 6$) were taken before, during and after the assessment to capture the full stress response. Stress reactivity was computed as area under the curve with respect to ground (AUCg).

Results: Under the baseline condition, AUCg and mean processing speed were associated (r = 0.45; p = 0.05), indicating that children with slower processing speed had higher stress reactivity. When children were sleep restricted, however, we found no association between AUCg and processing speed (r = 0.05; p = 0.83). Furthermore, AUCg was marginally predicted by an interaction between sleep condition and mean processing speed (β = -1.92; p = 0.06). Thus, we found a trend for sleep moderating the association between stress reactivity and processing speed.

Conclusions: These results suggest that healthy sleep may promote the "coupling" of stress and cognitive systems in preschool age children, which is likely adaptive when facing everyday life challenges. In contrast not obtaining enough sleep may "decouple" these processes. Future studies can build upon these findings by examining the developmental trajectories of such integrative systems and incorporating individual difference factors (e.g., SES, chronotype) into a model that may eventually be applied in intervention approaches to sleep, stress and behavioral problems in preschool-aged children.

TO INVESTIGATE THE IMPACT OF SLEEP DEPRIVATION RELATED TO THE USE OF SCREEN-BASED MEDIA BEFORE SLEEP IN NEUROCOGNITIVE FUNCTION AMONG HEALTHY TEENAGERS: A PRELIMINARY STUDY

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Introduction: Cumulative studies reveal the pervasive use of screen-based media and the high prevalence of insufficient sleep among the youth and teens. Receiving sufficient and good quality sleep is integral to the optimal development, academic success, and overall well-being of adolescents. This study aimed to identifythe different aspects of the sleep habits related to both neurocognitive performance and ANS function.

Materials and methods: We recruited 10 college freshmen from the public schools in an urban area, including 7 females and 3 males. The participants were scheduled for a screening interview and a baseline evaluation in a sleep laboratory.The participants who passed the screening were instructed to accomplish the experimental requirements, including filling out sleep logs and wearing the light-sensing wrist actigraphy throughout the 7-day study period. After the one-week self-monitoring period, participants should complete a package of questionnaires, the tasks involving vigilance, attention, executive functions of the Cambridge Neuropsychological Test Automated Battery (CANTAB), emotion dot probe task and HRV assessment.

Results: The screen time prior to bed had significant correlation to longer sleep onset latency (r=.845, p=.017)and poor sleep quality measured by PSQI (r=.814, p=.014). Blue light intensity measured by light-sensing wrist actigraphy is associated with poor sleep quality(r=.855, p=.030). Furthermore, the relation of insufficient sleep duration with hypervigilance toward emotional pictures (r= -.685, p=.062) and poor executive function measured by OTS in CANTAB (r= .695, p=.058) had a trend toward significance.

Conclusions: Our study suggested the extent of screen time and the intensity of blue light were associated with sleep disturbances among teenagers. Moreover, electronic media may impair sleep and further hazard neurocognitive function, such as executive function, and anxiety state. These data broadly support policy action to limit screen use because of evidence of causing health harms across a broad range of domains of mental health.

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EPIDEMIOLOGICAL STUDY OF SLEEP DEPRIVATION, SLEEP HABITS AND SYMPTOMS OF SLEEP DISORDERS IN A SAMPLE OF HIGH SCHOOL STUDENTS FROM THE NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO (UNAM)

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Introduction: The symptoms of sleep disorders have a high prevalence in students and are directly related to comorbidities and low school development. We want to identify the prevalence of sleep disorder symptoms in a sample of high school students from UNAM.We think that there is a high prevalence of sleep disorders symptoms in the studied population.

Materials and methods: A sample of 1669 students (age average of 15.5 years, 47.2% male sex) was studied. A form was applied which included symptoms of sleep disorders, sleeping habits and the Epworth sleepiness scale; applied as part of the UNAM Automated Medical Survey. The data was analyzed with the SPSS version 16.

Results: We identified that 20% rated their sleep quality as $\leq$ 5/10, 31.2% sleep less than 6 hours, 28% obtained a subjective sleep efficiency of less than 85%, 27.3% obtained $\geq$ 7 points on the Epworth Scale, 26.9% had insomnia onset, 24% reported tiredness, 58.7% difficulty getting up, 8.7% snoring and 6.9% nightmares, 62.1% use the cell phone in bed, 24.3% do homework in bed and 17.6% sleep with pets in bed.

Conclusions: A high prevalence of insufficient sleep syndrome and of nocturnal and daytime symptoms associated with sleep disorders was identified, also, dysfunctional sleeping habits. Therefore, it is urgent to design intervention strategies to improve the quality of sleep in high school students.

Acknowledgements: The entire team of the sleep disorders clinic and the General Directorate of Health Care of the National Autonomous University of Mexico.

SUSTAINED ATTENTION PERFORMANCE DURING SLEEP DEPRIVATION AND FOLLOWING NAP: ASSOCIATED WITH TRAIT-LIKE VULNERABILITY

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Introduction: Sleep deprivation (SD) is known to be associated with cognitive performance deficit. Especially, vigilant attention is consistently and robustly affected by total SD. We tried to identify patterns of sustained attention performance degradation during total SD and whether napping opportunity following SD could improve psychomotor performance. In addition, we examined individual differences in vulnerability to SD using psychomotor vigilance task (PVT).

Material and methods: Thirty healthy adults (aged 19-25y; 16 females) participated in a 2-day laboratory study. Participants underwent 24-hr (6:00-6:00) total SD under constant environmental conditions and performed the 3-min PVT (PVT-B) for objective vigilant attention, the Stanford Sleepiness Scale (SSS) and visual analogue scale (VAS) for subjective sleepiness at 3-hr intervals. After 24-hr SD, subjects were randomly assigned to one of three conditions: no nap (No-NAP; n=10), a 30-min nap (30-NAP; n=10) and a 90-min nap (90-NAP; n=10). After taking a nap, the PVT-B, SSS and VAS were undertaken at 1-hr intervals. Stress-related hormonal responses (blood concentrations of cortisol, epinephrine, and norepinephrine) were also measured at baseline, pre- and post-nap.

Results: Taking a nap, irrespective of nap length, improved the subjective sleepiness (SSS: P=0.035, VAS: P=0.003), but, did not affect the sustained attention performance task assessed using mRT (mean reaction time) and lapse (number of reaction time>500ms) by the PVT-B. Subsequently, we categorized all subjects as vulnerable or resilient, based on median split of averaged PVT lapse during 24-hr sleep deprivation. In both vulnerable and resilient groups, mRT and lapse increased near habitual bedtime, and there were marked differences between two groups in the magnitude of sustained attention performance (mRT: P=0.006, lapse: P=0.038). However, there were no differences between vulnerable and resilient groups in self-related sleepiness assessed using SSS and VAS for sleepiness. There was also no significant difference in blood concentrations of cortisol, epinephrine, and norepinephrine.

Conclusions: Total SD led to worsening in subjective sleepiness and sustained attention performance. Taking a nap after SD cannot mitigate an impairment of vigilant attention performance, but subjective sleepiness. Degraded sustained attention performance showed marked trait-like individual differences in vulnerability to SD. Small individual differences in sustained attention at baseline are amplified during prolonged wakefulness, especially in habitual bed time.

LATE CHRONOTYPE AND DAYTIME SLEEPINESS ARE ASSOCIATED WITH CONSUMPTION OF COFFEE, ALCOHOL, AND SMOKING IN KOREAN HIGH SCHOOL STUDENTS

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Introduction: Evening chronotype has been associated with health problems and unhealthy life habits including alcohol and caffeinated beverage drinking and smoking. The purpose of this study was to investigate the association between chronotype and consumption of coffee, alcohol, and smoking in Korean high school students.
Materials and methods: A cross-sectional, school-based online survey was performed in 2011. A total of 26,593 students were recruited from 75 middle and 75 high schools to represent nationwide adolescents from 15 administrative districts in South Korea. Among 12,672 high school students recruited, students attending general-education high schools (excluding various special-purpose high schools), age of 15 or more, and age less than 19 were included. A total of 8,655 participants were met these criteria. The sleep habits on weekdays and weekends, consumption of coffee, alcohol, and cigarette, and private lesson attendances were evaluated using a questionnaire. Chronotype, daytime sleepiness, and internet addiction were assessed using the Morningness Eveningness Scale for Children (MESC), Epworth Sleepiness Scale (ESS), and Internet Addiction Proneness Scale for Youth. Logistic regression was applied to estimate the odds ratio (OR) of consumption of coffee, alcohol, and cigarette with sleep characteristics by adjustment for relevant covariates.
Results: Excluding 90 students with unreliable responses, a total of 8,565 students were included in the analysis. Female were 4,104 (47.9%). Age of the students was 16.77 ± 0.85 years. Coffee, alcohol, and cigarette was regularly consumed in 3,675 (42.9%), 732 (8.5%), and 576 (6.7%) students, respectively. MESC score of all participants was 24.51 ± 4.36 (median 25, range 11-41). The MESC score can be ranged from 10 (eveningness) to 43 (morningness). All participants were divided into 3 groups according to the 1st (11-22), 2nd (23-26), 3rd (27-41) tertiles of MESC score. In multivariate analyses, 1st tertile of MESC score (OR 1.29, CI 1.14-1.46), age (OR 1.22, CI 1.16-1.29), female gender (OR 1.10, OR 1.01-1.21), and ESS (OR 1.04, CI 1.03-1.05) were positively associated with coffee consumption. Weekday sleep duration (OR 0.85, CI 0.81-0.89) were negatively associated with coffee consumption. Alcohol consumption was associated positively with the 1st tertile of MESC score (OR 1.35, CI 1.09-1.66), weekday sleep duration (OR 1.18, CI 1.09-1.27), and ESS (OR 1.06, CI 1.04-1.09), and negatively with female gender (OR 0.41, CI 0.34-0.49). Similarly, smoking was associated positively with the 1st tertile of MESC score (OR 2.13, CI 1.67-2.72), age (OR 1.38, CI 1.24-1.54), weekday sleep duration (OR 1.18, CI 1.09-1.28), and ESS (OR 1.06, CI 1.03-1.08), and negatively with female gender (OR 0.21, CI 0.17-0.27). Attending private lessons was positively associated with coffee consumption, and negatively with alcohol consumption and smoking.
Conclusions: Late chronotype was independently associated with higher probability of

coffee, alcohol, or cigarette consumption. Female had more association with consumption of coffee, while male was more prone to consume the alcohol and cigarette. Daytime sleepiness was also positively associated with these consumptions in Korean high school students.

RELATIONSHIP BETWEEN THE SEVERITY OF COGNITIVE IMPAIRMENT AND SLEEP QUALITY

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Introduction: Poor sleep are considered as potential risk factor for cognitive impairment and dementia including mild cognitive impairment (MCI) and Alzheimer`s disease (AD). However, studies on the relationship between the severity of cognitive decline and the quality of sleep have been sparse. The aim of this study is to investigate the relationship between severity of cognitive decline and sleep quality in subjects with MCI and AD.

Materials and methods: Twenty eight subjects with MCI and seventeen subjects with AD are included in present study. All participants were analyzed their demographics and clinical dementia rating (CDR) scale. Lumbar puncture was conducted in all participants and CSF $A\beta_{1-42}$, t-tau, and p- tau levels were analyzed using commercially available ELISA kits. Sleep quality is assessed using medical outcome scale (MOS) sleep scale.

Results: Worse sleep quality (higher sleep disturbance score, sleep problem index score and PSQI score) was not associated with greater AD related pathology (lower level of CSF $A\beta_{1-42,}$ and higher levels of CSF t-tau, and p-tau). Interestingly, patients with more advanced stage of dementia showed better sleep adequacy and lower sleep problems.

Conclusions: The negative association between CSF AD biomarkers and sleep quality in patients with MCI and AD dementia in the present study seems to be incongruent with the previously reported poor sleep in cognitive healthy adults with greater AD-related pathology. Growing evidence has suggested that changes in sleep and CSF AD biomarkers are present early in the course of AD and precede the onset of cognitive symptoms. Furthermore, some previous studies showed an absence of correlation between sleep score and disease severity in MCI and AD dementia patients. Therefore, our finding may support that the cause of sleep disturbance in the status of AD dementia is multi-factorial, such as individual or genetic susceptibility, co-morbidities, and environmental conditions. A larger number of study needs to confirm these results.

THE EFFECT OF MOOD STATUS ON THE SUBJECTIVE-OBJECTIVE SLEEP DISCREPANCY IN HEALTHY YOUNG SUBJECTS: A MULTILEVEL MODELING APPROACH

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Introduction: It has been well known that subjective report of sleep duration is less accurate than objectively measured sleep duration. While this is particularly seen in elderly and patients with insomnia, the discrepancy between subjective and objective sleep duration does exist in healthy subjects. Predictors of the discrepancy between subjective and objective sleep duration in healthy young adults are yet to be elucidated. This study aimed to examine the associations between mood on awakening and the subjective-objective discrepancy in sleep duration in healthy young subjects using multilevel modeling approach.

Methods: We studied 25 healthy young subjects (17 males and 8 females; 20.7 ± 2.1 years, mean ± SD) over an eight-day period. The subjects wore a tri-axis accelerometer on the non-dominant wrist throughout the study period and objective sleep duration and sleep efficiency were obtained. The subjects also completed a daily questionnaire on awakening, which included questions about subjective sleep duration and sleep quality; depression and anxiety mood scale; and mood status or physical symptoms such as happiness, fatigue, sleepiness, stress, pain, anger, and lack of concentration. Multilevel modeling was used to examine the intra-individual associations between the subjective-objective discrepancy in sleep duration and subjective mood states on awakening. The difference in sleep duration was calculated by subtracting objective sleep duration from subjective sleep duration. The discrepancy was calculated as the absolute magnitude of the difference between subjective and objective sleep duration.

Results: The discrepancy between subjective and objective sleep durations was 42.7 ± 31.2 min while the difference in sleep duration was 8.6 ± 52.3 min. Happy mood on awakening significantly predicted the discrepancy between subjective and objective sleep duration ($p = 0.01$); none of the other mood or physical symptoms significantly predicted the sleep discrepancy ($p > 0.05$). On the other hand, the discrepancy in sleep duration did not significantly predict happy mood on awakening ($p > 0.05$). Neither objective sleep efficiency nor subjective sleep quality significantly predicted the discrepancy in sleep duration ($p > 0.05$). No association was found for the difference in sleep duration ($p > 0.05$). These results held true after controlling for age or gender.

Conclusion: The mood of happiness could be a predictor of the discrepancy between subjective and objective measures of sleep duration, but not vice versa, in healthy young subjects, suggesting that the specific mood status may underlie the cognitive processes concerning sleep state misperception. The results indicated that the mood status on awakening, or underlying physiological processes regulating the specific mood state, could be a potential intervention target to normalize the sleep state misperception. The results also have implications for epidemiologic studies examining the relationship between self-reported sleep duration and mortality and/or comorbidity.

DELINEATING THE ROLE OF OSA ON MILD COGNITIVE IMPAIRMENT PROFILES AND MEMORY RECALL PERFORMANCE IN OLDER ADULTS AT-RISK OF DEMENTIA

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Introduction: Obstructive sleep apnea (OSA) is present in approximately 20% of older adults and has been associated with higher risk of developing dementia. Previous studies suggest that OSA should be screened for in older people at risk of dementia. Yet, it remains unclear which OSA indices are of most significance in this population and whether these relationships differ between people with subjective memory complaint (SMC) and subtypes of mild cognitive impairment (MCI), including those with either amnestic or non-amnestic profiles. In this study we aim to identify OSA indices that best predict memory recall performance. Furthermore, we aim to determine whether the relationship between these identified indices differ between people with different cognitive profiles.

Materials and methods: One hundred and ninety-one participants with subjective cognitive and/or mood concerns, were recruited, including those with MCI. A full neuropsychological battery was completed and 64 participants were diagnosed with amnestic mild cognitive impairment (aMCI), 84 with non-amnestic mild cognitive impairment (naMCI), and 43 with SMC (no objective cognitive impairment). Participants then underwent overnight polysomnography (PSG) in a sleep laboratory. From each PSG, the following measures were extracted: Total sleep time (TST), apnea-hypopnea index (AHI, average number of apneas and hypopneas per hour), respiratory disturbance index (RDI, average number of apneas, hyponeas, and respiratory events related arousals per hour), oxygen desaturation index (ODI, average number of drops in oxygen saturation that is ≥3% per hour), and average time spent below 90% SpO2. While a complete neuropsychological battery was performed, the current study will only examine the delayed recall component of the Rey Auditory Verbal Learning Test (delayed recall of verbal memory).

Results: Individuals with aMCI were significantly older than SMC group (p< 0.05) but no other groups were significantly different (p>0.05). Mean TST was 357.6 ± 80.6 minutes, mean AHI of 16.7 ± 15.9/h, mean RDI of 22.6 ± 19.8/h, average ODI of 12.4 ± 15.55/h). Average time spent below 90% SpO2 was 6.1 ± 13.1 minutes). There were no significant differences in any of sleep variables between cognitive diagnosis groups (p>0.05). Delayed recall of verbal memory was significantly predicted by RDI (p< 0.05) after accounting for sex, age, years of education, and cognitive diagnosis groups, while AHI (p>0.05) and ODI (p>0.05) were not significant predictors in our stepwise regression model. Follow-up analysis revealed that only RDI during REM was correlated with delayed recall of verbal memory in aMCI group (r=-0.410, p=0.001), but not significant for any other groups (p>0.05). RDI during NREM was not correlated with recall memory in any group (p>0.05).

Conclusions: These findings suggest that RDI may be a better indication of verbal memory performance than AHI and ODI. Furthermore, RDI during REM sleep may be driving the relationship, especially in individuals with amnestic MCI.

24 HOURS OF SLEEP DEPRIVATION IMPAIRS ADAPTATION TO EMOTIONAL CONFLICTS: ERP AND BEHAVIORAL FINDINGS

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Introduction: Increasing research attention is drawn to the impact of sleep deprivation on conscious emotion regulation over the past decade, but few empirical studies examined its effect on implicit regulation of emotions such as emotional conflict adaptation, which refers to the ability to detect emotionally-salient distractor and subsequently inhibit distraction information, and is closely linked to mood symptoms. The current study investigated the influence of sleep deprivation on the ability to implicitly resolve emotional conflict.
Materials and methods: Twenty-four healthy participants, aged 18-29 years (mean=22.75, SD=2.68, 11 female), completed a counterbalanced, repeated measures study design involving a night of normal sleep control condition (SC) and a night of in-laboratory sleep deprivation condition (SD), after 6/7 days of monitoring by actigraphy and sleep diary. Following each condition, participants performed an emotional conflict task with electroencephalographic (EEG) recordings. Emotional faces (fearful/happy) overlaid with words ("fear"/"happy") were used as stimuli creating congruent or incongruent trials, and participants were instructed to indicate whether the facial expression was happy or fearful. The effect of previous trial type on processing of current incongruent trial was measured by the incongruent conflict adaptation effect (iI-cI), whereas its effect on current congruent trial was measured by the congruent conflict adaptation effect (cC-iC). Negative values indicated that behavioral adjustment on iI trial is faster than adjustment on cI trial, and the adjustment on iC trial is slower than adjustment on cC trial.
Results: For the across-trial response time measures, a 2 (condition: SC/SD) x 2 (conflict adaptation effect: congruent/incongruent) repeated measures ANOVA showed a significant interaction effect between condition and conflict adaptation, $F(1,23)=8.87$, p=.007. Follow-up analysis revealed that the interaction effect was driven by a significantly more positive reaction time difference score during adaptation on incongruent trials (iI-cI) in the SD group, mean difference=46.51, p=.004. Participants showed compromised conflict adaptation during incongruent trials after SD, as indicated by a slower performance on post-incongruent incongruent trials than post-congruent incongruent trials, but this was not observed in the SC group, p>0.5. For the P300 peak amplitude, a 2 (condition: SC/SD) x 2 (trial congruency: congruent/incongruent) repeated measures ANOVA was performed at the CPz electrode data. Results showed a marginally significant main effect of condition, $F(1,13)=4.58$, $p=.052$. There was also a significant interaction effect between condition and trial congruency, $F(1,13)=5.13$, $p=.041$. A post-hoc paired samples t test revealed that P300 amplitude during congruent trials was significantly higher in the SD group than the SC group, $t(13)=-2.47$, $p=.028$, suggesting that the SD group allocated more resources to congruent trials than the SC group.
Conclusions: This study provides the first evidence that SD may impair the regulation of emotional processing in the absence of explicit instruction. The SC group effectively regulated emotional conflict from trial to trial, even though they were unaware of having done so. In contrast, incongruent conflict adaptation did not emerge for the SD group, suggesting the role of sleep in implicit emotional conflict adaptation.

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THE INFLUENCE OF COGNITIVE EMOTION REGULATION STRATEGIES ON DEPRESSIVE SYMPTOMS IN BREAST CANCER PATIENTS

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Introduction: Depression is highly prevalent in breast cancer patients. The regulation strategy for cognitive emotion, the way how cancer patients regulate their emotions, is important to cope well with their stressful events. This study aims to investigate the influence of cognitive emotion regulation strategies on depressive symptoms of breast cancer patients.

Materials and methods: We have reviewed medical records of 119 breast cancer patients retrospectively. Psychiatric assessment was done using Patient Health Questionnaire-9 (PHQ-9), Insomnia Severity Index (ISI), State subcategory of State and Trait Anxiety Inventory (STAI-S), Cancer-related Dysfunctional Beliefs about Sleep (C-DBS), Fear of Progression (FoP), and Cognitive Emotion Regulation Questionnaire (CERQ).

Results: Significant differences in C-DBS, ISI, FoP and regulation strategies of CERQ were observed between depressed groups (PHQ-9 $\geq$ 10, n=60) and non-depressed groups (PHQ-9 < 10, n=59, $p < 0.05$). The PHQ-9 score correlated with C-DBS, ISI, FoP, all maladaptive strategies except blaming others, and negatively correlated with most adaptive strategies excluding refocus on planning ($p < 0.05$). Linear regression analysis revealed that patients' depression was predicted by high score of ISI, FoP, low acceptance and high catastrophizing item scores.

Conclusions: This study demonstrated that depression of cancer patients was associated with their cognitive emotion regulation strategies. It is helpful to discuss with patients about their coping strategies to improve cancer patients´ depression.

24 HOURS OF SLEEP DEPRIVATION DOES NOT SHOW SIGNIFICANT IMPACT ON SOCIAL DECISION MAKING AMONG HONG KONG YOUNG ADULTS

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Introduction: Sleep deprivation (SD) has long been known to have a negative impact on cognitive functions. However, how sleep deprivation may influence social functions and the underlying neural mechanism is less explored. Previous studies have controversial findings on whether sleep deprivation will have an effect on decision-making tasks and only one study found that 36-h SD has negative impact on social decision making. Therefore, the current study aimed to investigate the effect of 24-h sleep deprivation on social decision making and its neural basis.

Materials and methods: Study 1: Thirty-five healthy young adults aged 18-29 years participated in the study and were randomly assigned to either SD or normal sleep (NS). Following a week of habitual sleep with acti-graph and sleep diary, participants went through a three-day experimental protocol. After one night of NS or SD, participants were told to distribute \$100 between himself/herself and their assigned partners on the Trust Game. They were also asked to decide whether to accept or reject 10 offers of a split of \$10 each by previous participants on the Ultimatum Game. Study 2: Thirty-one healthy participants, aged 18-29 years completed a counterbalanced, within-subject repeated-measure study design involving a night of NS and a night of SD. The experimental protocol was the same as Study 1. Electroencephalographic (EEG) data was additionally collected for 8 minutes during resting state on the last day. Frontal alpha asymmetry and slow wave/fast wave ratio in frontal sites (F3, F4, Fz) were two EEG indices that were of interest.

Results: Study 1: Participants of the SD group were sleepier ($t(33)=5.10$, $p< 0.001$) and less vigilant ($t(33)=3.99$, $p< 0.001$) than the control group. However, there was no significant group differences in the amount of money offered in the Trust Game (TG) and in the accepting rate in the Ultimatum Game (UG). Study 2: Participants in the SD condition were sleepier ($t(30)=-8.878$, $p< 0.001$) and less vigilant ($t(30)=-2.344$, $p< 0.005$) than the control condition. However, there was no significant group difference of participants' decisions in both games. Frontal alpha asymmetry in the NS group (M = -0.094, SD = 0.12) was similar to that in the SD group (M = -0.036, SD = 0.136). When comparing the SW/FW ratio between two groups, there was no main effect of group ($F_{1,17}= 0.073$, p = 0.790, $\eta_p^2 = 0.004$) or of site ($F_{2,34}= 21.915$, p < 0.001, $\eta_p^2 = 0.563$), indicating one night of SD did not have an impact on emotion-related EEG indices.

Conclusions: The current study adopted both within-subject design and between-subject design, but both showed no significant effect of 24-h SD on EEG indices and social decision making, a social function that may not be as changeable as cognitive functions. It is possible that as social beings, we have developed the ability to regulate our emotions and social cognitions in a well-controlled interactive environment, thus 24-h SD does not induce measurable changes in social decision-making processes.

Behavior, Cognition and Dreaming
Board #055 : Poster session 2
HYPERSOMNOLENCE AND COGNITIVE PERFORMANCE IN OLDER ADULTS: CROSS-SECTIONAL ANALYSIS OF THE CANADIAN LONGITUDINAL STUDY ON AGING

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Introduction: Hypersomnolence has been shown to be associated with dementia onset, but the mechanisms that link hypersomnolence and cognitive decline among healthier individuals remain relatively unknown. Thus, we aim to quantify the association between hypersomnolence and performance on neuropsychological tests within the older adult population not known to be suffering from dementia.
Materials and Methods: The baseline data for the Comprehensive Cohort of the Canadian Longitudinal Study on Aging (CLSA), a sample of 30,097 of the Canadian population between ages 45-85, were used. Hypersomnolence was classified according to the DSM-5 criteria, based on participant reports of sleep patterns. Cognitive performance tests captured memory through the Rey Auditory Verbal Learning Test (RAVLT); executive functioning through the Controlled Oral Word Association Test (COWAT), Time-based & Event-based Prospective Memory Test (TMT+PMT), Mental Alternation Test (MAT), Animal Fluency Test (AFT), and Victoria Stroop Test (VST); and psychomotor speed through the Choice Reaction Time Test (CRTT). We conducted a logistic regression analysis, where in order to identify clinically relevant indication of potential cognitive impairment, the continuous outcome was dichotomized by taking the worst performing individuals outside of 1 standard deviation from the mean as 'Impaired Cognitive Performance' and the rest as 'Not impaired' after adjusting for age, sex, and education. We also conducted sensitivity analyses on the sub-group without possible sleep apnea symptoms.
Results: Hypersomnolence was associated with worse performance in executive functioning, including verbal fluency, processing speed, and cognitive flexibility. Regression models showed worse test scores in the COWAT (OR=1.53, 95% CI=1.22-1.92), AFT (OR=1.26, 95% CI=1.00-1.59), and MAT (OR=1.38, 95% CI=1.10-1.73) as well as longer task completion time for the Dot (OR=1.53, 95% CI=1.22-1.93), Word (OR=1.42, 95% CI=1.13-1.79), and Interference (OR=1.56, 95% CI=1.26-1.94) tasks of the VST. Hypersomnolence was not associated with delayed recall or choice reaction time. Within the sub-group who did not report symptoms of sleep apnea, the degrees of association remained similar. Hypersomnolence was associated with impaired cognitive performance in RAVLT immediate recall (OR=1.42, 95% CI=1.04-1.94) but not in MAT (OR=1.21, 95% CI=0.90-1.62) in this sub-population.
Conclusions: In a large population study, among individuals without dementia, hypersomnolence was found to be associated with worse cognitive performance. There were only small changes in the strength of associations in the absence of possible sleep apnea symptoms, but memory retention and psychomotor speed could be explained by factors other than hypersomnolence.

ALCOHOL INTOXICATION = SLEEP DEPRIVATION? FROM "BEER- TO VIGILANCE-PONG": A NOVEL COMMUNICATION CONCEPT FOR SLEEP HEALTH ADDRESSING YOUNG PEOPLE

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Introduction: Alcohol consumption and sleep deprivation have similar effects on hand-eye coordination (HEC). Sleep deprivation impairs vigilance (the ability to sustain attention) and increases injury/accident risk. In 2018, high-school students at the Vancouver Summer Sleep School created a "Sleep Health Communication Concept" in order to disseminate knowledge among youth with "Vigilance-Games"; the first game suggested was "Vigilance-Pong", analogous to "Beer-Pong". We investigated the suitability of "Vigilance-Pong" in a knowledge dissemination concept.

Materials and methods: A. A literature review was conducted on Medline and PubMed to identify the most common method for measuring changes in HEC (search phrase): "alcohol" AND "fatigue" AND ["performance" OR "hand-eye coordination"].
B. "Vigilance-Pong", as initially suggested, was played by 12 lab-members at a pilot-run. The number of balls successfully tossed into a Pong-set was used as a measure of HEC. For assessing fatigue, we used the Karolinska Sleepiness Scale (KSS) and selfies; for assessing fatigue-affected-HEC, we used video recordings (camera facing participants). All data, except videos and selfies, were recorded in a customized digital-survey-tool (Qualtrics) on participants' mobile devices.
C. A Strength-Weakness-Opportunity-Threat (SWOT) analysis was conducted for the initial game and potential adaptation.

Results: A. 317 articles were identified; 7 RCTs assessing HEC under influences of both alcohol and fatigue were reviewed. Results show that 24-hours awake is equivalent to 0.10% blood alcohol content. The most common testing methodology for HEC was computerized tracking, which involves centering a cursor on a constantly moving target.
B. Self-experience at the pilot-run revealed that the game set-up was operational and the association to alcohol sparked major interest. To account for experience levels, participants suggested a fixed number of throws, instead of limiting with a timeframe, and the inclusion of practice throws. Although selfies were encouraged, they were not collected for data analysis. Scores from the KSS generally remained similar, with slight fluctuations of 1 or 2 units in 3 participants. Quality of the video recordings allows movement analysis with customized movement analysis software.
C. "Vigilance-Pong" - S: effective communication strategy; W: HEC-measurement not standardized; O: appealing for addressing adolescent/young drivers in a prevention campaign; T: based on North American alcohol-education-culture, might be perceived negatively. Tracking - S: based on literature; W: insensitive to moderate levels of fatigue; O: simple instructions; T: unengaging.

Conclusions: Based on the SWOT analysis, "Vigilance-Pong" retained its original procedures, but was adapted to incorporate participant suggestions. The adapted game takes approximately 2-minutes to complete and the setting allows collection of valuable HEC-information. Participation in "Vigilance-Pong" and reviewing changes in HEC in context

with the KSS and selfies is a unique way for communicating sleep health. Most importantly, the game's similarity to alcohol consumption, use of selfies for personal reflection of affected behaviours and its appropriateness for different ages raises lively discussions on accident prevention in the context of athletic/occupational injuries. The equation "Sleep Deprivation = Alcohol Intoxication" might be a new way to communicate the hazardous effects of sleep deprivation to youth and adults.

COMMUNICATING SLEEP HEALTH WITH A VIGILANCE TOOLBOX: REVIEW OF THE CLINICAL TEST "TASK-SWITCHING PARADIGM" AS A POSSIBLE "VIGILANCE GAME"

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Introduction: Vigilance (the ability to sustain attention) fluctuations in response to circadian rhythm and acute sleep deprivation increase the risk of preventable injuries. In 2018, high-school students at the Vancouver Summer Sleep School created a "Sleep Health Communication Concept" in order to disseminate knowledge among youth with "Vigilance-Games"; Timed Simple Math (TSM) was created to communicate the interaction between Cognitive Flexibility (the ability to switch between different mental tasks; CF) and sleep. We investigated TSM's suitability as a knowledge dissemination tool.

Materials and methods: A. A literature review was conducted on Medline and PubMed to identify the most common method for measuring CF under the influence of sleep deprivation (search phrase): "sleep*" AND ["cognitive flexibility" OR "task switching"].

B. TSM, as initially suggested, was investigated by 12 lab-members at a pilot-run. TSM consisted of 8 elementary-level math questions organized into 2 sets - set 1: same operation; set 2: multiple operations. For assessing task-switching speed and accuracy, difference in completion time and correctness between the 2 sets was measured and recorded in a digital survey tool (Qualtrics) on participants' mobile devices. For assessing fatigue, the Karolinska Sleepiness Scale (KSS) and selfies were used; for assessing fatigue associated vigilance fluctuations, video recordings were used to capture facial appearance.

C. A Strength-Weakness-Opportunity-Threat (SWOT) analysis was conducted for the original and the adapted game.

Results: A. the Task-Switching Paradigm (TSP; https://www.psytoolkit.org/experiment-library/taskswitching.html) was used by 16/172 articles assessing CF under fatigue. TSP consists of repetitive mental tasks (either A: categorizing a letter as consonant or vowel, or B: categorizing a digit as odd or even) and switching (A & B) trials.

B. Math operations as vigilance tests are unstandardized; self-experience revealed that TSM's data collection method was well organized. KSS scores pre- and postgame generally remained the same; changing by +/-2 for only three participants. Although selfies were encouraged, they were not collected for data analysis. Quality of the video recordings allows movement analysis with customized movement analysis software.

C. TSM - S: organized data entry method, tasks were not repetitive; W: unstandardized testing method; O: 'fun' discussion about testing; T: high performance may be due to ability. TSP-test - S: standardized testing method; W: significant practice effect; O: displayed scores lead to competitive atmosphere; T: results affected by participant engagement.

Conclusions: According to the results of the SWOT analysis, TSP was chosen. The downloadable TSP-test measures Switch Cost (reaction time difference between task-repetition & task-switching), and can be used at home or in school, allowing participants to review the direct effects of sleep on vigilance and performance. The TSP-test takes approximately 4 minutes, allows multiple measurements (e.g. morning, noon and before school ends), and is less affected by individual ability (in comparison to TSM), but engagement and practice. The application of the TSP-game supports the creation of a

"Vigilance Toolbox", enabling self-assessment of own vigilance. The computed data collection allows creation of machine learning algorithms for detection of vigilance fluctuations.

SLEEP FRAGMENTATION AND INTELLIGENCE QUOTIENT OF EXECUTION RELATIONSHIP IN SCHOLAR CHILDREN

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Introduction: The school phase is a period of great learning for children, related to different stimuli from the environment, new friendships and access to more information. The learning, acquisition of new knowledge, is possible through the consolidation, during the continuous sleep, of the memories obtained in the waking periods. The fragmentation of sleep negatively influences the cognitive and motor performance of the child. Thus, school children, need a good night´s sleep and a full day of activities for adequate performance in the studies. The objective of this research was to identify the relationship between the fragmentation of the activity-rest rhythm and the intelligence quotient of execution in school children.

Casuistic and Method: Cross-sectional study was developed with children enrolled in a private educational institution in São Paulo, Brazil, from the first to the fourth year of elementary education. Between August and November 2018, the Wasi-II test was applied and an actimetry sensor (ActTrust®) was maintained in the non-dominant upper limb of the child for 15 consecutive days. The variables analyzed were related to the children´s characterization, activity-rest rhythm fragmentation and execution intelligence quotient. The Wasi-II tests were analyzed by a psychologist and the data obtained by the actimetry sensor were analyzed in the software ActStudio©. Statistical analysis was performed using SPSS Statistics 2.0 using the mean, standard deviation and the GLzM test to analyze the non-parametric data ratio, considering significant values of $p \leq 0.05$.

Results: Fourteen children were analyzed, the half were boys, with a mean age of 7.55(±1.09) years. The mean values of activity-rest rhythm fragmentation were 0.61(±0.07) and the Intelligence Quotient of Execution mean was 103.7(±18.73), with no significant relationship between these variables (p=0.353). Although no difference statistically significant was identified in this sample, it was possible to demonstrate that children with higher values of activity-rest rhythm fragmentation showing lower Intelligence Quotient of Execution values (OR=1.891).

Conclusion: We found an inversely proportional relationship between activity-rest rhythm fragmentation and the Intelligence Quotient of Execution among children in the school phase, which indicates a worse execution performance of children with fragmented sleep.

EFFECTS OF PROLONGED WAKEFULNESS AND DISTRACTION ON SIMULATED DRIVING PERFORMANCE

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Introduction: This study examined the combined effects of drowsy driving and distracted driving, two of the most preventable causes of motor vehicle crashes. Since prolonged wakefulness reduces attentional capacity and distractors cause competition for attentional resources, it was predicted that the negative consequences of prolonged wakefulness and distraction would combine, producing more profound effects on driving performance than either alone. Based on the literature, it was also predicted that visual distractors would produce greater decrements in driving performance than a cognitive distractor, that text-based signs would produce more deterioration than symbol-based signs, and that dual distractors would have a greater effect than individual distractors.

Materials and methods: Participants (19F; 13M; Mean age = 22.0y) completed four simulated 30-minute driving sessions in the York Driving Simulator at 2400, 0200, 0400 and 0600. Stanford Sleepiness and Fatigue Scale ratings were obtained before and after each session. The distractor tasks included text- and symbol-based road signs and an addition task which required participants to add seven single-digit numbers and indicate whether the sum was odd or even by pressing buttons on the steering wheel. The distractor tasks were presented as text based signs alone, text based signs plus the addition task, symbol based signs alone, symbol based signs plus the addition task, and the addition task alone. They occurred at random intervals throughout the drive but with each task occurring once in each five-minute period. Prior to the occurrence of the roadside signs, participants were instructed to look for a particular text or symbol and indicate its presence by pressing a button on the steering wheel. The effect of distractors was assessed by comparing driving during the 30m adjacent to the distractor with that during the previous 30m which acted as a baseline.

Results: Sleepiness and fatigue increased as wakefulness was prolonged (p< 0.001). Mean speed (p< 0.001) and road position variability (p< 0.002) increased with prolonged wakefulness. While the presence of distractors produced a number of effects on driving performance including changes in road position (p< 0.001), road position variability (p< 0.001), speed (p< 0.001), and speed variability (p=0.035), contrary to hypothesis prolonged wakefulness did not produced an additive effect.

Conclusions: The principle hypothesis was not supported possibly because the distractor tasks had an alerting effect on participants. Partial support was found for the specific predictions about distractor effects. Overall, text-based road signs produce greater deterioration in driving performance, an effect which is exacerbated in the presence of the addition task.

FURTHER EXAMINATION OF THE EFFECTS OF PROLONGED WAKEFULNESS ON RISK TAKING IN A DRIVING SIMULATOR

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Introduction: In a previous study we demonstrated that, consistent with the literature, prolonged wakefulness increased risk taking in men but not women (MacLean and Banwell, Canadian Sleep Society, 2017). It is also known that even partial sleep deprivation decreases the ability to respond to unusual or unexpected events. The present study investigated the hypotheses that prolonged wakefulness would increase risky driving and would impair drivers' capacity to avoid a pedestrian walking out from parked cars. In addition, we investigated the hypothesis that an incentive to complete the driving course as quickly as possible would increase risk taking.

Materials and methods: Participants (24F; 12M; Mean age = 20.3y) completed four simulated 30-minute driving sessions in the York Driving Simulator at 2400, 0200, 0400 and 0600. Stanford Sleepiness and Fatigue Scale ratings were obtained before and after each session. Risk taking was assessed by having participants turn left through a stream of oncoming traffic. Three levels of risk were created by varying the distance between cars in the oncoming stream. Risk taking was measured by the amount of time participants waited before turning and by the number of vehicles they allowed to pass before attempting to turn. Response to unexpected events was measured by reaction time to a pedestrian crossing the street in front of the participant's car and by the number of times the pedestrian was struck by the simulation vehicle. In order to encourage participants to complete the drive in as short a time as possible there was an opportunity to win $200 based on performance. The more quickly participants completed each drive the more points they received although points were also deducted for driving infractions.

Results: Sleepiness and fatigue increased as wakefulness was prolonged (p< 0.005). While mean speed (p=0.009), and variability in speed (p=0.034) and road position (p< 0.0005) increased with prolonged wakefulness, contrary to hypothesis risky driving did not increase as measured by either the time participants took to turn across the traffic stream (p=0.271) or by the number of cars they allowed to pass before turning (p=0.105). Again contrary to hypothesis, prolonged wakefulness did not affect the response time to the appearance of a pedestrian (p=0.230). The probability of a pedestrian being struck was partially consistent with the hypothesis; for the four test times the probabilities were, respectively, 0.22, 0.11, 0.19, 0.28. All are significantly greater than 0.00 (p< 0.05).

Conclusions: Contrary to hypothesis, neither prolonged wakefulness nor an incentive increased risky behaviour. Possibly, the incentive actually produced more careful driving because participants wished to avoid losing points for driving infractions. The high probability of a pedestrian being struck at 2400 may be due to insufficient practice; what is more concerning is the increased probability of a pedestrian collision as wakefulness was prolonged.

THE EFFECT OF OLFACTORY STIMULATION ON NEURONAL ACTIVITY IN DREAMING DURING NREM 2 STAGE OF SLEEP AND SENSORY PERCEPTION DURING DREAMS

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Introduction: Dreams are vivid experiences that occur in both non rapid eye movement (NREM) and rapid eye movement sleep. Neuronal correlates of dreaming have been widely researched along with sensory perception that occur dreams. It is known that sensory stimulation, such as olfactory stimuli might affect sleep in terms of its quality. The aim of this study is to investigate the effect of olfactory stimulation on NREM 2 stage of sleep and on sensory perception in dreams.

Methods: 60 healthy adults (24 women; age 24.14 years) were included in our study. They underwent 3 video-polysomnography nights (vPSG) during which they were either exposed to vanillin (OdorV), thioglycolic acid (OdorTh) or placebo (w/o Odor). Participants were awaken during second half of the night and in the morning and they were presented with questionnaires assessing qualitatively the content of dreams and their subjective perceptions in dreams. In order to analyse power spectra we selected 2-minute intervals of 19-channel electroencephalography (EEG) recordings captured during vPSG and determined standard frequency bands. We compared power spectra in selected EEG samples in all three groups. For statistical evaluation of power spectra analysis we used permutation tests of Fieldtrip toolbox for Matlab. For each sample, conditions were compared using t-values. To correct the false alarm rate, we used Bonferoni´s correction. For the rest of our comparisons we used non-parametric Kruskal-Wallis test.

Results: We found statistically significant increase in delta power and decrease in alpha and beta over all scalp in subjects who experienced dream and were exposed to negative odorant (OdorTh) when compared to positive odorant (OdorV). Increase in delta power and increase in fast frequencies for dreams in OdorTh was also found when compared to w/o Odor. Exposition to positive odorant did not lead to statistically significant changes in EEG when compared to w/oOdor. Statistically significant increase in delta and decrease in alpha and beta power was found in other modalities (hearing, vision and touch) in OdorTh compared to OdorV and to w/o Odor. Positive odorant did not produce statistically significant changes in EEG in these modalities. We did not have enough data to analyse other sensory perception (pain, vestibular, smell, taste). Subjective assessment of dream emotional charge or pleasantness of dreams assessed for every modality did not differ between groups (w/oOdor, OdorV, OdorTh)

Discussion: Our results indicate that both positive and negative olfactory stimulation affect neuronal activity in dreaming during NREM 2. Our data indicate that exposition to negative odorant might have grater impact on neuronal activity in dreams that exposition to positive odorant. However, this has only a limited impact on pleasantness during dreams and emotional charge in them. Thus, further research is needed to explore the effect of olfactory stimulation on sleep and particular sleep stages to elaborate on clinical potential of these findings.

MORE SLEEP TIME HAVING IMPACT ON LOWER SUICIDAL BEHAVIORS IN AGRICULTURE POPULATION: USING STUDY OF PREVENTING FOR AGRICULTURAL INJURY OF FAMERS COHORT OF JEJU ISLAND, SOUTH KOREA

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Introduction: As the country develops, the number of the population employed in agriculture tends to decrease. However, agriculture is still an important industry because it contributes to preventing hunger and nutritional deficiencies by producing foodstuffs, which is essential for the sustenance of life. Suicidal behaviors, such as suicidal ideation, planning or attempt tends to be considered as a psychiatric emergency, and the agriculture population is known to be at greater risk of suicide than general employed people in several previous studies. This study was conducted to identify the association between sleep time and suicidal behaviors in the agriculture population on Jeju Island, South Korea.
Materials and methods: We utilized the Study of preventing for Agricultural Injury of Famers cohort collected from September 2015 to June 2018, which was a survey data on the health and behaviors of the adult agriculture population of Jeju Island, South Korea. Univariable analyses were performed to determine the relationship between suicidal behaviors and the variables including sociodemographic factors, health behavior/status, psychiatric conditions and sleep time. Subsequently, we performed multivariable analyses to identify the independent effects of sleep time on suicidal behaviors.
Results: A total of 964 participants were included in the analysis, and 3.8% of them were identified as having suicidal behaviors (suicidal ideation, planning or attempt). The average sleep time of all participants was 6.4 ± 1.5 h in a day, and it was shorter in individuals with than without suicidal behaviors (5.7 ± 1.5 h vs. 6.5 ± 1.5 h, p=0.001). Multivariable analyses revealed that sleep time was significantly negatively associated with suicidal behaviors (adjusted odds ratio= 0.52, 95% confidence interval=0.34-0.80).
Conclusions: Our findings suggest that the more sleep time result in the lower suicidal behaviors in agriculture population.Therefore, proper evaluation of sleep time should be required, and it is important to control the factors associated with short sleep time to reduce the suicidal behaviors in the agriculture population.

RESTORATION OF A WAKE-LIKE STATE DURING EXPOSURE TO SEVOFLURANE ANESTHESIA DOES NOT RESTORE CORTICAL FUNCTIONAL CONNECTIVITY

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Introduction: We recently demonstrated that carbachol-mediated cholinergic stimulation of the prefrontal cortex in rat induced a wake-like state despite continuous administration of the general anesthetic sevoflurane. Similar delivery of carbachol into posterior parietal cortex or delivery of noradrenaline into prefrontal or posterior parietal cortices in sevoflurane anesthetized rats failed to induce a wake-like state. We have previously demonstrated that functional connectivity in high gamma bandwidth (85-155 Hz) is a correlate of wakefulness and depressed during anesthesia or sleep. Therefore, we hypothesized that pharmacological restoration of a wake-like state during exposure to anesthesia would also restore depressed functional cortical connectivity. In this study, we used the electroencephalographic data collected during successful and unsuccessful reversal of anesthesia to study the concurrent changes in cortical connectivity in the gamma frequency bandwidth [low gamma (25-55 Hz), medium gamma (85-125 Hz), and high gamma (125-155 Hz)].

Materials and methods: Monopolar electroencephalogram from frontal, parietal, and occipital cortices was recorded between 0.1-300 Hz (sampling rate 1 kHz), and analyzed using two different measures of functional connectivity: 1) corticocortical coherence, quantified using the magnitude squared coherence method with 'mscohere.m' function in MATLAB signal processing toolbox (MathWorks Inc., Natick, MA, USA) and Welch's averaged-modified periodogram method; and 2) frontal-parietal directed connectivity, analyzed using normalized symbolic transfer entropy, which is an information theoretic measure and is considered a surrogate for directed cortical communication.

Results: Compared to the baseline wake state, sevoflurane-induced unconsciousness was characterized by a significant reduction (p≤0.006) in the cortical coherence and frontal-parietal connectivity in the medium and high gamma bands in all experimental groups. Carbachol delivery into prefrontal cortex of sevoflurane-anesthetized rats was shown to produce a wake-like state but the analysis of the electroencephalogram in the same data epoch showed that, despite the induction of a wake-like state, the corticocortical gamma (medium and high) coherence or the frontal-parietal connectivity were not statistically different from that observed during sevoflurane anesthesia (p≥0.09), and remained significantly reduced as compared to the baseline wake state (p≤0.001). Delivery of carbachol into posterior parietal cortex or noradrenaline into prefrontal and posterior parietal cortices during sevoflurane anesthesia was not reported to produce any signs of wakefulness and was unable to restore the gamma (medium and high) coherence or the frontal-parietal connectivity, which remained significantly low (p≤0.001) as compared to baseline wake state. The changes in cortical coherence and frontal-parietal connectivity in the low gamma band were widely variable.

Conclusions: The level of consciousness can be dissociated from cortical functional connectivity in high-gamma bandwidths, suggesting that depression of connectivity in higher-frequency oscillations correlates with presence of anesthetic drug in the brain rather than the state of general anesthesia.

IMMEDIATE AND DELAYED EFFECTS OF TARGETED MEMORY REACTIVATION DURING SLEEP ON PROCEDURAL LEARNING AND DREAM CONTENT

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Introduction: Memory replays during sleep can be triggered by replaying a stimulus associated with prior learning, a method known as targeted memory reactivation (TMR). Whether TMR is beneficial for whole-body motor learning and whether it influences dream content is still unknown. Our study aims to enhance procedural learning of a virtual reality (VR) flying task with auditory TMR and assess if and how dream content is influenced by it.
Materials and methods: A total of 97 healthy participants (23.9±3.9yrs old; 62F) took part in the VR task prior to and following a polysomnographically-recorded morning nap or resting period, during which task-associated tones were either replayed in NREM sleep (N=20), in REM sleep (N=20), in wake (N=13) or were absent (N=20; Control-sleep, N=19; Control-wake). Our room-scale procedural task involves flying through a circuit of rings in a virtual environment as precisely and quickly as possible, to engage spatial, vestibular and motor systems. Dream reports were collected upon REM sleep awakening, as well as for the five days prior to and ten days following the visit to the laboratory. Two independent judges rated dreams on whether they incorporated visual or kinesthetic elements of the task.
Results: While all groups significantly improved at the task after either a nap or a resting period, the group stimulated in REM sleep improved significantly more (+24%) than the Control-sleep group (+13%) (p=.012). Across all sleep groups, participants incorporating kinesthetic elements similar to the VR task (e.g. flying, floating, driving fast) into their dreams showed more improvement than did those without incorporation, while those who dreamed about static visual elements of the task (e.g., landscapes) did not differ. Contrary to our expectations, the presence of TMR stimulation during naps did not enhance dream replays of the VR task. However, a delayed effect on dream content was observed: participants dreamt more about the task 1-2 days (day residue, p=.016) or 5-6 days (dream-lag effect; p=.031) after TMR was applied in REM and NREM sleep, respectively, compared to the Control-sleep group.
Conclusions: These results suggest that TMR applied during REM sleep influences complex, sensorimotor skill performance. Independently of TMR, dreaming about kinesthetic elements of a procedural task is also associated with performance. While TMR may not directly shape dream content in the form of memory replay, delayed effects on dream content may reflect steps in memory consolidation that unfold over several days. Findings may help explain observed temporal relationships between dreaming and memory replays and contribute to the development of new sleep-based methods that use VR to optimize motor memory.

COGNITIVE PERFORMANCE AND BRAIN ACTIVATION RECOVERY AFTER A NAP FOLLOWING TOTAL SLEEP DEPRIVATION

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Introduction: Sleep deprivation (SD) has negative consequences on cognitive function, it affects alertness and attention, and is associated with alterations of brain activity. Research has focused on the effect of SD on brain functions in relation to cognitive performance. However, little is known about the immediate effects of recovery sleep after total SD on brain functions.

Materials and Methods: 19 young good sleepers (mean age 21, 12 female) underwent 2 simultaneous high-density EEG/fMRI morning visits, separated by one week and the order counterbalanced across participants. One visit consisted of two EEG/fMRI sessions: following a night of total sleep deprivation (Total SD) and after a 1h recovery nap opportunity (After nap). The other visit consisted of a single EEG/fMRI session after a night of regular sleep (Non-SD). Both nights took place in a controlled sleep laboratory environment.

MRI was acquired on a 3T GE scanner simultaneously with MR compatible high-density EEG (Electric Geodesic Inc, 256 electrodes). Each session comprised a set of T2*-weighted functional images (TR 2500ms, resolution 4mm) and T1-weighted images (TR 7908ms, resolution 1mm) acquired for co-registration purposes. EEG during the nap was used to monitor sleep and automatically detect sleep spindles during NREM2-NREM3 sleep. In each scanning session, three cognitive tasks were performed: a psychomotor vigilance task (PVT), a working memory task (N-back), and an attention network task (ANT).

Percentage of correct responses were entered into repeated-measures ANOVAs followed by post-hoc t-tests. fMRI activation was detected using standard GLM analysis in SPM12. For each task, the 3 sessions and contrasts of interest within- and between-sessions were entered at the first-level, and one-sample t-tests were used at the group-level (threshold $T > 4$, $p < 0.001$ uncorrected).

Results: Mean nap duration was 50 ± 12min, mean sleep spindle density was 10 ± 4 spindles/min. After Total SD, performance at all tasks significantly decreased (Total SD *vs.* After nap and Total SD *vs.* Non-SD $p < 0.05$). The nap allowed recovery of performance (After nap *vs.* Non-SD $p > 0.05$). Performance recovery did not correlate with sleep duration in all tasks, but performance recovery in the ANT was positively correlated with spindle density (Pearson's $r = 0.46$, $p = 0.05$).

The PVT activated fronto-parietal (middle frontal gyrus, superior parietal lobe) and ventral attention (medial part of the middle frontal gyrus, insula) networks. The ANT activated the ventral attention (middle cingulate and insula), dorsal attention and fronto-parietal (inferior parietal lobe) networks. The N-back task activated the dorsal attention (middle frontal and inferior parietal) and fronto-parietal (inferior frontal gyrus, medial superior frontal gyrus) networks. In accordance with task performance, brain activity in the task-related networks was lower after Total SD and recovered after the nap. However, activations in regions of the somatomotor and dorsal attention networks only partially recovered after the nap in the ANT.

Conclusions: SD strongly and non-specifically affects cognitive performance and alters

brain activity in psychomotor, working memory and attention domains. A 50-minute nap following SD allows cognitive performance recovery. However, fMRI activity levels in some regions did not completely recover, which might explain the interindividual variability in performance recovery after the nap.

THE RELATIONSHIP OF NIGHTMARES, INSOMNIA, CATAPLEXY, MIRROR BEHAVIORS, AND PSYCHOLOGICAL DISTRESS TO SUICIDAL IDEATION IN UNDERGRADUATE STUDENTS

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Introduction: Mirror behaviors represent the tendency to imitate another person's actions or emotions. Previous research has shown that frequent engagement in mirror behaviors is related to a propensity toward nightmares. Insofar as nightmares are also associated with suicidal thoughts and self-harm, mirror behaviors may likewise be associated with suicidal ideation and behaviors.
Materials and methods:
Undergraduate university students (N = 470) completed an online survey that assessed various aspects of sleeping, dreaming, and psychological functioning.
Results: In the primary analysis, frequency of suicidal ideation was found to be positively correlated with nightmare frequency, insomnia, psychological distress, and mirror behaviors (all $p < .001$). In step 1 of a hierarchical regression analysis, nightmares ($\beta = .217$, $p < .001$), insomnia ($\beta = .164$, $p = .001$), and mirror behaviors ($\beta = .118$, $p = .018$) were each uniquely predictive of suicidal ideation; when psychological distress was added in step 2 of the analysis, only nightmares ($\beta = .140$, $p = .003$) and psychological distress ($\beta = .447$, $p < .001$) were unique predictors of suicidal ideation. In a secondary analysis, cataplexy was also found to be positively correlated with suicidal ideation ($p < .001$)
Conclusions: These results are consistent with previous research showing that suicidal ideation in college students is more strongly associated with nightmares than insomnia. The results are also consistent with the possibility that psychological distress exacerbates not only nightmares and insomnia, but also a tendency to express mirror behaviors, which may in turn contribute to the nature of suicidal ideation and behaviors. The association between cataplexy and suicidal ideation is consistent with research showing an increased risk of suicide among individuals with narcolepsy.

ATTENTIONAL DEFICITS IN OSA ARE MODERATED BOTH BY OLDER AGE AND LOWER COGNITIVE RESERVE

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Introduction: Obstructive Sleep Apnoea (OSA) is a nocturnal-breathing disorder associated with poor cognitive performance. However, the aetiology of cognitive deficits in OSA is disputed- largely because of weak relationships between OSA severity and cognition.
The current study tested whether the relationship between OSA severity and attention was moderated by age and cognitive reserve in community-dwelling older adults. Older age is a risk factor associated both with higher OSA severity and higher neurological vulnerability. In contrast, cognitive reserve is a resilience factor representing the degree of mental efficiency that buffers against physical impairment.

Materials and methods: An epidemiological sample was drawn from the city of Busselton, Western Australia (2,594 participants aged 44-70) from the electoral roll (M Age = 57.81 years, SD = 5.85 years; 44.6% male). All participants included in the present study completed screening for OSA using ApneaLink[TM], a portable two channel-device measuring oxyhaemoglobin saturation and airflow from which we derived an apnoea-hypopnoea index. As part of their participation in the Busselton Healthy Ageing Study, attention was measured using computerised neuropsychological testing (Cognitive Drug Research Battery). Cognitive Reserve was measured using the National Adult Reading Test (NART), which scores participants on pronunciation of 50 irregularly spelled English words. The NART is commonly used as a measure of premorbid intelligence.

Results: A hierarchal stepwise-regression and a moderated moderation model supported our hypothesis; people with increasing OSA severity had significantly poorer attention if they were older and had lower cognitive reserve. The model results were significant for a 3-way interaction between AHI, age and cognitive reserve $F(1, 2585) = 6.57$, $p < .001$, such that the strongest effect of OSA severity on attention was observed in the oldest group (M = 63.33 years) at the lowest (M = 95.99), and average (M = 103.97) estimated premorbid IQ.

Conclusions: Previous studies of the relationship between OSA severity and attention report small significant relationships but show distinct heterogeneity, with some individuals showing acute deficits and others seemingly unaffected. The moderated-moderation model tested in the present study was derived from an a priori and theoretically derived vulnerability model which posited that the effects of OSA severity on attention would be significant in the presence of two risk factors: higher age and lower cognitive reserve. Statistical models such as the moderated regression used in this study can test for interactions between multiple variables and may be useful for detecting subtle variations that can be missed in traditional analyses.

AGE AND SEX INTERACTIONS BETWEEN SLEEP DISORDERED BREATHING AND SLEEP DURATION WITH NEUROCOGNITIVE DECLINE IN SOL-INCA, AN ANCILLARY TO THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS

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Introduction: To determine age, sex, differences in the relation between sleep-disordered breathing (SDB) and sleep duration with 7-year neurocognitive (NC) function and decline in a large and diverse sample of U.S. Hispanic/Latinos (N=5,247).

Materials and methods: We evaluated data from SOL-INCA (2016-2018), an ancillary to the Hispanic Community Health Study/Study of Latinos (HCHS/SOL; Visit 1 2008-2011). Sleep exposures measured at baseline included SDB, defined by a respiratory event index ≥15, and self-reported short < 6 hours (h), average 6-9 h, long >9 h sleep duration. We also evaluated synergisms in sleep disorders by cross-classifying categories of SDB and sleep duration (< 6 hours, 6-9 hours, >9 hours). Cognitive outcomes (all z-scored) included episodic learning and memory (B-SEVLT-Recall), processing speed (DSS; Digit Symbol Substitution and Trails B), and a global cognitive function measure derived from a confirmatory factor model. We tested longitudinal associations between Visit 1 sleep measures and cognitive performance in SOL-INCA, measured on average 7-years later, as well as 7-year cognitive change using standardized regression-based formulas. We used survey-based regression analyses to evaluate modification in associations between sleep exposures and cognitive outcomes by age and sex adjusting for depression scores, vascular risk scores, sleep medication, follow-up time and study site.

Results: The mean age was 63±8 years, 54.8% females with 7.0% Central American, 24.5% Cuban, 9.3% Dominican, 35.9% Mexican, 14.4% Puerto Rican, and 5.1% South American background. Overall, the prevalence of SDB was 17%, while for short and long sleep was 6.6% and 14.8% respectively. SBD was associated with significant decline in both memory and processing speed among participants ≥65 years of age, but these effects varied by sleep exposure and cognitive domain. Age-modified the associations between SDB and processing speed and sleep duration and memory. Age also modified the joint association of SDB and sleep duration with neurocognitive performance and change in memory and processing speed. We did not observe sex differences in the association between sleep exposures and neurocognitive performance and change.

Conclusions: Among middle-aged and older Hispanic/Latinos, SBD and longer sleep was associated with lower cognitive function and more 7-year cognitive decline. Older age modified associations between SDB and sleep duration with neurocognitive function and decline in a large and diverse sample of U.S. Hispanic/Latino adults.

EEG AND BEHAVIOURAL CORRELATES OF MILD SLEEP RESTRICTION AND DAYTIME VIGILANCE

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Introduction: Canadians sleep about 1 hour less per night than one decade ago. This lack of sleep is having a significant and detrimental impact on society in terms of health, productivity and safety. Here, we aim to understand the behavioral, cognitive and neural consequences of mild and acute sleep loss while performing a monotonous sustained attention task for a prolonged period during the daytime. **Materials and Methods:** Twenty-three participants (N=18 females, mean age=22±3 years) were instructed to sleep from 1am to 6am (Sleep Restriction condition), or from 12am to 9am (Sleep Extension condition) for the night prior to each testing afternoon. For testing, participants were asked to complete six sessions with 100 trials each of the Psychomotor Vigilance Task (PVT), where participants' brain activity was recorded via EEG. Participants also completed the Stanford Sleepiness Scale (SSS) prior to the first PVT session and following each PVT session thereafter. EEG data was scored in 5-second epochs based on the Hori method of sleep onset stage scoring.
Results: Overall, PVT response speed was significantly faster in the Sleep Extension vs. Sleep Restriction condition ($F(1, 22) = 9.02$, $p < 0.01$) and became slower across the 6 blocks ($F(5,110) = 8.12$, $p < 0.001$). SSS scores were higher in the Sleep Restriction vs. Sleep Extension condition ($F_{(1, 22)} = 6.20$, $p = 0.02$) and increased over the course of the testing session ($F_{(6, 132)} = 14.61$, $p < 0.001$). Across both sleep conditions, participants spent less time in Hori Stage 3 ($F_{(5, 110)} = 3.36$, $p < 0.01$) and more time in Hori Stage 4 ($F_{(5, 110)} = 2.73$, $p < 0.05$) in the later PVT blocks. The total amount of time spent in each of the Hori stages did not significantly differ based on sleep condition ($F(1, 22) = 2.19$, $p = 0.15$). However, across both sleep conditions, more time was spent in the earlier than the later Hori stages ($F(6, 132) = 323.30$, $p < 0.001$).
Conclusion: Mild and acute sleep restriction can impair performance and reduce both objective and subjective vigilance. These results suggest that even a small amount of sleep loss can have deleterious consequences for visual attention and behavioral responding in the face of actively trying to sustain vigilance. Thus, this type of sleep restriction has direct implications for scenarios such as the daylight savings time change, long-haul highway driving, academic performance and for a variety of workplace settings that require sustained vigilance in the face of a monotonous task.

ONE NIGHT OF SLEEP CONTINUITY DISRUPTION ENGENDERS IMPAIRMENT IN OVERNIGHT MEMORY CONSOLIDATION AND VIGILANCE BUT NOT EMOTION PERCEPTION OR REGULATION: RESULTS FROM A RANDOMISED, LAB-BASED EXPERIMENTAL STUDY

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Introduction: Evidence suggests that biases in emotion processing contribute to the development and maintenance of psychopathology. Previous research also indicates that experimental sleep deprivation alters emotion processing, suggesting a potential mechanism linking chronic sleep loss (insomnia) and mental ill-health (particularly depression). Extending previous work, we experimentally fragmented sleep in good sleepers with a view to simulating one night of insomnia. We randomised to intervention (forced awakenings) or control (8 hour sleep opportunity) and assessed next-day emotion processing and regulation using established tasks known to be sensitive to depression and its treatment. Concurrently we assessed the effects on 'cold' cognition using measures of memory consolidation and vigilance.

Materials and methods: 51 good sleepers (37 female; mean age = 24 years, SD= 3.63) were randomized to either one night (23:00-07:00) of Uninterrupted Sleep (US) (n=24) or one night of sleep continuity disruption via Forced Awakenings (FA) (n=27). Participants in the FA condition were awoken eight times (comprised of 20 mins (x6), 40 mins (x1) and 80 mins (x1) in a fixed pattern standardized across participants. The Emotional Test Battery (Oxford ETB) was administered the following day, enabling assessment of bias in emotion perception (Facial Emotion Recognition Task (FERT), Emotion Categorization Task (ECAT)) memory (Emotional Recall Task (EREC), Emotional Recognition Memory Task (EMEM)) and attention (Faces Dot Probe Task (FDOT)). Participants also completed an emotion regulation task (Breathing focus task) which measured ability to maintain attention and the number and valence of intrusive thoughts following a worry induction. Overnight declarative memory consolidation (Word-Pairs Task), psychomotor vigilance (PVT), subjective sleepiness (KSS), mood and anxiety (PANAS, S-DERS, STAI) were also measured. Independent t-tests tested for difference in subjective measures, overnight memory consolidation and vigilance, while ANOVAs were used to test for effect of condition (FA vs US), and a condition*emotion/valence interaction on the emotion processing tasks.

Results: Confirming the effects of the manipulation, sleep continuity disruption led to a decrease in total sleep time, increased subjective sleepiness (↑KSS score $p =< 0.05$), and anxiety (↑STAI, $p=0.05$), as well as decreased positive affect (↓PANAS-Positive scale, $p=< 0.05$), impaired overnight memory consolidation ($p=< 0.05$) and psychomotor vigilance (↑RTs $p=< 0.05$ & ↓ lapses $p=< 0.05$), relative to uninterrupted sleep. In contrast, experimental sleep disruption had no effect (p values all >0.1) on emotion perception (FERT accuracy and RTs across seven facial emotions OR ECAT: RTs), attentional biases for fearful or happy faces (FDOT: Vigilance Scores), or emotional memory (EREC: Number of recalled words OR EMEM: recognition memory for negative or positive emotional words). Furthermore, sleep disruption did not affect emotion regulation in response to a worry induction (Breathing Focus Task: breathing focuses and thought intrusions).

Conclusions: This study suggests that one night of sleep disruption has no appreciable effect on emotion processing or emotion regulation in response to worry induction, despite clear impairments in declarative memory consolidation, vigilance and mood. Future studies may wish to investigate the effects of chronic sleep restriction protocols on emotion processing, or changes as a consequence of sleep intervention in patient populations

SLEEP SPINDLES AND COGNITIVE PERFORMANCE ACROSS PRE-ADOLESCENCE: A LONGITUDINAL INVESTIGATION

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Introduction: Adolescence involves significant cortical development and altered sleep patterns, with sleep spindles being one facet of EEG that may reflect these changes. Past studies are largely cross-sectional in design or investigate EEG power spectra exclusively, with scarce evidence of changes to specific spindle characteristics in the transition from childhood to adolescence. Furthermore, sleep spindles have been implicated in cognitive functioning across many age groups, however the nature of the relationship in childhood is less clear, and often opposite, to that seen in adolescents and adults. The developmental trajectory of spindle characteristics and the relationship between spindles and cognition was therefore tested in the present longitudinal study of emerging adolescents.
Materials and methods: Twenty pre-adolescent boys attended the sleep laboratory for one night of sleep monitoring every 6 months over an 18-month period (mean age at baseline = 10.3 ± 0.4yrs). Slow and fast spindle characteristics of density, duration, amplitude and frequency were investigated, along with cognitive performance (working memory and fluid intelligence).
Results: Fast and slow spindle frequency significantly increased over the four time points, supporting previous findings, however no other spindle characteristic showed significant variation. Spindle parameters and cognition did not show cross-sectional associations at any time point, contrary to past findings, and while working memory and fluid intelligence improvements were related to changes in slow and fast spindle frequency and slow density, these did not show consistent or meaningful patterns.
Conclusions: Developmental changes in spindle characteristics may appear later in adolescence, aligning with expected synaptic pruning and network refinement, while early adolescence shows only small changes. Furthermore, the relationship between sleep spindles and cognition may be unstable in early adolescence due to the complex brain reorganisation in this developmental period.

Behavior, Cognition and Dreaming
Board #064 : Poster session 2

EFFECTS OF SLEEP DURATION, TIME-OF-DAY, AND SYNCHRONY WITH CIRCADIAN PREFERENCE ON FLANKER-TASK PERFORMANCE IN INTERNET BRAINGAME USERS FROM TEENS TO ADVANCED AGE

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Introduction: Research elucidating the effects of sleep and circadian rhythm on cognitive performance is advancing, yet many important questions remain.

Materials and methods: Using flanker task performance scores from a large internet sample (N=48,881) with repeated measures of cognitive performance and linked prior-night self-reported sleep duration, this study analyzed the relationship between sleep duration, time-of-day of task performance, and chronotype synchrony with performance in participants aged 15 to 80.

Results: Results strengthen prior findings indicating a performance peak at 7 hours habitual sleep duration and point to a variable effect of deviation from habitual sleep duration depending on users' habitual sleep duration and age. Time-of-day effects were notable for a steady decline in performance up until 1 to 2 am for the group as a whole, which was accounted for by nighttime deterioration on trials requiring inhibitory executive functioning, particularly in older subjects. Time-of-day analysis did not demonstrate an advantage for playing in synchrony with self-identified chronotype.

Conclusions: These analyses strengthen findings indicating an inverted u-shaped relationship between sleep duration and cognitive performance across a broad spectrum of age groups. These findings underscore the importance of daytime task performance for tasks requiring inhibitory function, especially in elderly people. Findings highlight the utility of large-scale internet data in contributing to sleep and circadian science as well as their potential to address questions on sleep, chronotype and the synchrony effect in cognition.

SLEEP DISTURBANCES AND STRESS AMONG THE FOREIGN MEDICAL STUDENTS OF EUROPEAN UNIVERSITY, GEORGIA

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Introduction: The vast amounts of scientific literature documents the high prevalence of stress among the university students worldwide. Especially vulnerable to the development of the stress and different sleep disturbances are the students of medical faculty because of the heavy curriculum, tough schedule, financial issues, being separated from the family, etc. Sufficient amount of sleep is necessary for recovering different body function, memory consolidation and learning process. Stress, anxiety, and hyperarousal are often presumed to play a major role in causing sleep disturbances, decreased cognitive functioning and academic performance.

Presented study is a pilot study and first attempt to evaluate daytime sleepiness and dysfunction, cognitive and somatic pre-sleep arousals, also to analyze the association between student's life stressors and sleep difficulties among the foreign medical students in Georgia.

Materials and Methods: A population based study was conducted of foreign medical students of the European University, Tbilisi, Georgia (November, 2018). 44 foreign (Indian and Turkish) volunteer students participated in this pilot study. Participants completed The Epworth Sleepiness Scale -**ESS**, Pre-Sleep Arousal Scale-**PSAS** and Student-Life Stress Inventory-**SLSI**. The demographic information (age, gender and grade level) was collected from all subjects. Data were analyzed by using SPSS 21.0.

Results: The students presented sleep problems and high level of stress, the severity of which will differ between gender groups. Although excessive daytime sleepiness was slightly but significantly higher in **male** foreign students (p< 0.05), they had considerably lower level of cognitive pre-sleep arousal (p< 0.05); overall self-rating as well as total scores of SLSI were significantly higher in **male** students (2.0 vs 1.9; p< 0.05; and 146.5 vs 141.1; p < 0.01, relatively); Male and female groups were different in all SLSI dimensions with higher scores in males, except emotional reactions, but significant was only difference in experienced pressure (p< 0.01).

In the **female** foreign students somatic pre sleep arousal was significantly but negatively associated only with student's grade level (p< 0.05); in turn, correlation of cognitive pre sleep arousal was significant with ESS (p< 0.05), overall self-rating scores (p< 0.05), and total SLSI (p< 0.05).

In the **male** students ESS was significantly correlated with both somatic and cognitive Pre Sleep Arousal (p< 0.05), more strong correlation was found between ESS and overall self-rating scores (p< 0.01) which in turn was significantly correlated with somatic and cognitive arousals (p< 0.05). Both arousals were strongly correlated with student-life stress inventory total scores (p< 0.01).

Conclusion: The medical, especially male foreign students are at high risk to develop sleep problems and psycho-behavioral disturbances. The evidences of the presented research showed importance of further proactive planning of the prevention and stress management measures among the medical students of Universities. More studies are needed for assessing the specific relationship of sleep patterns to stress and academic performance of foreign students of medical faculty.

Acknowledgements: We are grateful to all the volunteers for their time and help.

Behavior, Cognition and Dreaming
Board #071 : Poster session 3

INDIVIDUAL DIFFERENCES BETWEEN POOR AND GOOD SLEEPERS ON THOUGHT CONTROL STRATEGIES, OBJECTIVE AND SUBJECTIVE SLEEP QUALITY

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Introduction: Alongside the peculiar objective and subjective aspects of sleep architecture, also sleep-related metacognitive strategies, such as the thought control strategies adopted in attempt to control intrusive thoughts during bedtime, seem to play a role on sleep quality. The aim of this study was to examine the individual differences between self-reported poor and good sleepers on thought control strategies (i.e., aggressive suppression, cognitive distraction, reappraisal, behavioral distraction, social avoidance, and worry), as well as on objective and subjective sleep quality.
Materials and methods: One hundred and forty-seven healthy people (from 18 to 79 years of age) participated to this study. Participants were divided into poor (n=65) and good sleepers (n=82) based on Pittsburgh Sleep Quality Index (PSQI). Then, thought control strategies, using the Thought Control Questionnaire Insomnia-revised (TCQI-r), and subjective sleep quality, using sleep diary, were assessed. Objective sleep quality was also measured over 7 days of actigraphic recordings.
Results: Poor sleepers resulted to employ aggressive suppression, reappraisal and worry strategies to a larger extent than good sleepers. As shown by logistic regression, worry strategy was, however, the only strategy that distinguished between good and poor sleepers. In addition, poor sleepers had a much larger objectively-measured sleep onset latency (SOL), but lower total sleep time (TST) and sleep efficiency (SE) than good ones. In contrast, good sleepers had also much smaller subjectively-reported wake after sleep onset (WASO) and higher sleep efficiency (SE) than the poor sleepers.
Conclusions: The use of some thought control strategies, worry strategy in particular, together with some objective and subjective sleep parameters, seem to be crucial aspects in distinction between self-reported poor sleepers and good ones.
Keywords: Good and poor sleepers; Individual differences; Actigraphy; Metacognition; Sleep; Thought control strategies

ACUTE SLEEP RESTRICTION, INHIBITORY CONTROL, AND SELF-REGULATION IN 2-YEAR-OLD CHILDREN

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Introduction: Poor sleep health in early childhood is known to negatively affect behavioral self-regulation, which is linked to reduced school readiness and poor later life outcomes. This study examined the role of acute sleep loss in behavioral self-regulation strategies and inhibitory control using a standard task that measures a child's capacity to delay gratification. Compared to a day when toddlers had a daytime nap, it was hypothesized that after acute nap deprivation they would have a shorter latency to touching the toy and would resort to more immature, maladaptive self-regulation strategies to delay gratification.

Materials and methods: In this experimental, counterbalanced study, 25 healthy children (11 males, 34.1±2.3 months-old) followed an individualized, structured sleep schedule for ≥5 days prior to a baseline (nap) and an acute nap deprivation condition (no-nap). Inhibitory control was assessed using age-appropriate, alternative forms of an attractive toy. After being introduced to the toy, children were left alone for a 3-minute waiting period and videotaped. The videos were behaviorally coded for latency to touch and 11 discrete self-regulation strategies employed during the waiting period. Based upon theoretical developmental science and our previous findings with older preschool-age children, we combined strategies into adaptive (i.e., self-talk, passive waiting, removing self, object distraction) and maladaptive (i.e., visual inspection, fidgeting, self-soothing) composites. Higher scores on each composite indicated more frequent use of the strategies. Between condition analyses included: 1) a McNemar repeated measures chi-squared test to compared the number of children who touched the toy; 2) a paired t-test (one-tailed) to compare latency to touch; and 3) a Wilcoxon signed rank test (one-tailed) to compare differences in adaptive and maladaptive composite scores.

Results: During the nap condition, 19 children touched the toy (latency to touch = 70.0±60.7 sec); during the no-nap condition, 18 children touched the toy (latency to touch = 65.4±71.6 sec). We found no difference between conditions in the number of children who touched the toy ($X^2=0$, $p=0.50$) and no difference in their mean latency to touch ($t=0.27$, $p=0.39$). The adaptive composite score was 1.58±0.25 for the nap condition, in comparison to 1.17±0.27 for the no-nap condition. The maladaptive score was 0.92±0.17 for the nap condition and 0.83±0.19 for the no-nap condition. Additionally, no differences were found in the composite scores of adaptive ($z=0.35$, $p=0.12$) and maladaptive strategies ($z=0.09$, $p=0.69$) between conditions.

Conclusions: These findings indicate that acute nap deprivation in early toddlerhood may not have an immediate impact on inhibitory control and self-regulation strategies. Limitations in the task administration and contextual factors (e.g., SES, childcare, birth order) may contribute to conflicting results with older children. Through early childhood, there are striking developmental changes in behavior and self-control. At 30-36 months of age, children may not have sufficient cognitive resources to exert inhibitory control and self-regulate whether or not they have obtained adequate daytime sleep. Future research should examine developmental changes in the effects of acute sleep restriction on inhibitory control and self-regulation strategies as children progress through early childhood.

EXAMINING THE ASSOCIATION BETWEEN HOME ENVIRONMENTAL FACTORS AND ADOLESCENT SLEEP QUANTITY: A CROSS-SECTIONAL ANALYSIS IN THE U.S. FAMILY LIFE, ACTIVITY, SUN, HEALTH, AND EATING (FLASHE) STUDY

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Introduction: As the obesity rate continues to rise among adolescents, it is important to identify and address modifiable risk factors to help mitigate this trend and decrease associated disease burdens. Sleep health is a known obesogenic factor. However, adolescent sleep health is an understudied area. Following behavioral approaches (e.g., the social ecologic model and social cognitive theory) that recognize the role of social and environmental context on behaviors, we hypothesize that adolescent sleep health- represented by sleep quantity- may be influenced by home environmental factors. The purpose of this study was to examine the association of two such factors- screen time and parental sleep behaviors- with adolescent sleep quantity by gender in the U.S. National Cancer Institute's Family Life, Activity, Sun, Health, and Eating (FLASHE) study.
Materials and methods: Cross-sectional surveys were administered to parent-child (aged 12-17y) dyads between April - October 2014 to examine multiple cancer-preventive behaviors and their correlates. Dyads with adolescents in middle or high school at the time of the survey were included in the analyses. Dyads with missing data or unrealistic total sleep values (< 2h or >16h) were excluded.
Adolescent total screen time was defined as the combination of self-reported time spent watching television, playing videogames, and using computers, tablets and cell phones. Total average sleep quantity was calculated based on the average self-reported times participants went to sleep and woke up on a typical weekday and weekend day ([(weekday sleep*5) + (weekend sleep*2)]/7).
Chi square tests were used to compare differences in demographics, screen use, and sleep characteristics by gender. Sex-stratified, linear regression models were fitted to examine the associations between: 1) adolescent screen time and adolescent sleep quantity and 2) parental and adolescent sleep quantity, while controlling for adolescent screen time. Models controlled for socio-demographics: adolescent age, adolescent race/ethnicity, total household income, and parent marital status. Statistical tests were two-sided, with a significance level of 0.05.
Results: Of the 1202 dyads, 51.2% included female adolescents. There were no differences in demographic characteristics, total screen time, or sleep quantity by gender. Adolescent screen time was inversely associated with adolescent sleep quantity in males (Beta (β): -0.061 (standard error (SE): 0.016), $p < 0.0001$ but not females (β: -0.021 (SE: 0.016), $p = 0.203$). Screen time remained significant only in males when parental sleep quantity was added to the model (male β: -0.060 (SE: 0.015), $p < 0.0001$; female (β: -0.022 (SE: 0.016), $p = 0.160$), while parental sleep quantity was significantly positively associated with adolescent sleep quantity in both groups (male β: 0.189 (SE: 0.035); female β: 0.152 (SE: 0.036), both $p < 0.0001$).
Conclusions: Our study highlights the importance of the home sleep environment for adolescent sleep quantity. We found a positive association between parental and adolescent sleep quantity, regardless of gender, while the effect of screen time was gender-dependent. We cannot infer causality due to the cross-sectional design of the study. We suggest that both parental sleep quantity and screen time should be considered in future sleep interventions among adolescent populations.

FREQUENCY-TAGGED RESPONSES TO BEAT AND METER OF MUSICAL RHYTHMS DURING SLEEP AND WAKEFULNESS

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Introduction: Perceiving periodicities from sounds is fundamental for the emergence of temporal structure representations such as the beat and meter perceived while listening to music. Increasing evidence has shown that the ability to entrain to beat and meter periodicities is reflected by neural responses such as auditory steady-state evoked potentials (SSEPs). These responses are selectively enhanced at beat and meter-related frequencies which correspond to the frequencies present in the acoustic envelope of non-isochronous rhythmic sequences. Furthermore, perceived beat frequencies do not always correspond to the acoustic frequencies showing the most energy in the sound envelope as in the case of syncopated rhythms, and yet the cortical responses are enhanced at these frequencies. Since SSEPs have shown to reflect the spontaneous emergence of an internal representation of beat during wake, here we address the question of whether these responses persist during the different stages of sleep.

Materials and methods: Participants spent one night at the sleep laboratory where PSG signals were recorded with an Active-Two Biosemi System. Two rhythmic non-isochronous sequences were presented through electromagnetically shielded Etymotic earphones during sleep stages N2, N3 and REM and post-sleep wakefulness. The auditory stimuli consisted of 40.8s sequences of a chord amplitude-modulated in such a way to generate a syncopated or an unsyncopated rhythm. Previous studies in wakefulness have consistently shown that both rhythms induce a beat perceived at a frequency of 1.25 Hz and related metrical periodicities which are reflected on both the acoustic envelope of the sound and on electroencephalography (EEG) SSEPs. For the present analysis we focused on the EEG responses at beat and meter-related frequencies (i.e. 0.4167, 1.25, 2.5 and 5 Hz). Each rhythm was presented in blocks of nine trials with 3s of silence in between (block order counterbalanced across participants) for each sleep stage and during wake. Pre-processed 40.8s EEG epochs were averaged across trials for each participant and block of stimulation and were transformed into the frequency domain. The magnitude of the responses at the meter-related frequencies of interest was then compared across conditions for both types of rhythms.

Results: Preliminary results from twelve participants (four male, mean age 24.7, SD 3.7) show a main effect of state ($p= 0.004$) and a main effect of frequency ($p=0.001$) for the syncopated rhythm and a main effect of state ($p=0.002$) and frequency ($p=0.001$) for the unsyncopated rhythm. Namely, SSEPs at meter-related frequencies were enhanced during wakefulness in comparison to all sleep stages for both rhythms. Responses at the slowest meter-related frequency (grouping of 12 sound and silent intervals from the sequence) were significantly lower than the other faster meter-related frequencies for the syncopated rhythm while responses at 5 Hz (reflecting the 200 ms duration of sound intervals) were enhanced in the unsyncopated condition.

Conclusions: Preliminary results show that responses to complex rhythms decrease during sleep, possibly reflecting a reduced capacity to group events into temporal structures giving rise to internal representations of beat and meter.

CAFFEINE FIX?: NEUROPHYSIOLOGICAL MEASURES OF VISUAL ATTENTION ON THE WORLD'S MOST POPULAR DRUG

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Evening-type individuals often perform poorly in the morning because of a mismatch between internal circadian time and externally imposed social time, a condition recognized as social jetlag. Individuals commonly consume caffeine in an attempt to alleviate the symptoms of social jetlag by increasing alertness and attentional focus. Despite its widespread consumption, and its well-documented efficacy as an alertness aid, little is known about how caffeine influences the neurophysiology of specific lower-order attentional processes beyond broad modulation of alertness. Measurement of electrophysiological indices of attentional selection (N2pc) and suppression (P_D) has revealed that evening-type individuals have a specific disability in suppressing irrelevant visual distractions in the morning, as evidenced by an attenuated P_D. Here we assess the ability of caffeine to rescue this circadian mismatch-associated attentional impairment in evening-type individuals. Evening-type adults (mid sleep on free days ≥ 5:30AM) completed a visual attention task at 9AM following ingestion of 2mg/kg, and again with no caffeine. If a larger P_D is elicited in the morning following caffeine consumption, then this would indicate that caffeine may be an effective countermeasure against the increased susceptibility to distraction in the morning. Other potential neurophysiological consequences of caffeine intake may indicate that caffeine improves performance in visual search through another mechanism such as improved target detection (N2pc). The failure to filter out irrelevant stimuli at an early stage of perceptual processing contributes to impaired cognitive functioning at non-optimal times of day, and may underlie real-world performance impairments, such as distracted driving. Understanding how, and whether, caffeine affects specific attentional impairments beyond general alertness levels is important since as it is likely already being used as aid by millions of commuters, and much of the workforce during early morning hours.

SELF–REPORTED SLEEP QUALITY CORRELATES WITH FLUID INTELLIGENCE, BUT NOT CRYSTALLIZED INTELLIGENCE OR SHORT-TERM MEMORY IN HUMANS

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Introduction: It has previously been reported that sleeping 7-8 hours per night is associated with greater performance on higher order cognitive abilities, including fluid and crystallized intelligence, whereas deviation from optimal sleep duration has no effect on short-term memory (Wild et al., 2018). Therefore, we investigated whether these cognitive domains would be similarly affected by sleep quality. It was hypothesized that greater sleep quality would most robustly affect fluid intelligence, based on previously established relationships between fluid ability, sleep spindles, and sleep quality.

Materials and methods: A sample (N=12118) from The Cambridge Brain Sciences cognition and sleep survey (University of Western Ontario) was completed by volunteers, and included 12 cognitive tasks. These tasks have previously been shown to correlate with brain networks, each with weighted contributions to reasoning (fluid) ability, crystallized (verbal) intelligence, and short-term memory (Hampshire et al, 2012). In addition, sleep quality was assessed using the Pittsburgh Sleep-Quality Index (Buysse et al, 1989).

Results: Fluid intelligence showed a significant relationship with sleep quality, where higher quality sleep was associated with greater reasoning ability; $t(3,12184) = .8059$ $p = 0.01$. No significant relationship was found between sleep quality and crystallized intelligence or short-term memory abilities.

Conclusions: Greater sleep quality appears to uniquely relate to fluid intelligence, whereas it is not significantly associated with performance on crystallized intelligence nor short-term memory. These findings complement previous neuroimaging work which showed that greater BOLD-indexed brain activity during sleep spindle events is also associated with higher fluid intelligence, and is also not associated with crystallized intelligence nor short-term memory (Fang et al, 2019). It is possible that an underlying relationship between sleep spindles and sleep quality may contribute to the effect on fluid intelligence, as spindles have previously been shown to contribute to greater arousal thresholds in humans (Dang-Vu et al, 2010) allowing for greater quality sleep.

DISORDERED SLEEP IS ASSOCIATED WITH DELUSIONAL IDEATION AND DEPRESSION DURING PREGNANCY AND POSTPARTUM

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Introduction: Sleep disturbances are highly prevalent during pregnancy and postpartum, and are associated with adverse outcomes in mothers and children. Delusional ideation (DI) is relatively prevalent in the general population, including pregnant women. DI may contribute to the development of psychosis and exacerbate symptoms of other disorders, including depression. Sleep is known to affect DI both in schizophrenia and in postpartum depression. This study investigates the associations between sleep disturbances, DI and depressive symptomatology across the perinatal period.
Materials and methods: A community sample of 316 mothers completed the Sleep Symptom Checklist (SSC), Peters Delusional Inventory (PDI), and Edinburgh Postnatal Depression Scale (EPDS) at three time points: second trimester of pregnancy (12-14 weeks gestation; PN2), third trimester (32-34 weeks gestation; PN3) and two months postpartum (PP).
Results: Longitudinal path analysis revealed a bidirectional relationship between sleep disturbance and DI across pregnancy. Sleep disturbances in early pregnancy directly predicted symptoms of depression in late pregnancy and had an indirect effect on postpartum depression through DI in late pregnancy.
Conclusions: Our results suggest that disturbed sleep during pregnancy plays a role in increased levels of DI and depressive symptoms during pregnancy and postpartum. Prioritizing interventions to improve sleep quality may thus be clinically relevant and contribute to diminishing symptoms of cognitive and affective disturbances during the perinatal period.

Behavior, Cognition and Dreaming
Board #072 : Poster session 3

THE IMPACTS OF SLEEP VARIABILITY ON SLEEPINESS, MOOD AND COGNITIVE FUNCTIONING IN YOUNG ADULTS: AN EXPERIMENTAL STUDY

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Introduction: Sleep variability has often been reported in association with a wide range of impaired daytime functioning among young adults. However, current evidence, which was mostly based on the observational studies, could not delineate the causal relationship and underlying mechanisms. This study aimed to evaluate the impacts of experimentally induced variability in sleep duration on daytime sleepiness, mood and cognitive functioning in young adults.

Materials and methods: Thirty-six healthy young adults (16 males, aged 18-22 yrs) with habitual sleep duration over 7 hours per night, intermediate chronotype and no diagnosed sleep or psychiatric disorders were recruited. Before the experimental period, participants were asked to sleep at home on a regular schedule with 7.5h of time in bed (TIB) daily for a week with their sleep monitored by actigraphy. Participants subsequently underwent an 8-day protocol in the sleep laboratory consisting of two baseline nights with 7.5h of TIB, followed by either six nights of sleep with variable sleep schedule (TIB alternating between 6h and 9h on a daily basis for the variable sleep group) or fixed sleep schedule (TIB for 7.5h daily for the control group). Sleepiness, mood and cognitive functioning were measured in the morning and evening every day during the experimental period.

Results: Participants in the variable sleep group reported a significantly higher level of daytime sleepiness on the days after 6 hours of sleep (day x condition: p=0.009), especially in the mornings (day x condition: p=0.005), as compared with the control group. Participants in the variable sleep group also had higher daily negative mood as compared with the control group particularly in the evenings at the margin of significance (day x condition: p=0.071). However, there were no significant differences in the positive mood and the performance on the cognitive tasks (i.e., sustained attention and processing speed) between the two groups.

Conclusions: Our study found that moderate variability in daily sleep duration led to changes in daytime sleepiness and negative mood whilst daytime cognitive functioning was preserved. On the other hand, previous experimental studies showed that chronic sleep restriction followed by weekend recovery sleep might not be sufficient to restore impaired daytime functioning. Future studies should further explore the extent to which timely sleep compensation after sleep restriction, despite the induced sleep variability, could recover certain domains of functioning impairments.

SLEEP QUALITY, GENERAL HEALTH AND RELIGIOUSNESS IN GREEK OLDER ADULTS: PRELIMINARY RESULTS

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Background: A plethora of studies provide insight into the links between religiousness and subjective well-being. This study aims to investigate whether older adults with high self-reports in a questionnaire measuring the personal experience of religiousness, do also experience a better general health and better quality of sleep.

Method: One hundred healthy participants (57 women and 43 men; Mage = 73.08, SDage = 4.90, age range 65-84 years; Meducation = 10.24, SDeducation = 3.70, education exactly 12 years for all of the participants) were divided into two groups: those with a high score-above the median- in the Systems of Belief Inventory (SBI-15R), and those below that score. The Systems of Belief Inventory (SBI-15R) consists of 15 questions regarding religiousness and spirituality. Immediately after the completion of SBI-15R, participants completed the General Health Questionnaire (GHQ-28), which is used to indicate psychological well-being and detect possible cases of psychiatric disorders, and the Pittsburg Sleep Quality Index (PSQI), which is a self-report questionnaire that assesses sleep quality.

Results: Results indicated that there was no statistically significant difference between the two groups regarding total scores in GHQ-28 ($p > .05$), as well as the PSQI scores ($p > .05$).

Conclusions: Scores in the SBI-15R do not differentiate older adults' total scores in GHQ-28 and PSQI. Future research should further investigate the possible influence of other factors in perceived general health and quality of sleep in older adults.

MODELLING MELANOPSIN-MEDIATED EFFECTS OF LIGHT ON CIRCADIAN PHASE AND SLEEPINESS

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Introduction: The effect of light on non-visual processes is mainly mediated by melanopsin expressed intrinsically photosensitive retinal ganglion cells (ipRGCs). The contribution of melanopsin among other opsins, makes short wavelength light a stronger element to reduce sleepiness and shift circadian phase rather than longer wavelength light. A model that predicts the effect of light wavelength on circadian clock and sleepiness would prove highly useful, especially under shiftwork and jetlag conditions where increased sleepiness increases the risk of accidents. A number of models have succeeded in prediction of alertness measures depending on the circadian phase. However, none of them accounted for the contribution effect of melanopsin on direct alerting effect of light and circadian phase. In this study, our model of arousal dynamics is extended to incorporate the light wavelength dependency associated with melanopsin on circadian phase and subjective sleepiness, and is tested against experimental data.

Materials and methods: Our model of arousal dynamics simulates the flip-flop switch between the sleep- and wake-active neuronal populations under the effects of the homeostatic and circadian drives. The phase of the circadian drive is adjusted by light according to the human phase- and dose-response curves. The model has been successful in prediction of subjective sleepiness and objective performance under acute sleep deprivation and forced desynchrony in dim light conditions. To account for the non-visual effects of light, a circadian illuminance is introduced in the model as the light input which focuses on the role of melanopsin andis calculated from the spectral power distribution of the light source and its irradiance, photon density, or photopic illuminance. The dynamic of the circadian oscillator is revised based on the circadian illuminance and is also tested against experimental studies. A new light wavelength dependent term is introduced in the homeostatic weight component of subjective sleepiness to represent the direct alerting effect of light. The new term is calibrated against experimental studies using different light conditions.

Results: The modified arousal dynamics model predictions are tested against 15 experimental data sets by normalized root mean squared error assessment. The revised dynamic circadian oscillator is tested against dose-response and phase-response curve studies using coloured lights and is successful in predicting the circadian phase shift due to broadband and monochromatic blue light. Introduction of the new model term to account for the direct alerting effects of light allows to reproduce the light-dependent decrease in subjective sleepiness observed under variety of polychromatic and monochromatic blue and green light conditions during day and night. The model also successfully reproduces the experimentally-observed sigmoidal dose-response of subjective sleepiness to light.

Conclusions: A modified model of arousal dynamics is successful in reproducing the experimentally observed wavelength-dependent effects of light on the circadian phase and alertnessand allows for testing of potential mechanisms.Compared to the old model, the new model produces better agreement with data, in particular for the polychromatic and blue light sources, and should thus be used when non-white light conditions are of interest.

ABDOMINAL OBESITY, SLEEP AND BEHAVIORAL CHARACTERISTICS AMONG BRAZILIAN SHIFT WORKING WOMEN

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Shift work affects circadian rhythm and metabolic functions, including melatonin and cortisol levels (DESANTIS et al., 2011; FOLKARD, 2008; GRUNDY et al., 2011; MANENSCHIJN et al., 2011), and as expected studies have identified a higher prevalence of obesity, metabolic syndrome, and others chronic diseases among populations of shift workers (BRUM et al, 2015; GUO et al, 2015; LEE et al, 2016; CANUTO et al, 2015).

Women appear to be more affected by shift work with increased abdominal obesity compared to men. A recent meta-analysis showed that among shift workers, women were more likely to be obese than men (OR 1.25; 95% CI: 1.17, 1.34) (SUN et al, 2018).

The aim of this study was to explore the association between behavioral characteristics and the prevalence of abdominal obesity among Brazilian shift working women.

Materials and methods: A cross-sectional study was conducted 450 female shift workers of large plastic utensils located in southern Brazil. Data were collected using standardized questionnaires. All interviews were conducted on the factory during work hours. Abdominal Obesity was estimated using waist circumference (WC) and was used to classify women as having abdominal obesity (WC, $\geq$ 88 cm) and self-reported hours of sleep in the 24 hours, (categorized $\leq$ 5 or > 5 hours).

Shift workers were classified as dayshift workers (shifts between 07.00 a.m. and 02.00 p.m. or afternoon 02.00 p.m. to 10.00 p.m.) or nightshift workers(10.00 p.m. to 07.00 a.m). Prevalence ratios were estimated using Poisson regression with robust error variance.

All participants provided written informed consent for their participation. This project was approved by the Research Ethics Committee of the University of Vale do Rio dos Sinos, RS, Brazil, under number 2.057.810/2017, as recommended by resolution 196/96 on human research.

Results: The prevalence of the abdominal obesity in the women shift workers was 44.5% (95% CI 40.0 to 49.2%). Night shift work was 56.1% compared to 40.9% among day shift workers (p=0.006). After adjustments for covariates, the prevalence of abdominal obesity was greater among older women, who had a partner, slept five or fewer hours, were employed for six or more years and that had three or fewer meals per day. Physical activity was associated with a decrease in the prevalence of abdominal obesity compared to sedentary.

The adjusted association between hours of sleep and number of meals, and abdominal obesity, stratified of shift work. The prevalence of abdominal obesity increases by 45% among night workers that had five or fewer hours of sleep per day and by 130% among night shift workers who had fewer meals per day (three or less), compared to those eating more frequently, with statistical significance.

Conclusion: Our findings indicate that behavioral characteristics are associated with a higher prevalence of abdominal obesity in female shift workers, independently of work shift. Suggesting that behavioral modifications among women working shifts, such as increase meal frequency, increase physical activity, and increase in the number of hours of sleep may reduce abdominal obesity.

COMMUNICATING SLEEP HEALTH WITH A VIGILANCE TOOLBOX: REVIEW OF THE "STROOP COLOUR-WORD TASK" AS A POSSIBLE "VIGILANCE GAME"

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Introduction: Lack of sleep affects the ability to sustain attention (vigilance). Vigilance fluctuations impact attention and reaction time, increasing the risk of injury. In 2018, high-school students at the Vancouver Summer Sleep School created a "Sleep Health Communication Concept" in order to disseminate knowledge among youth with "Vigilance Games". The Stroop Colour-Word Task (SCWT), which measures attention, reaction time, and interference (the ability to overcome distracting stimuli), was suggested as one "game". We investigated how well the SCWT-test can be adapted as a "vigilance game" and as part of a "fun knowledge-dissemination event".
Materials and methods: A. A literature review was conducted on Medline and PubMed to identify the most common methods for measuring (search phrase): "sleep*" AND "attention" AND "reaction time" AND "interference".
B. A SCWT-test, as initially suggested, was played by 12 lab-members at a pilot-run to investigate its adaptability as a game. Reaction time was measured automatically using a downloadable computer program (https://www.psytoolkit.org/). Interference was measured by counting the amount of errors. For assessing fatigue, we used the Karolinska Sleepiness Scale (KSS) and selfies; for assessing fatigue associated vigilance fluctuations, we used the built-in video recording to capture characteristic cues in facial appearance. All data, except videos and selfies, were recorded in a customized digital-survey-tool (Qualtrics) on mobile devices.
C. A Strength-Weakness-Opportunity-Threat (SWOT) analysis was conducted on the applicability of the manual SCWT-test as a game.
Results: A. 15 articles were identified; 10/15 responded to the content of the search phrase and were analyzed; four RCTs used the manual and oral SCWT.
B. Self-experience and participant feedback revealed that the test instructions were clear and understandable. In contrast to the reference which suggests 100-216 trials, the adapted game was limited to 50 trials to maintain engagement. Feedback revealed the need for practice trials and separating participants to standardize performance. The game took less than 4 minutes to complete. KSS scores reported consistent levels of sleepiness and a slight increase in sleepiness for 3 participants after the game. Although selfies were encouraged, they were not collected for data analysis. Quality of the video recordings allows to assess facial cues of vigilance fluctuations with customized movement analysis software.
C. SWOT-analysis: S: calculates reaction time; W: interference data must be added manually; O: participants receive immediate feedback allowing to connect performance with vigilance, the game setting allows for multiple use over the day; T: more trials could increase reliable data, but reduce participant enjoyment, thus applicability as a "game".
Conclusions: The SCWT-test measures exact reaction times using a standardized program. Adaptations to the SCWT-test for use at home or in a classroom setting allows participants to review the direct effects of sleep on vigilance and performance without becoming bored. Further, participant's vigilance can be captured via the computer webcam. The hesitancy to

share selfies is possibly a first step in self-reflection of sleepiness-associated 'ugly'-appearance and needs further exploration.

KNOWLEDGE AND BELIEFS ABOUT SLEEP AND THE SLEEP PRACTICES (KNOBS SURVEY)

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Introduction: Sleep beliefs and attitudes contribute to practices of sleep hygiene, which influence sleep quality. Sleep knowledge, beliefs and practices in various populations including school children, adolescents, college students and resident doctors have been studied in India. However, data regarding the same and circadian typology of the general population is lacking. In the present study which was an online survey, we aimed to evaluate the knowledge and beliefs about sleep hygiene in the Indian population.

Materials and methods: Persons aged 18 years or older who were willing to participate were invited to take part in this online survey using a predesigned proforma. Informed consent was included in the online proforma. Data from questions based on sleep habits and hygiene (15 items) including exercise practices and relaxation methods were collected. Circadian typology was assessed using the revised morningness-eveningness questionnaire and sleep beliefs and attitudes using the Sleep Beliefs Scale (SBS).

Results: This online survey is ongoing and so far 743 responses have been obtained and analysed. Three respondents were excluded as the age reported was below 18 years. The mean ±SD age of the respondents was 34.39 ± 12.98 years. The population was predominantly females (54.5%) with most hailing from the urban areas (88.4%). Majority of them were educated -postgraduates (47.6%) and graduates (42.6%).
Sleep hygiene evaluation revealed 76.8% participants used electronic devices before bedtime and 66.3% used online social media before bedtime. For sleep related problems, information was sought from the internet by a majority (35.9%) while only 15.1% sought professional medical advice. The predominant circadian type was morning type (46.8%), followed by neither type (43.6%) and evening types (10.1%). On SBS most of the respondents had good knowledge with 77.4% scoring above 10.

Conclusion: The survey results depict the urban educated population and reveal the effects of electronic media on sleep hygiene, beliefs and practices. The effects of circadian type and age on sleep beliefs and hygiene needs to be evaluated further. It also brings out the poor medical attention seeking behaviour for sleep related problems which need future attention.

BELIEFS OF CHILDBEARING AGE WOMEN ON SLEEP HYGIENE BEHAVIORS: A REASONED ACTION APPROACH ELICITATION STUDY

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Introduction: Sleep is important for physical and mental health. A good sleep hygiene among women of childbearing age could promote the health of both the woman and her child immediately at the start of pregnancy. There is little information on the factors that influence the sleep hygiene behaviors (SHBs) of women of childbearing age. This study's objective was to identify women of childbearing age's beliefs on SHBs based on a psychosocial theory, the Reasoned Action Approach.

Materials and methods: Thirty women of childbearing age (18-44 years) with no reported mood or sleep disorder and not taking sleep medication were randomly assigned to complete a 10-15 minute semi-structured phone interview. Participants were asked one question on sleep duration and another on overall sleep quality using items from the Pittsburgh Sleep Quality Index. Other questions were on behavioral beliefs (cognitive and affective), normative beliefs (injunctive and descriptive) and control beliefs (barriers and facilitating factors) regarding one of three SHBs: avoiding media use (television, cellphone/smartphone and/or laptop/tablet) in bed; avoiding caffeine, alcohol and cigarettes within 4 hours of going to bed; and having a regular bedtime and wake up time even on weekends. Phone interviews were first transcribed using the exact wording from participants. A content analysis was performed independently by two experts to identify the most important beliefs using a 75% cumulative frequency of mention. Disagreements were discussed and resolved by consensus.

Results: The mean age of participants was 26 years (range: 18-41 years). Most slept less than the minimum recommended 7 hours/night (53.3%). The mean sleep duration was 6.7 hours/night (range 4.5-10.0 hours/night). The vast majority (76.7%) rated their sleep quality as fairly good. Participants reported that adopting the SHBs would improve sleep (e.g., fall asleep faster, sleep better), avoid side effects (e.g., headache, fatigue), help them relax before bedtime and make them feel like they were missing out on things. Adopting the SHBs was associated with positive emotions such as feeling relaxed and satisfied, but also with negative emotions such as being qualified as unpleasant and not normal. Participants mentioned their parents, partner, siblings and children would approve or disapprove if they adopted the SHBs and were the most or least likely to adopt them. Barriers were having activities in the evening (e.g., work, household chores, social activities) and social situations (e.g., eating out, birthday parties). Facilitating factors were putting their turned-off devices away from bed, having alternatives (e.g., reading a book, herbal tea, meditation) and a regular schedule.

Conclusions: These results can guide the development of behavioral interventions to promote SHBs and sleep among women of childbearing age in order to improve their physical and mental health and promote a healthy pregnancy early on.

Behavior, Cognition and Dreaming
Board #058 : Poster session 1
NEUROCOGNITIVE FUNCTIONING IN AN OBESE PEDIATRIC POPULATION WITH AND WITHOUT OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is associated with deficits in neurocognitive functioning in otherwise healthy children. However, there is a paucity of data describing neurocognition in adolescents with OSA. The objective of this study was to evaluate and compare neurocognitive function in adolescents with obesity, with and without OSA.
Methods: This was a prospective study of adolescents with obesity between 8-18 years of age who were referred for a baseline polysomnogram. All subjects completed the Conners-3 Self-Report Short and the Behavior Rating Inventory of Executive Function (BRIEF) questionnaires. Responses were analysed for differences between subjects with and without OSA. OSA was defined as an overall obstructive apnea-hypopnea index (OAHI) $\geq$ 5. T-scores greater than 65 were considered clinically significant and abnormal. T-scores were compared using χ2 test for categorical variables and independent sample t-tests for continuous variables.
Results: Of the 97 adolescents included in this analysis, 41 (42%) had OSA (73% were male, mean age 14.1±2.3 years, mean BMI 42.6±9.4 kg/m^2, mean OAHI 23.6±28.6) while 56 (58%) did not have OSA (41% were male, mean age 13.6±2.7 years, mean BMI 36.5±7.4 kg/m^2, mean OAHI 1.5±1.4). Both BMI and OAHI were significantly different between OSA and no OSA groups (p < 0.001). The percentage of patients with abnormal T-scores for the BRIEF questionnaire were: behavioral regulation (OSA=25.6%, no OSA=20.4%), metacognition (OSA=33.3%, no OSA=27.8%) and global executive composite (OSA=30.8%, no OSA=24.1%). Similarly, on the Conners questionnaire the percentage of patients with abnormal T scores were: inattention (OSA=26.5%, no OSA=38.1%), hyperactivity/impulsivity (OSA=32.4%, no OSA=23.3%), learning problems (OSA=28.1%, no OSA=34.9%), defiance/aggression (OSA=12.1%, no OSA=25.6%) and family relations (OSA=3.1%, no OSA=11.6%). There were no statistically significant differences in frequency of abnormal T-scores between the OSA and no OSA groups.
Conclusion: Although previous studies have found significant changes in neurocognitive function amongst children with OSA, our study of adolescents with obesity found no significant group differences in neurocognition scores between those with and without OSA. However, 54.6% of this adolescent population with obesity has evidence of adverse neurocognitive function. Future research is needed to identify adolescents with obesity at highest risk for neurocognitive deficits.

GENE EXPRESSION PROFILES IN DAILY AND SHIFT-WORKERS WITH AND WITHOUT BREAST CANCER

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Introduction: The International Agency for Research on Cancer (IARC) has classified shift-work, which involves circadian disruption, in group 2A of probable carcinogens. In humans, no conclusive relationship has been found between breast cancer (BC) and shift-work, which includes night work. Some prospective evidence shows that shift-work, even in the long term, could slightly affect breast cancer incidence. Therefore, the association could be restricted to some women, more susceptible to the consequences of staying awake during the biological night. However, the investigation on relationship between BC and shift-work deserves further studies. Here, we started a pilot study to investigate if gene expression changes in Peripheral Blood Mononuclear Cells (PBMCs) might explain the connection between shift-work and BC susceptibility.
Materials and methods: At the moment, we have investigated 3 groups of women: daily healthy workers and shift-workers with and without breast cancer. The enrolled population is composed of 12 subjects (4 for each group), who underwent peripheral blood sampling. PBMCs were isolated and used for the analysis of the gene expression profile of 624 genes related to cancer, by Real-Time Open Array PCR.Daily sick workers (12 women) are still under evaluation.
Results: Comparing the gene expression panels of workers diagnosed with BC with those not exposed to night work, 38 genes were significantly over-expressed and 48 under-expressed were highlighted; in comparison with those of healthy workers exposed to night work, 45 genes that were significantly over-expressed and 48 under-expressed emerged. Comparing the panels of healthy female workers not exposed to night work with those of healthy female workers exposed to night work, 36 genes that were significantly over-expressed and 13 under-expresses were detected. From the cross analysis of these comparisons 2 significant genes were detected: CENPA, a gene sensitive to the effects of night work and commonly up-regulated in cases of BC; CTSE, a gene sensitive to the effects of night work and commonly down-regulated in cases of BC.
Conclusions: Preliminary data seem to support the hypothesis that changes in gene expression profiles in PBMCs may correlate with the presence of BC in workers exposed to night shifts.Furthermore, this approach, if confirmed on a larger sample, will allow to verify the relevance of molecular genetic studies for determination of professional risk to BC.

QUANTIFYING THE INFLUENCE OF TRAVEL CHARACTERISTICS ON SUBJECTIVE JETLAG

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Introduction: Greater circadian disruption is anticipated when air travel is eastward rather than westward and when more time zones are crossed. The influence of travel characteristics on subjective jetlag remains to be quantified.
Methods: Passengers on east- and westward flights crossing 1 to 18 time zones were surveyed in the week after flight. Subjective jetlag was assessed using the Liverpool Jetlag Scale (range 0 to 80 points). Time zones crossed, direction of travel, flight cabin, and aisle seating were examined for their influence on subjective jetlag using a multivariable regression model, controlling for passenger age and gender.
Results: N=463 passengers (43% male; mean age 50, SD 15 years) reported mean jetlag of 24.0 (SD 11.9). For westward flights, jetlag showed inverse U with time zones crossed, peaking at 14 time zones (mean 29.5 points; 95% CI 24.4-34.7). For eastward flights, jetlag increased with time zones before plateauing at ≥9 time zones (27.5; 22.8-32.2). Men had 2.4 (0.0-4.6) points less jetlag than women. Each year increase in age was associated with a 0.1 (0.1-0.2) point decrease in jetlag. Aisle/non-aisle seating was not associated with jetlag. There was a trend towards reduced jetlag in premium and business cabins compared to economy (p=0.05). Exclusion of passengers with previous flights or shift work did not alter results.
Conclusions: Preliminary analysis indicates subjective jetlag is not well predicted by travel characteristics contributing to circadian disruption. Factors such as individual characteristics and behaviours around time of flight need to be explored as >90% of variability in subjective jetlag remains unexplained.
Acknowledgements: We thank Qantas Airways for facilitating participant recruitment.

Chronobiology/Circadian Disorders
Board #075 : Poster session 3
STRATEGIES USED BY AIR PASSENGERS TO REDUCE JETLAG AND TRAVEL FATIGUE

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Introduction: Global growth in long-haul flights means an increasing need to mitigate jetlag and travel fatigue. Understanding what passengers currently do can inform the development of effective interventions.
Methods: Passengers on flights of ≥9 h duration into and out of Australia were surveyed post-flight. Changes to sleep and eating patterns, use of sleep aids including melatonin, caffeine, alcohol, physical activity, relaxation, light exposure, jetlag calculators, and compression stockings were queried. Free responses were also requested.
Results: For N=463 respondents (43% male; mean age 50, SD 16 years), 45% were travelling for leisure/holidays, 35% were visiting friends and family, and 17% were travelling for work, business, or study. Responding was typical of flight cabin distribution: 72% economy, 13% premium economy, and 15% business. Before flight, the most common strategies used were eating healthily (32%), going outdoors for sunlight (24%) and engaging in physical activity (23%). During flight, 60% used naps, 54% used ear plugs/headphones, and 38% used alcohol. After flight, 50% altered bed- and wake-times, 47% went outdoors for sunlight, and 45% changed the amount of sleep they got to reduce jetlag and travel fatigue. Hydration was the strategy most commonly suggested by 14-25% of respondents that was not originally queried. Women, younger age groups, and those on direct flights appeared more likely to use strategies but there were no differences by reason for travel or flight cabin.
Conclusions: The use of circadian strategies for jetlag was moderate and suggests further education or intervention may be helpful. Nearly all passengers changed some aspect of behaviour around flight suggesting interventions involving sleep, food/drink, and physical activity would be highly acceptable.
Acknowledgements: We thank Qantas Airways for facilitating participant recruitment.

INTERNAL CONSISTENCY OF THE LIVERPOOL JETLAG QUESTIONNAIRE

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Introduction: Objective measures of circadian disruption are difficult and costly to capture in free-living environments. Standardised questionnaires may be helpful for the assessment of jetlag but have not been independently validated. We examined the internal consistency and convergent and divergent validity of the Liverpool Jetlag Scale.
Methods: Online survey of passengers was conducted after long-haul flight. Jetlag was captured using the Liverpool scale, both as a single rating, and a total score. Fatigue was measured using the Vitality subscale of the Short-Form Health Survey (SF-36). Anxiety, worry, or distress before, during, and after flight was captured. Correlations within Liverpool items and between jetlag, vitality, and anxiety were calculated. Linear regression was used to determine which symptoms contributed most to jetlag ratings.
Results: Data from 463 passengers were analysed. Inter-item correlations of the Liverpool scale were low to moderate (rho 0.1 to 0.6). Item-total correlations were moderately strong (rho 0.5 to 0.6). Cronbach's alpha was 0.85 indicating high internal reliability. Changes in concentration, time to get to sleep, fatigue, sleep quality, and frequency of bowel motions were the strongest independent predictors of jetlag ratings, explaining 27% of variability. As expected, jetlag was more strongly correlated with vitality/fatigue (rho~0.5) than with anxiety (rho 0.1 to 0.2).
Conclusions: The Liverpool Jetlag Scale is internally consistent and shows expected convergence and divergence from measures of fatigue and anxiety. The jetlag rating may be useful for capturing subjective experience, whilst the total score better reflects circadian symptoms that passengers may consider to be unrelated to jetlag. Validation against objective measures of circadian disruption is needed.
Acknowledgements: We thank Qantas Airways for facilitating participant recruitment.

THE ROLE OF SLEEP IN THE DEVELOPMENT OF BURNOUT, CHRONIC FATIGUE AND BIOLOGICAL AGING IN THE DAY AND NIGHT WORKERS

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Introduction: The restoring function of sleep strengthens its importance for working people, especially those under tension and/or difficult work conditions. The purpose was to reveal the role of sleep during development of burnout, chronic fatigue and biological aging in the day and night workers.
Materials and methods: The length of daily sleep, the degree of burnout (by Boyko) and chronic fatigue (CF - by Leonova-Shishkina) development, the health complaints index (HCI), pathological index (PI) and biological aging tempo (BAT - by Voytenko) were studied in 2 groups of telephonists: (1) working day, afternoon and night shifts (51 women 30-55 y.o., M±SD: 41±5), (2) working day and afternoon shifts (42 women 30-52 y.o., M±SD: 42±6). Two sleep related complaints were considered: (1) sensitive sleep and (2) sleep loss due to excitement. TTEST and Pearson correlation at p< 0,05 were applied.
Results: Telephonists of both groups showed no formed burnout syndrome except for resistance phase that is at the stage of forming; initial stage of chronic fatigue development; mean-population tempo of biological aging and HCI scores corresponding to the mean ages of the studied groups - at no significant differences between the groups. They slept about 8 hours per day (M±SD: 8,18±1,01 and 7,89±1,01 correspondingly, p=0,16). Sensitive sleep reported 61% and 56% of subjects within the first and second groups correspondingly, sleep loss due to excitement - 64% and 74% correspondingly. In this, amongst 1st group of workers the extent of burnout development (and each of three its phases - tension, resistance and exhaustion) positively correlated to the length of the daily sleep (p< 0,05), while amongst 2nd group - only the extent of the tension stage of burnout development did this. This phenomenon took place amongst workers of the 1st group who did not report the sleep related problems. No significant correlation was found between the length of daily sleep and the extent of CF development, HCI, PI or BAT values. The extent of CF development, HCI and PI were pronounced in workers who complained about sleep related problems compared to those who did not complain (p< 0,05) except for the 1st group of workers regarding sensitive sleep complaints. The same regularity was found in BAT of workers of the 1st group regarding the sleep loss reports and workers of the 2nd group regarding the sensitive sleep reports.
Conclusions: Sleep problems are accompanied with the increase in chronic fatigue, health complaints and pathological development contributing into the accelerated biological aging tempo. The enough length of sleep is the important restoring resource for night workers regarding the burnout development that is eliminated by the sleep problems. To normalize the daily sleep conditions for night workers is necessary to maintain their health and longevity.

SLEEP COMPLAINTS RELATE TO THE ANXIETY, CARDIOVASCULAR HEALTH, OBESITY AND SUBJECTIVE WELL-BEING IN TRUCK DRIVERS

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Introduction: Sleep complaints, cardiovascular diseases and obesity are the wide spread health problems of night and shift workers. Anxiety is occupationally vital characteristic of human-operators of moving objects as the known criterion of the reliability and safety of their work. The purpose was to reveal the relations of sleep complaints to the anxiety, cardiovascular health, obesity and subjective well-being in international truck drivers.

Materials and methods: Eighty six truck drivers aged 28-67 years old were observed by measured heart rate, blood pressure systolic and diastolic, height, weight, waist, ECG registration and questionnaires. Health complaints index (HCI) and pathological index (PI) were calculated by Voytenko´s method from 29 points of the questionnaire. Two sleep related complaints in connection with the other studied parameters were investigated:
(1) sensitive sleep and
(2) sleep loss due to excitement.
TTEST at $p < 0,05$ was used to compare shiftworkers of 2 groups: those who complained, and those who did not complain - for each problem separately; and also for 4 groups: those who did not complain for two problems, who complained for the sensitive sleep only, who complained for the sleep loss only and those who complained for both problems.

Results: Sensitive sleep and sleep loss both complaints were accompanied with higher personal anxiety (within its middle level - by Spielberger-Khanin) compared to those who did not complain ($p < 0,001$) mainly for the account of sleep loss ($p < 0,004$). Similar relations were found regarding HCI increase ($p < 0,0001$ and $p < 0,0001$ correspondingly). PI increased mainly for the account of sleep loss ($p < 0,002$). Sleep loss was accompanied with felt stronger fatigue ($p < 0,001$), tension ($p < 0,005$), lower mental workability ($p < 0,05$) at the lowest cardiac output (tendency level: 2,98 l versus 3,61 l, $p < 0,07$) and pronounced changes in ECG parameters reflecting a worsening in myocardial contractility, increase in QT/QTc and STj ($p < 0,05$). Sensitive sleep was accompanied with bigger weight (100,2 kg versus 87,1 kg in those who did not report the sleep problems - at no significant difference in height; $p < 0,008$) and waist girth (108,2 cm [abdominal obesity] versus 97,5 cm [abdominal overweight]; $p < 0,011$), heart pain complaints ($p < 0,03$) and the necessity to use heart medications ($p < 0,03$) at some changes in ECG parameters.

Conclusions: Sleep complaints manifest strong ties with the increase in personal anxiety, health problems and deterioration in felt workability of truck drivers. Sleep loss due to excitement is accompanied first with the worsening in myocardium function, anxiety and workability under increase in health complaints. Sensitive sleep is accompanied rather with obesity related problems and heart pain complaints. The improvement the hygiene of sleep is required to maintain health and workability of truck drivers.

Chronobiology/Circadian Disorders
Board #078 : Poster session 3
EFFECT OF CHRONOPEDAGOGY AND CLINICAL SYMPTOMS ON ACADEMIC PERFORMANCE IN A SAMPLE OF COLLEGE STUDENTS: AN EXPLORATORY STUDY

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Introduction: Chronopedagogy is a recent approach in neuroeducation consisting of delaying college schedule to adjust it to the delayed circadian and homeostatic system of young adults. The goal is to enhance academic performance by introducing a greater opportunity for sleep. In autumn 2018, a college in Quebec (Canada) has instituted a delayed college start time (i.e. starting at 9 AM) for more than 50 % of their students. In this study, we aimed to determine the predicted effect of chronopedagogy and clinical symptoms (i.e. anxiety, depression and insomnia) on academic performance. Each clinical variable is known to negatively impact performance.

Materials and methods: 64 students (17 - 22 y; M = 18.59 y, SD = 1.28 y) from one Quebec college completed questionnaires containing questions about demographics (age, sex, college parameters), clinical information (medication, diagnosis), depression (CES-D, score ranging from 0 to 60), anxiety (BAI, score ranging from 0 to 63), insomnia symptoms (ISI, score ranging from 0 to 28) and their dominant chronotype (MEQ, score ranging from 16 to 86, higher score meaning a more pronounced morning chronotype). Participants also gave use access to their final academic score calculus (score ranging from 0 to 40+). Using a multiple regression analysis, we aimed to determine which variables better predict academic performance.

Results: Of the 64 students (87% females), 20 (31%) declared living on a college schedule starting mostly at 9 AM. A multiple linear regression was calculated to predict academic performance based on college start time (i.e., chronopedagogy), number of schooling years, college program, chronotype and depressive symptoms. The results of the regression indicated that the model explained 24% of the variance (adjusted R^2=0.24, $F_{(5,58)}$ = 4.982, p = 0.001). Higher chronotype score (β=0.136, p=0.245) and schooling years (β=0.147, p=0.191) predicted greater performance score. Plus, higher score on the depression scale (β=-0.170, p=0.143), a later school time (β=-0.228, p=0.047) and a more condensed college program (i.e. technical education program; β=-0.364, p=0.002) predicted lower performance score. Only college start time and college program (p < 0.05) were significant predictors of academic performance.

Conclusions: In view of our results, interventions to promote greater sleep opportunity in college students cannot be declared beneficial for academic performance. Conversely, the typical college start time (i.e. 8 AM) predicted better performance. Though, an important limitation of this study is the small number of participants. Anterior studies have shown contradictory results, exposing that delayed college schedule increased performance. However, some of our results converge with anterior studies, suggesting that more pronounced depressive symptoms and more condensed college program predict inferior performance. Morning type chronotype and more schooling years were also predictors of better academic performance which support prior results.Further studies investigating chronopedagogy should include measures such as motivation in school, objective sleep quantity and efficacy and whether or not students modified their schedules by themselves as a way to better understand the effect of college start time on academic performance.

CALORIC INTAKE IN NORMAL WEIGHT, OVERWEIGHT, AND OBESE ADOLESCENTS: CIRCADIAN AND HOMEOSTATIC INFLUENCES MEASURED FROM 28-HOUR FORCED DESYNCHRONY (FD)

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Introduction: Earlier (circadian) meal timing is associated with more favorable weight outcomes, including lower weight, reduced weight gain, and greater weight loss. Whether caloric intake across the endogenous circadian cycle and/or time across the waking day differs depending on body weight is unknown. The pattern of caloric consumption across days that are aligned or misaligned with circadian time is also unknown for adolescents. We addressed these issues in adolescents using 28-h forced desynchrony (FD), hypothesizing that overweight (OW) and obese (O) adolescents have a higher proportion of daily energy consumed later in the wake episode and at a later circadian phase compared to normal weight (NW) adolescents. Caloric intake across days that are in alignment or misaligned to circadian phase was also assessed

Materials and methods: Fifty-one (29 male) adolescents (12-15yr) completed 7, 28-h FD cycles in dim light, with saliva collected for subsequent melatonin assessment. Six meals occurred at fixed times each cycle: Meal1 was 1.7h after scheduled awaking, Meal2 was 2h after Meal1, and Meals3-6 followed at 3-h intervals. Foods were selected about 1h before each meal from a menu of approximately 100 items arranged into discrete categories and with category limitations; food items were weighed before and after each meal. Proportion of energy intake for each meal across each wake episode was computed relative to total energy consumed in that FD cycle. Weight categorization used body mass index (BMI) percentiles (CDC): NW (>5th and < 85th; n=24), OW (≥85th and < 95th; n=13), or O (≥95th; n=14). Endogenous circadian period was determined using salivary melatonin onsets (Mean period: NW=24.19h; OW=24.23h; O=24.22h); time points for every protocol event within participant were assigned a circadian phase based on computed period. Effect of circadian phase and of time since scheduled awakening was assessed by Repeated Measures ANOVAs using 6 circadian and 6 time-awake bins. Aligned and misaligned "days" were FD cycle 1 and FD cycle 4, respectively

Results: Repeated Measures ANOVAs of 6 circadian and time-awake bins indicated a significant influence of time awake ($F(5,2086)=113.5, p< .01$) that differed by weight category ($F(10,2076)=4.9, p< .01$), with O group showing more consistent consumption across the day and a greater relative caloric intake in the last meal of the day compared to the other two groups. There was also a significant circadian influence ($F(5,2086)=38.08, p< .01$) that differed by weight category ($F(10,2076)=2.75, p < .01$), with O group showing a lower amplitude and later acrophase. We also found a significant effect of alignment ($F(5,550)=14.32, p< .01$) that differed by weight category ($F(10,528)=2.21, p=.02$), with aligned vs. misaligned days showing lower consumption at the end of the day and the difference being less pronounced in O group.

Conclusions: Consistent with our hypotheses (though only for the obese adolescents), the O group showed higher consumption in the evening and at a later circadian phase compared to other weight groups. The circadian phase of peak intake was later, amplitude lower, and misalignment influences weaker for O group compared to OW and NW groups.

Chronobiology/Circadian Disorders
Board #059 : Poster session 1
SHIFT WORK AND SLEEP PATTERNS AMONG PREGNANT NURSES USING ACTIGRAPHY

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Introduction: Millions of American women work shift schedules and half of them do so when of childbearing age. Sleep disturbances are prevalent in individuals with night or shift schedules. Very little research has objectively examined the effects of shift work on sleep disturbances during pregnancy beyond pregnancy-associated changes in sleep patterns.Prior studies have observed an association between short sleep duration and adverse pregnancy outcomes. Therefore, the effect of shift work during pregnancy on sleep is an important clinical and public health issue. This study aims to describe the relationship between shiftwork during pregnancy and sleep patterns throughout pregnancy.

Materials and methods: This prospective cohort study included 32 pregnant nurses who worked on inpatient units, were younger than 45 years of age and 6 to 20 weeks of gestation when enrolled . Assessments of work schedule and sleep measures were completed at: 1) 14 to 20 weeks; 2) 21 to 28 weeks; and 3) 30 to 36 weeks of gestation. At each assessment, participants shared their work schedule for the preceding 2 weeks. The outcome of interest was sleep during pregnancy including total sleep time per 24 hour period including naps, sleep efficiency, sleep onset latency, wake after sleep onset, and wake occurring during the sleep period. Sleep information was collected using actigraphy and sleep diaries for 7 days. We used mixed-effects models to examine crude and adjusted associations between shift work and sleep parameters.

Results: The mean maternal age was 29.8 (SD 4.43) years. The majority of study subjects were married and of non-Hispanic white race. Fifty-six percent of subjects were overweight or obese prior to pregnancy and the average participant had 1 child. Most subjects reported day shift only as their typical work schedule type during pregnancy. Interestingly, about one third of enrolled nurses worked nights or rotating with nights during pregnancy. The majority of the enrolled nurses reported working more than 60 hours per week in the preceding two weeks. Pregnant nurses working shift schedules experienced significantly lower sleep efficiency than those who worked day schedules. However, total sleep time, sleep onset latency, and duration of wake after sleep onset throughout pregnancy appeared to be similar for nurses who worked day schedules and shift work.

Conclusions: The present study used wrist actigraphy to measure sleep parameters throughout pregnancy among nursing professionals.The main strengths of the present study lie in the objectively measured sleep parameters and the repeated assessments of shift work exposure prospectively throughout pregnancy. Most previous studies primarily assessed self-reported sleep quality and quantity with a single measure occurring at a variety of times during pregnancy. Our study found few differences between day and night shift with regard to sleep parameter among pregnant nurses except for sleep efficiency. Longitudinal studies with larger sample sizes are needed to validate our findings and determine the impact of shift work on sleep in women during pregnancy in order to maximize maternal and fetal outcomes.

Chronobiology/Circadian Disorders
Board #079 : Poster session 3
EFFECTS OF LIGHT ON DAYTIME SLEEP AFTER 12H NIGHT SHIFT WORK

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Introduction: Night shift workers experience difficulty in sleeping because their internal circadian rhythms rarely phase shift to align with the sleep-wake schedule demanded by their jobs. The daytime sleep of night workers is shorter than that obtained at night, by about 2-4 h. This study aimed to investigate the role of environmental light on daytime sleep after 12h-night shift work.

Materials and methods: We enrolled 12h- shift female nurses working at one university-affiliated hospital (n=23, mean age 26.6±2.95 years, shift work duration 4.0±3.00 years). This is a cross-over study to examine the effects of minimal environmental light exposure (30 lux) compared with darkness (< 5 lux) on daytime sleep after 12h-night work. The schedules of participants were the same as DDNN and 4 consecutive free days. Two sessions of experiment were conducted on the daytime sleep after 1st night shift within one month intervals. Participants were allowed to sleep according to their habitual sleep time. Participants completed the self-reported sleep questionnaires, habitual sleep after the 1st night shift, and previous sleep before PSG. After awakening from daytime sleep, they performed the psychomotor vigilance test (PVT), which includes mean reaction time (RT), number of lapses, and number of false starts and estimated sleep latency and duration.

Results: Significant health problems were found in participants such as insomnia (87%), gastric soreness (65.2%), irregular menstruation cycles (34.7%), or depressive mood (30.4%). 70% of participants suffer from clinically significant insomnia (mean ISI 16.7). According to sleep diary, they slept more than 9.5 h after 2 consecutive day shifts, while sleep time after 1st night shift was reduced to 5.1±1.16 h. Time in bed was significantly longer under darkness (6.01 h) compared to light exposure (5.41 h, p=.031). Other polysomnography parameters were not different between sessions. Sleep latency, efficiency, and sleep structure were within normal regardless of light exposure. REM sleep latency was not different but shortened in both sessions (64.6 vs. 50.9 min, p=.101). Mean RT of PVT was definitely shortened after sleep under darkness than light exposure (271.4 vs. 295.1 msec, p=.023).

Conclusions: This study showed that daytime sleep of 12h night shift workers was well-maintained both under darkness and light exposure. Sleep parameters and alertness were not impaired even under 30 lux light exposure. Normal sleep and shorter REM latency suggest that homeostatic pressure (Process C) might compensate the difficulty of sleep initiation by the circadian misalignment (Process S) in 12h night shift workers. It is remarkable that the alertness was better after sleep under darkness compared to light exposure.

Chronobiology/Circadian Disorders
Board #075 : Poster session 2

QUANTITATIVELY DECODING THE CIRCADIAN TRANSCRIPTIONAL REGULATIONS: AN ADVANCED APPROACH IN SLEEP MEDICINE

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The day-to-day physiologies are largely influenced by circadian rhythms. Disruption of such rhythms is associated with many diseases. Among which the circadian rhythms disrupted sleep disorders (CRSDs) have become a global psycho-social and public health issues. It is also linked with many moderate-to-severe life-threatening diseases.

Adjusting the disturbed circadian rhythms to a healthy one can be promising to treat CRSDs. However, the regulations underlying the circadian rhythms are much complicated and systematic. It may involve thousands of genes. Temporal recruitment of core-clock proteins, different transcriptional and translational regulators and chromatin modifications are imperative towards a comprehensive understanding of the spatio-temporal regulation of such complex rhythms. Despite many experimental affirmations about the circadian transcriptional controls, there is still an interesting question remains unexplored that how do these few components belonging to the same molecular architecture are capable to govern such divergent gene expressions? Nevertheless, how they are being regulated and their regulatory logics have not gained any inclusive attention yet. Thus, a systematic understanding considering all-encompassing circadian TFs and their relational interplay could help us to unleash their potential to therapeutically modulate the circadian rhythms. Experiments alone are indeed quite challenging to achieve this.

Interestingly, several studies indicated the knockout of the circadian transcriptional factors (TFs) results in changing the rhythms. And, rescuing them helps to regain the circadian functionality substantially. However, knocking out all possible combinations of circadian TF-genes experimentally is merely very tedious, time-consuming and expensive. Also, some essential genes cannot be knocked out. Besides, another challenge is not yet well elucidated before, could be enlightened using our study. The CRSDs are mostly diagnosed with delayed or advanced phase shifts of the individual´s circadian rhythms, knowingly, delayed sleeping phase syndrome (DSPS) or advanced sleeping phase syndrome (ASPS) respectively. Advanced sleep-medicine must demand to adjust those misaligned rhythms. But, how to adjust those misaligned rhythms triggering at the molecular level is still a big challenge to be resolved. Theoretically, some extent of molecular level discrepancies among the DSPS and ASPS can be perceived. Hence, aligning the disturbed rhythms by means of advancing the phase in DSPS and delaying the phase-in ASPS to achieve the rightly aligned circadian rhythmicity to treat CRSDs, the recommendations for molecular targets for therapeutic interventions must be different in both conditions. Thus, the real challenge is not only aligning the rhythms but also, having a strong understanding of the directionality of the alignment varying in different clinical contexts is the most crucial.

Therefore, to address these ambiguities, a quantitative understanding of the circadian gene regulation and the molecular interplay among the key regulators are quite important. Here, we introduced a computational approach, to decode the quantitative transcriptional regulatory landscapes of circadian genes. Based on which, we were able to engineer the molecular regulators underpinning the circadian rhythms. This potentially indicates a clue towards adjusting the circadian rhythmic phases in desired directions depending on clinical requirements.

Chronobiology/Circadian Disorders
Board #076 : Poster session 2
NON-DIPPING AND SLEEP OUTCOMES IN AFRICAN-AMERICAN NON-STANDARD SHIFT WORKERS

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Introduction: Shift work has been associated with increased risks for cardiovascular disease (e.g. hypertension, atherosclerosis, stroke, heart failure, arrhythmias) as well as alterations in lipid metabolism, insulin resistance, and disrupted diurnal patterns of growth hormone and glucocorticoid release. In a report issued by the Bureau of Labor Statistics (2005), while 16.7% of white Americans sampled in May 2004 were working either the night shift or rotating shifts, African Americans (23.2%) were more likely to work an alternative shift when compared to other racial/ethnic groups. Clinical and epidemiological studies have provided evidence that shift work, particularly night shift or rotating shifts, produces sleep loss, internal circadian desynchrony and cardiometabolic disease; however, there is a paucity of data in underserved minority populations. In this study, we examined the association of non-dipping nocturnal blood pressure and sleep outcomes in a cohort of non-standard African-American shift workers.

Materials and methods: Cross-sectional study of self-identified, African-American shift workers in the Atlanta metro area. All study participants were ages 18-65 engaged in non-standard shift work for at least 12 months. Information on demographics, occupational and medical history, education, smoking status and physical activity were collected. Participants were excluded for any history of hypertension, diabetes, hyperlipidemia, myocardial infarction, stroke, coronary artery disease, obstructive sleep apnea, pregnancy or taking any antihypertensive medication or a medication known to affect blood pressure. We administered study related baseline vital signs, anthropometric measures, questionnaires of Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and the Horne-Ostberg Morningness-Eveningness (MEQ). Participants were also tested with an ambulatory blood pressure monitor to assess 24-hour blood pressure and heart rate changes. Wrist actigraphy was used to measure sleep-wake timing, sleep latency, sleep efficiency, arousals and total sleep time for 7 days duration.

Results: A total of 44 participants, male (79%) and female (20%) were studied. 75% of the participants worked night shift and 63% were morning chronotype. 42% of the participants were dippers and 57% non-dippers. Amongst individuals with daytime sleepiness (34%) non-dipping was more common. We found a statistically significant relationship between non-dipping status and increased sleep fragmentation (p=0.03).

Conclusions: Increased disease states in African-Americans involves genetic and environmental factors. The implications of circadian misalignment and sleep loss should be considered as we strive for health equity in African-American shift workers.

THE EFFECT OF ROTATING SHIFT SCHEDULES ON SLEEP, MOOD, STRESS, ENERGY EXPENDITURE AND PHYSICAL ACTIVITY OF AUSTRALIAN PARAMEDICS: A FIELD STUDY

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Introduction: Shift-work disrupts normal circadian rhythmicity, which can have both acute and chronic effects on health and performance. Few studies have investigated, in-depth, the acute effects of different phases within a shift schedule on sleep, mental health, and physical activity. This study aimed to investigate the effect of rotating shift across four consecutive time points within the shift schedule on sleep, mood, stress, energy expenditure and physical activity in Australian paramedics.

Materials and methods: Paramedics working on a rotating roster were invited to take part in a field study across four consecutive time points within their eight-day shift schedule: pre-shift day (PSD), day shift (DS), night shift (NS), and recovery day (RD). Participants wore an actigraphy device (Phillips Actiwatch 2) and BodyMedia SenseWear Armband (BSA). They also completed the following battery of tests: Pittsburgh Sleep Diary, Karolinska Sleepiness Scale, Samn-Perelli Fatigue Checklist, Positive and Negative Affect Scale and a self-reported stress rating. Actigraphy and BSA were worn throughout the protocol to record sleep, galvanic skin response (GSR), energy expenditure and physical activity (step count). The sleep diary was completed before and after bedtime. Sleepiness, fatigue, mood and stress ratings were completed before, during and after work or at the same times during break/recovery days. Repeated measures ANOVA were used to examine the effect of the shift period (PSD, DS, NS, RD) on the outcome measures.

Results: Twelve paramedics (Mean age = 39.91±11.04 years; women=7) from Victoria, Australia, participated in the study. There was a significant effect for shift periods on total sleep time (TST) measured by actigraphy ($F(1.66, 13.27) = 17.56$, $p < 0.001$). *Post hoc* tests using Bonferroni correction revealed that TST during the NS (3.56±1.51 hours) was significantly lower compared to PSD (6.36±1.35 hours; $p < .001$), DS (7.15±1.28 hours; $p < .05$), and RD (7.24±1.28 hours; $p < .05$). Similarly, stress, sleepiness, and fatigue during NS were significantly higher compared to PSD and DS (p's $< .05$). However, the levels of stress and fatigue were significantly higher during the RD compared to PSD (p's $< .05$). The recorded levels of physical activity were significantly higher across NS compared to PSD ($p < 0.05$). The levels of GSR, energy expenditure, positive and negative affect did not significantly change across the shift schedules.

Conclusions: Paramedics recorded significantly lower sleep duration when on night shift compared to other times in their schedule. Also, paramedics recorded a significantly higher amount of physical activity when on night duty compared to pre-shift day, possibly due to being awake for a longer period of time. Despite reporting significantly higher levels of stress, fatigue, and sleepiness while on night shift compared to pre-shift and day shift, levels of stress and fatigue were still significantly elevated during the first recovery day compared to pre-shift. Having one day of recovery after night duty may not be enough to allow paramedics recover fully. The findings of this study may assist in developing shift schedules that lead to less sleep disruption and better control of occupational fatigue and stress.

Chronobiology/Circadian Disorders
Board #080 : Poster session 3

IMPLEMENTATION AND EVALUATION OF A NAP-AT-NIGHT INTERVENTION FOR FRONT-LINE HOSPITAL STAFF IN CRITICAL CARE

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In Canada, approximately 45% of healthcare workers are shift-workers. Although planned naps at night are recommended to alleviate sleepiness and performance decrements, there are barriers in the hospital setting including being too busy, understaffed, lack of safe napping spaces, and lack of management support. Few studies have implemented and evaluated a nap-at-night strategy during work-breaks for front-line hospital staff.
We established a working group including front-line staff for a trial implementation of a nap-at-night on night shifts and obtained feedback regarding the study protocol and its implementation. Concerns and logistical issues were addressed, and Corporate and Union support for the nap intervention trial was obtained. We held information sessions on sleep and shiftwork with staff including nurses, unit clerks and patient care assistants, and provided guidelines for the nap-at-night study. In the unionized setting, rest breaks may be a total of 45-90 minutes in length for a 12-hour shift, and 30-60 minutes for an 8-hour shift. When staff went for a nap, they informed their co-worker, they kept the Vocera logged in and charged in case of emergent contact, adhered to their respective union break rules, and were responsible for setting their own alarms. A nap logbook was used for staff to sign-up for breaks, of up to one-hour scheduled between 00:30 to 05:30, in a nap room with a recliner chair that was in close proximity to the inpatient care unit. A baseline survey for front-line staff examined night-time sleepiness and fatigue, overall sleep quality and current practice for breaks. We initiated the intervention on March 1, 2018 with a post-intervention survey seven months later.
Thirty-nine participants completed the baseline questionnaire, mean age 34 years and average of 9 years shiftwork. At baseline, 69% (n= 27) reported that they did not nap at night. After seven months, 53 staff completed the survey, mean age 36 years and average of 10 years shiftwork. Out of 82 staff, the response rate improved from 48% to 65%. Compared to 31% at baseline, after seven months 56% of staff reported taking a nap-break away from the bedside. With implementation of the intervention study, 98% of staff felt comfortable/ supported to take breaks on a night shift compared to 75% at baseline; 90% felt that taking a nap was beneficial. Our nap logbook demonstrated that more staff scheduled and took a break from 37 naps during the first month to 174 naps twelve months later and peak nap timing 4:00-5:00 AM.
Staff surveys post-trial reported better sleep quality, less sleepiness/fatigue during night shifts and higher scores of overall health. As a balance measure, we evaluated the number of staff-reporting patient safety incidents on night shifts. The number of patient safety incidents as a rate of overall unit occupancy was static with a slight decrease in incidents reported in one month. The successful outcomes of the napping trial have resulted in nap-at-night becoming a permanent practice on the unit.

THE EFFECT OF WATER LOADING FOR ACUTE WEIGHT LOSS FOLLOWING FLUID RESTRICTION ON SLEEP QUALITY AND QUANTITY IN COMBAT SPORTS ATHLETES

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Introduction: Combat sport athletes commonly engage in established and novel acute weight loss strategies to achieve weight division targets. The effect of such practices on sleep is unknown.This study examined the effects of best practice acute weight loss, both with and without the use of a novel technique (water loading) on sleep.

Methods: Twenty-two combat sports athletes wore wrist actigraphy devices for nine days/nights during a training camp and completed questionnaires assessing daytime sleepiness, insomnia, sleep apnoea and chronotype. Athletes were assigned to a control (CG) or water loading group (WLG). Both followed a low residue diet for 96 h-, and restricted fluid for 24h- prior to weigh-in. Prior to restriction, CG consumed 40ml/kg and WLG consumed 100ml/kg fluid daily.

Results: Four athletes responded positively for the potential prevalence of sleep apnoea (2 CG/WLG), reporting subthreshold insomnia 8±4, athletes were assessed as "intermediate chronotype". Sleep latency estimates in CG were greater on days 4/6 relative to 3 ($p < 0.05$). There was a between group difference for sleep latency on day 6, with CG taking 35 mins longer (95% CI 5-64 mins, p=0.022) to fall asleep.

Conclusion: Acute weight loss by means of a low residue diet, both with and without water loading before fluid restriction is a safe and effective means of manipulating body mass to in the context of sleep.

SLEEP PROBLEMS MEDIATE THE RELATIONSHIP BETWEEN CHRONOTYPE AND SOCIOEMOTIONAL PROBLEMS DURING EARLY DEVELOPMENT

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Introduction: Studies have found that evening-chronotype (optimal physical and mental functioning during evenings in school-aged children is associated with elevated risks of socioemotional problems and symptoms of psychopathology. Moreover, these children also experience greater sleep problems compared to school-aged children with morning chronotype (optimal physical and mental functioning during mornings). However, similar studies in preschool children are limited.

Materials and methods: The current study included 491 typically-developing 4-year-old children from the Growing Up in Singapore Towards healthy Outcomes (GUSTO) birth cohort study. The GUSTO study is a longitudinal study that investigates how conditions during pregnancy and early childhood may affect the development of women and children in a multi-ethnic Asian population. Level of morningness/eveningness was assessed using the parent-reported Children´s Chronotype Questionnaire, and supported by objective measurement of midsleep-point based on sleep actigraphy of the child, while sleep problems were measured with the parent-reported Child´s Sleep Habits Questionnaire. Socioemotional problems were examined with the parent-reported Child Behavior Checklist while symptoms of psychopathology were investigated using a structured clinical interview, the Computerized Diagnostic Interview Schedule for Children (CDISC-IV).

Results: After adjusting for potential confounding factors such as ethnicity, maternal education and maternal mood, increased levels of eveningness were significantly associated with greater parent-reported sleep problems and socioemotional problems. In addition, we found results suggesting that sleep problems play a mediating role in the relationships between eveningness and internalizing, externalizing and total behavioral problems, as well as symptoms of psychopathology such as anxiety problems, compulsive behavior, attention problems and oppositional behavior. Intriguingly, when analyses were stratified by gender, sleep problems fully mediated the relationship between eveningness and multiple symptoms of psychopathology in girls but only for attention problems in boys.

Conclusions: Given that sleep problems are potentially modifiable, the results of our study provide clinical implications that development of socioemotional problems and symptoms of psychopathology may be circumvented by improving sleep during early development, particularly among preschool children with greater levels of eveningness. Our findings suggest that it may be important to also take into account gender as a risk factor for early symptoms of psychopathology.

RESULTS OF A PHASE 1, 4-PERIOD CROSSOVER, PLACEBO-CONTROLLED, RANDOMIZED, SINGLE DOSE STUDY TO EVALUATE THE SAFETY, TOLERABILITY, PHARMACOKINETICS, AND PHARMACODYNAMICS OF TAK-925, A NOVEL OREXIN 2 RECEPTOR AGONIST, IN SLEEP-DEPRIVED HEALTHY ADULTS, UTILIZING MODAFINIL AS AN ACTIVE COMPARATOR

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Introduction: Interaction of orexin at the orexin type 2 receptor (Ox2R) has been shown to modulate wakefulness and sleep in multiple preclinical studies in mice and monkeys. Orexin levels are believed to increase during waking hours and decrease at night based on measurements in cerebrospinal fluid in both humans and nonhuman primates. TAK-925, a selective Ox2R agonist, has been previously reported to increase wakefulness time during nocturnal sleep time in cynomolgus and marmoset monkeys. This translational study is the first evaluation of whether supplementation of orexin stimulation will increase wakefulness during normal sleep times in sleep-deprived humans with a normal orexin system. We report the results of a single dose of a novel Ox2R agonist on maintaining wakefulness in an acute sleep-deprived condition in healthy male volunteers (ClinicalTrials.gov Identifier: NCT03522506).

Materials and methods: This was a phase 1b, single-center, randomized, double-blind, double dummy, placebo- and active-controlled, 4-period crossover study in sleep-deprived healthy male volunteers. The primary objective was to determine the effect of 2 different doses of TAK-925, given as a single intravenous (IV) infusion, compared to placebo on promoting wakefulness as measured by sleep latency on the Maintenance of Wakefulness Test (MWT). Modafinil 300 mg was used for assay sensitivity. Subjects were randomized equally to 4 sequence groups, which defined the order of treatment administration. The 40-minute MWT was performed approximately 2, 4, 6, and 8 hours after IV infusion, starting at approximately 1:00 AM. Secondary objectives included i) assessment of safety, tolerability, and pharmacokinetic (PK) parameters of a single IV infusion of TAK-925 in these study subjects, ii) assessment of the effect of a single dose of modafinil 300 mg on promoting wakefulness as measured by sleep latency on the MWT to confirm sensitivity of the assay, and iii) evaluation of the effect of TAK-925 on the Karolinska Sleepiness Scale (KSS), a subjective measure of sleepiness, compared to placebo.

Results: Twenty subjects were enrolled and 18 completed the study. Results of the MWT showed increased wakefulness with administration of both doses of TAK-925, which was significantly higher than with placebo administration. Administration of modafinil demonstrated assay sensitivity, with clear effects on wakefulness. The PK profile was linear and the drug was rapidly cleared after the infusion was stopped. Dose response data for the MWT and KSS are under analysis and will be presented. Single doses of TAK-925 IV infusion were well tolerated at the doses tested in healthy volunteers. Specifics of TAK-925 safety and tolerability will be reported.

Conclusions: The use of an Ox2R agonist resulted in increased wakefulness at night in healthy sleep-deprived male volunteers. This study suggests that an Ox2R agonist may be useful in treatment of conditions characterized by excessive sleepiness in which orexin systems are normal or near normal. Further clinical studies are warranted.

OBJECTIVIZATION OF CHRONO-BIOLOGICAL PARAMETERS USING ACTIGRAPHY

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Introduction: Actigraphy is a non-invasive observational method used to study activity patterns in the individual´s personal environment. Although there is a variety of promising ways to estimate circadian parameters from actigraphy, there is no consensus on the use and interpretation of some actigraphic parameters, especially when compared to subjectively defined questionnaire-based circadian, such as social jet-lag (SJL) or individual circadian preference - chronotype. Our goal was to compare actigraphy calculated parameters with chronotype and social jet-lag questionnaire scores to foster standardization in actigraphy-related chronobiology.

Materials and methods: In this study, a wristband (MindG actigraph by Mindpax.me) was worn on the wrist of the non-dominant arm in 129 women for up to three months. All participants were screened by the Morningness-Eveningness Questionnaire (MEQ), Munich Chronotype Questionnaire (MCTQ for MSFsc and SJLrel ie. social jet-lag). Exclusion criteria: less than 20 valid recorded days and BMI>55kg/m^2 resulted in sample size n=122. We selected actigraphy parameters which we assumed to be closely connected to their subjective counterparts: cosinor analysis (acrophase), non-parametric features (interdaily stability - IS, M10time, L5time - the time of the most/least active 10h/5h time window in averaged daily activity and their free days version M10time$_{free}$, L5time$_{free}$) sleep parameters based on actigraphy (mid-sleep time, MSFsc$_{Acti}$, SJL$_{Acti}$). The relationship between chronotype scores and predictors were tested using univariate linear regression. Results were corrected for multiple comparisons using the Bonferroni correction (n = 18). The prediction root mean square errors (RMSE) were estimated on test sample using 5-fold cross-validation. All feature extractions were performed on raw actigraphy data. All analyses, apart from sleep detection, and statistics were done using the Matlab 2018b.

Results: Multiple actigraphy parameters were significantly correlated with the MEQ: Acrophase, Mid-sleep, MSFcs$_{Acti}$, L5time, L5time$_{free}$ (all p< 0.0001), M10time (p=0.0026) and M10time$_{free}$ (p=0.0059). Similarly, the MCTQ-MSFcs, was significantly correlated with Acrophase, Mid-sleep, MSFcs$_{Acti}$, L5time (all p< 0.0001), the L5time$_{free}$ (p=0.0003) and M10t (p=0.0055), but not M10time$_{free}$ (p=0.075). The average prediction error measured by RMSE varies from 7 MEQ points (Mid-sleep) to 8 MEQ points for (M10time and M10time$_{free}$). In the case of MCTQ-MSFcs the average RMSE is around 45-47 minutes for the highly significant features. For MCTQ-SJLrel the most useful predictors are SJL$_{Acti}$ and difference in Mid-sleep between free and working days (p< 0.0001, RMSE 47-49 minutes), IS was also significant (p=0.0269).

Conclusions: In this study we were looking for an actigraphy counterparts to self-estimated questionnaires which are prone to overestimation or underestimation and their results can often be influenced by current fatigue or mood. Objective measurement using actigraphy can replace the subjective determination of circadian markers (chronotype, mid-sleep, SJL). The expected deviation in the measurement is 7-8 points on the MEQ scale and 45-49 minutes on the MCTQ scales which is close the test-retest reliability of the questionnaires themselves.

Chronobiology/Circadian Disorders
Board #078 : Poster session 2
ON-CALL WORK AND SLEEP: WHAT ABOUT THE PARTNERS?

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Introduction: On-call work is an effective way for emergency service agencies to manage unpredictable service demands. However, as on-call arrangements are frequently used overnight, there are well known adverse impacts for sleep of on-call personnel. In addition, there is some evidence that sleep is disturbed even in the absence of calls. Sleep is a critical element in physical and mental health and well-being, in addition to being important for optimal functioning. While a growing body of research is focused on supporting the sleep of on-call personnel, little attention has been paid to the impact of on-call work on the sleep of co-sleeping partners. Our work and others' shows that partners play a critical role in supporting on-call personnel to fulfil their roles, and thus their physical and mental well-being is an important part of the equation. This study examined the self-reported impact of on-call activity on the sleep of partners of auxiliary firefighters and consequences for sleepiness and relationship quality.

Materials and methods: Sixty partners (93% female) completed an anonymous online survey to assess sleep, daytime sleepiness and relationship quality in relation to their partner's on-call commitments. Information about the study was sent to auxiliary firefighters via email listings of the state fire service and social media networks. Firefighters were requested to pass the link to the survey to their co-sleeping partners to complete. Data were analysed using the Pearson's chi-square test (to determine impact of on-call activity on sleep of partners), Wilcoxon Signed Rank test (to compare perceived sleep quality on nights with and without calls), Spearman's rho correlation (to assess direction and strength of the association between on-call activity and partner sleep outcomes and relationship happiness) and Mann-Whitney U tests (to detect differences between poor and good sleep of partners in relation to relationship happiness).

Results: Subjective sleep quality was significantly poorer on nights with calls, than on nights without calls, mostly related to disturbance by the on-call alarm. There was a significant association between the frequency of sleep disturbances related to calls and sleep quality. No significant associations were found between on-call sleep disturbances and sleep duration, next day sleepiness or relationship happiness. Further, there were no differences in levels of relationship happiness reported by co-sleeping partners who had poor sleep and those who had good sleep.

Conclusions: This study is an important first step in understanding the impacts of on-call working time arrangements for co-sleeping partners. As expected, sleep of co-sleeping partners was impacted by the on-call alarm. However, this does not appear to translate to negative outcomes for relationship happiness. Another finding from this study was that participants on the whole, were supportive of their partner remaining in the on-call role. This suggests that the sleep disturbances experienced by the co-sleeping partner are an accepted feature of the on-call work. Future research should explore the extent of the sleep disturbance using objective measures, and assess next-day and longer term consequences of disturbed sleep.

TAILORED LIGHTING INTERVENTION TO IMPROVE SLEEP IN PATIENTS WITH DEMENTIA

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Introduction: Sleep disturbances are one of the main reasons why patients with Alzheimer´s disease and related dementia are placed in institutions. Sleep medications are not always effective and can have serious side effects. Light is the major synchronizer of circadian rhythms to the local time on earth and has the potential to promote alignment between circadian and homeostatic processes. Lighting characteristics affecting the circadian system are different than those affecting vision. As a result, lighting installed in nursing homes are constantly dim and do not provide a robust light-dark pattern to promote circadian entrainment.

Materials and methods: We enrolled 60 patients (44 completed the protocol) in a within-subject, cross over, placebo controlled study investigating the impact of a tailored lighting intervention designed to promote circadian entrainment in Alzheimer´s disease and related dementia patients living in nursing homes. The active lighting intervention emitted more short wavelengths and provided higher light levels at the eye; therefore, it was a stronger stimulus for the circadian system. A lighting intervention emitting lower light levels and warmer color was used as placebo. Participants collected 1 week of baseline data (actigraphy and questionnaire, including the Pittsburgh Sleep Quality Index, the Cornell Scale for Depression in Dementia, and the Cohen-Mansfield Agitation Index), after which they were exposed to either the active or the placebo lighting intervention. After baseline data collection, lighting intervention was used for 4 weeks. At the end of the 4th week, actigraph and questionnaires were again collected. There was a washout period, after which participants were exposed to the other lighting intervention for 4 weeks and data were again collected.

Results: Personal light exposures measured with a calibrated light meter was significantly greater during the active lighting intervention than during the baseline and the placebo conditions. As a result, subjective sleep, depression and agitation scores were significantly improved (p< 0.05) with the active lighting intervention compared to baseline.

Conclusions: A lighting intervention designed to maximally affect the human circadian system improves sleep and behavior in Alzheimer´s disease and related dementia patients living in nursing homes.

POLYMORPHISM RS2278749 GENE ARNTL ASSOCIATED WITH SOME COMPONENTS OF AFFECTIVE AND SLEEP DISTURBANCES IN MALE POPULATION 25-44 YEARS IN RUSSIA/SIBERIA

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Introduction: To study the association of polymorphism rs2278749 gene ARNTL with some components of affective and sleep disorders in male population 25-44 years in Russia/ Siberia (Novosibirsk).

Materials and methods: In 2014-2016 yy a random representative sample of the male population25-44 years was surveyed in one of districts of Novosibirsk. Randomly selected 200 men had a mean age of 35.5 years who underwent psychosocial testing. We used questionnaire "4-item Jenkins Sleep Questionnaire». Anxiety and depression assessed by modified questionnaires of the Welsh Depression subscale of the MMPI and Bendig Anxiety subscale of the MMPI. Vital exhaustion evaluated by the Maastricht Questionnaire (MQ). Questionnaire "Knowledge and attitude towards their health" was also proposed. Males included in the study examined for the frequency distribution of genotypes of rs2278749 ARNTL gene.

Results: It was found that the most common genotype rs2278749 ARNTL gene was homozygous C/C genotype was in 74.9% of men, C/T genotype was in 22.3%, genotype T/T was in 2.8%. It was revealed that persons with genotype C/T more likely to experience serious conflicts in the family, more experienced their frustration and they often have disturbing dreams They wake up tired and exhausted. In addition, they often met the high level of vital exhaustion and they soon became frustrated. Persons with T/T genotype often took the trouble "to heart" and were more punctual. On the other hand, persons with C/C genotype were more hostile. Those were inclined not to trust anyone, almost "never" accept negative situations "close to the heart" and much less experienced disturbing dreams.

Conclusions: It was determined that the C/T genotype of ARNTL gene associated with sleep disorders in the Siberian population.

THE INFLUENCE OF INTENSITY AND TIMING OF LIGHT EXPOSURE ON ACTIVITY, SLEEP, AND CIRCADIAN TIMING IN ADOLESCENTS WITH AN EVENING CIRCADIAN PREFERENCE

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Introduction: Light is one of the primary zeitgebers that facilitates the timing of the circadian rhythm. In healthy adolescents, phase delays occur in response to light in the evening around bedtime while phase advances occur in response to light in the morning around risetime (Crowley & Eastman, 2017). The aim of the present study was to examine the non-linear relationship between the light exposure, activity timing, sleep timing, and dim light melatonin onset (DLMO, a marker of endogenous circadian phase) in adolescents with an evening circadian preference.

Materials and methods: Ninety-nine adolescents with an evening circadian preference (mean age 14.76, 59.6% female) wore a wrist actigraph for one week to assess light exposure and activity timing (activity offset in the evening, activity onset in the morning, and rest duration or the period between activity offset and onset) and completed a sleep diary to assess sleep timing (bedtime, risetime, and total sleep time). Light data included approximately 24 hours of light exposure preceding the main sleep window of interest. Any values below the device sensitivity threshold were set to 1 lux and light data was $\log_{10}$ transformed. Data were smoothed using a local polynomial regression procedure (LOESS; Cleveland, Grosse, & Shyu, 1992). The first time and the last time the smoothed data crossed 1 $\log_{10}$(lux) threshold each day was used to determine times of first and last exposure to more than 10 lux respectively (Wams et al., 2017). Raw average light intensity was calculated from the nonsmoothed $\log_{10}$-transformed data. Participants also completed a dim light melatonin onset protocol in the laboratory to assess endogenous circadian phase.

Results: Lower average intensity of light exposure in the preceding 24 hours was associated with a later activity offset. A non-linear relationship was found for both time of first light exposure to more than 10 lux and time of last light exposure to more than 10 lux with respect to activity and sleep timing. A time of first light exposure around 7-8am was associated with an earlier activity offset, an earlier risetime the next morning, a longer total sleep time, and a longer rest duration. A time of last light exposure after 9pm was associated with a later activity offset, a later bedtime, a later risetime the next morning, a later activity onset the next morning, a shorter rest duration, and a shorter total sleep time. Later DLMO was associated with a later last exposure to more than 10 lux.

Conclusions: The timing of activity and sleep is associated with preceding light exposure. Later last exposure was associated with a later endogenous circadian phase. Additionally, this study is one of the first to examine the non-linear relationship between light timing and activity and sleep timing in a sample of adolescents with an evening circadian preference. These findings highlight a direct relationship between light, activity timing, sleep timing, and endogenous circadian phase and provides new targets for clinical intervention studies to support and improve adolescent sleep and health.

Chronobiology/Circadian Disorders
Board #202 : Poster session 2

DAILY AFFECT AND SLEEP IN ADOLESCENTS WITH AN EVENING CIRCADIAN PREFERENCE: AN ACTIGRAPHIC AND ECOLOGICAL MOMENTARY ASSESSMENT STUDY

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Introduction: The link between daytime affect and nighttime sleep is well established in the literature (Konjarski, Murray, Lee, & Jackson, 2018). Researchers have examined the relationship between sleep and affect in healthy adolescents (Tavernier, Choo, Grant, & Adam, 2016; van Zundert, van Roekel, Engels, & Scholte, 2013) and adolescents with depression and anxiety (Cousins et al., 2011). However, less is known about this relationship in adolescents with an evening circadian preference, who are at increased risk for both insufficient sleep and internalizing and externalizing problems (Giannotti et. al., 2002; Crowley, Acebo, & Carksadon, 2007; Gau et al., 2007). The goal of the present study was to examine the bidirectional relationship between daytime affect and nighttime sleep on a night-by-night basis in a sample of adolescents with an evening circadian preference using actigraphy and ecological momentary assessment (EMA).
Materials and methods: One hundred seventy-four adolescents with an evening circadian preference (mean age 14.77, 59.6% female) wore a wrist actigraph for one week to assess sleep (bedtime, total sleep time, and sleep onset latency). During the same week, EMA was used to assess daily affect. Using the PANAS (Watson, Clark, & Tellegen, 1998), participants rated four positive emotions (happy, excited, cheerful, interested) and five negative emotions (sad, nervous, upset, angry, bored). Two composites of the positive emotions (positive affect) and the negative emotions (negative affect) were also calculated. Data were analyzed using hierarchical linear modeling, controlling for age, sex, weekday/weekend, and previous nights' sleep.
Results: Higher ratings of positive affect were associated with a later bedtime and a shorter sleep onset latency, while higher ratings of negative affect were associated with a shorter total sleep time. For individual positive emotions, higher ratings of excited and interested were associated with a later bedtime and higher ratings of happy and excited were associated with a shorter sleep onset latency. For individual negative emotions, higher ratings of upset and nervousness were associated with a later bedtime and higher ratings of anger, upset, and nervousness were associated with a shorter total sleep time. There was no association between sleep and next-day positive or negative affect. However, for individual emotions, a shorter sleep onset latency was associated with higher ratings of next-day cheerful and interested and lower ratings of next-day boredom.
Conclusions: Higher positive affect and lower negative affect were associated with better sleep. Additionally, a shorter sleep onset latency was associated with higher next-day cheerfulness and interest and lower next-day boredom. Surprisingly, positive affect was associated with both a later bedtime and a shorter sleep onset latency. While a later bedtime is typically associated with poorer sleep, it is also consistent with an evening circadian preference and previous research has found that individuals who are allowed to select their own bedtime for when they are sleepy fall asleep more quickly (Randler et al., 2008). Our findings provide additional support for a relationship between affect and sleep in a sample at increased risk for both insufficient sleep and internalizing and externalizing problems.

PROBING THE PROCESSING UNDERPINNINGS OF ASYNCHRONY AND SYNCHRONY EFFECTS WITH A CONFLICT TASK AND SEQUENCE-INDUCED RESPONSE EXPECTANCIES - A TEST OF THE CONDITIONAL AUTOMATICITY HYPOTHESIS

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Introduction: Chronotype and time-of-day interactions are often manifest in differences between performance at times-of-day matching the individual's chronotype (on-peak) and off-peak performance. However, it is not clear which processing variables determine whether on- or off-peak benefits/costs will occur. Some research suggests that voluntary control is enhanced on-peak, and unconscious/automatic processes off-peak; overall, results are inconsistent. We aimed to ascertain whether top-down control per se (voluntary or unconscious/automatic) benefits from on- vs off-peak times (synchrony effect) and whether unconscious/automatic processes (either top-down or bottom-up) intrinsically benefit from off- vs on-peak times (asynchrony effect). We hypothesized that only processes entangled by conditional automaticity (CA) would manifest (a)synchrony effects: on-peak enhancement of core voluntary top-down control and off-peak augmentation of conditioned automatic processes. CA is an unconscious processing bias that reflects the enhancement of pathways linked, but not directly relevant, to the control structure of an ongoing, or recently completed, explicit task.

Materials and methods: Participants were 124 young adults (60.48% women, 18 - 31 y/o, M = 21.04 y/o, SD = 3.33). Thirty-four evening-types participated on-peak, 31 off-peak; Thirty morning-types participated on-peak, 29 off-peak. We used a conflict task (pressing a button congruent with the left-right orientation of an arrow displayed on the left-right side of a computer screen, while resisting incorrect responses induced by the arrow's on-screen position) to probe (i) top-down voluntary executive control (inhibiting responses triggered by on-screen locations that mismatch the arrow's orientation), (ii) bottom-up CA (facilitation of the response opposite to the one currently under controlled inhibition), and (iii) a low-level expectancy regarding the correct response, induced by the trials' sequencing, favoring response alternations vs. response repetitions, i.e., an unconscious/automatic top-down control process autonomous wrt (i) and (ii). Expected results were derived from the CA hypothesis, and pertain to reaction times (RT) and accuracy (ACC) that result from the interaction of (i), (ii) and (iii) in the task's four critical conditions: I. no-conflict trials (arrow's direction congruent with its on-screen position) facilitated by alternation expectancy (trial's response to the opposite side of the previous trial's) [Predicted: RT asynchrony; ACC synchrony]; II. no-conflict trials hindered by alternation expectancy (response repetition trials) [Predicted: RT asynchrony; ACC asynchrony], III. conflict trials (arrow's direction incongruent with its on-screen position) facilitated by alternation expectancy [Predicted: RT asynchrony; ACC neutral]; IV. conflict trials hindered by alternation expectancy [Predicted: RT asynchrony; ACC synchrony].

Results: CA predictions were supported by morning-types' RTs in I, II, III, IV, but were not

statistically significant for evening-types. Evening-types' ACC data supported IV CA predictions (morning-types ns). Both types' ACC data supported I and III CA predictions, but only non-significant differences emerged for II.

Conclusions: Explanations of (a)synchrony effects based on the distinction between controlled/automatic processing are over-simplistic, and CA offers a promising framework for understanding the processing underpinnings of (a)synchrony. We also observed that morning and evening-types' on/off-peak performance sometimes patterns quite differently. This suggests that further research focusing on morning vs evening-types contrasts should be pursued.

CAUSAL ANALYSIS OF "WEEKEND CATCH-UP SLEEP" USING 1-WEEK WRIST ACTIGRAPHY

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Introduction: The present study aimed to investigate the causes of "Weekend Catch-up Sleep (WCS)" through comparing the weekday activity data collected from persons with and without WCS. Since it is reported that the amount of sleep debt and WCS are correlated, to specify the causes of WCS may contribute to sleep debt prevention. Considering the possibility that diurnal activity rhythms affect WCS, we used wrist actigraphy that can evaluate diurnal activities continuously.

Materials and methods: The present study included 324 healthy male employees (43.8 ± 8.37 years) at a drug wholesaler in Osaka, Japan. We collected their 1-week wrist actigraphy data (Actiwatch AW-Light, Mini-Mitter) and their answers of questionnaires, including the Zung Self-Rating Depression Scale (SDS), Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), Social Rhythm Metric (SRM) and 36-item Short-Form Health Survey (SF-36). All participants were classified into a WCS group and a non-WCS group based on whether the difference between the weekend sleep duration and the mean weekday sleep duration was longer than 120 minutes or not. We evaluated a sleep duration of each day, their standard deviation, interdaily stability (IS), mid-sleep on free days (MSF), and the other indicators of the sleep rhythm, the activity rhythm, and chronotype from the weekday actigraphy data. A classifier whose explanatory variables are these indicators was trained for predicting WCS. In addition, permutation variable importance was calculated based on the trained classifier, which evaluates the degree of the effect of each explanatory variable on the WCS prediction. Furthermore, the mean of explanatory variables and the mean scores of the questionnaires were compared among the two groups.

Results: Our analysis results show the following four points.
1) The weekday sleep duration was significantly shorter in WCS group than non-WCS group.
2) MSF had high importance for the prediction, and WCS group had a significantly stronger eveningness tendency in comparison with non-WCS group.
3) IS and the standard deviation of weekday sleep duration had high importance for the prediction. The daily activity rhythm including sleep was indicated less stable in WCS group than in non-WCS group.
4) When comparing the importance of the weekday sleep duration, Thursday had the highest importance for the prediction, which suggests that the work content on Thursday was different from other weekdays.

These findings indicate that the lack of sleep duration, evening chronotype, instability of the daily activity rhythm, and the differences in work contents on a specific day of the week may cause WCS. Thus, it is necessary to evaluate the rhythms of diurnal activities as well as sleep for WCS prediction.

Conclusions: The analysis result indicated that the diurnal activity rhythm influences WCS. It is also suggested that the activity rhythm regulation contributes to the prevention of sleep debt.

ACCURATE PATIENT DLMO MEASUREMENTS FACILITATED BY CONVENIENT AT-HOME SAMPLE COLLECTION KITS, CELL-PHONE BASED APP AND ROBUST SALIVARY IMMUNOASSAY

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Introduction: Accurately measuring the dim light melatonin onset (DLMO) in the clinical or research setting has become of tremendous value as we better understand the impact of circadian sleep disorders on the individual and society as a whole. The utility of measuring melatonin in saliva for DLMO measurements aids in the willingness of the general public to participate in these types of studies and have their onset measured. Saliva sampling enables home-based collection and avoids the inconvenience of sleep labs for blood sampling. The ease of collection allows for more samples to be collected at shorter frequencies resulting in ever more precise curves for onset calculations. With improved assay performance and development of assays that no longer rely on radioactive isotopes and confer the precision necessary to establish clear baselines and produce smoother induction curves, salivary DLMO has truly come of age.

Materials and methods: Here we outline a complete workflow for optimal at-home collection, from sample handling, shipping, and testing to DLMO calculation and reporting data in CLIA regulated testing labs or central testing sites for sleep researchers.

Results: we present data from a home-based study facilitated by a cell-phone based app that accurately time stamps the sample upon collection used in conjunction with a convenient pre-assembled collection pack.

Conclusions: Accurate patient DLMO measurements are facilitated by convenient at-home collection kits that can be shipped directly to patients or study participants. Our cell-phone based app enables accurate timing of collection and unmatched precision of the melatonin immunoassay together improve the quality of DLMO determinations.

Chronobiology/Circadian Disorders
Board #062 : Poster session 1

SEX DIFFERENCES IN THE ASSOCIATION BETWEEN CHRONOTYPE AND DEPRESSION: RESULTS FROM THE SEVENTH KOREA NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY, 2016

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Introduction: Depression is a common psychiatric disorder in the global population and major causes of disability. The relationship between sleep and depression has been reported in previous studies. Several studies have investigated the association between chronotype and depression, but sex differences of that association remains to be determined. Herein, we conducted a study to investigate sex differences in the association between chronotype and depression through quantitative chronotype analysis in a representative sample of the entire population in Korea.

Materials and methods: The Seventh Korea National Health and Nutrition Examination Survey in 2016 (KNHANES VII, 2016) is a population-based survey for representing the health and nutritional status of the Korean population. Chronotype were measured by mid-sleep time on free days corrected by sleep debt accumulated over the workdays (MSFsc). Chronotypes were classified into three groups according to MSFsc. Early is lesser than mean-1SD, intermediate is mean±1SD, late is greater than mean+1SD. The patient health questionnaire (PHQ)-9 scores of 10 or higher were defined as having depression. Data was analyzed by complex sample analysis methods.

Results: Of the 5,550 participants with non-shift worker aged 19 years or more, 1327 were early, 3579 were intermediate, and 644 were classified as late chronotype. Depression were significantly more prevalent (p< .001) in early (7.7%) and in late (7.9%) chronotype than in intermediate (4.5%) chronotype. Late chronotype (p< .001, OR=2.9) demonstrated statistically significant higher depression prevalence in females, while there was no significant association between chronotype and depression in males after adjusting age, education, job, smoking, alcohol, body mass index, sleep duration.

Conclusions: Late chronotype is associated with depression in females but not in males.

GENDER DIFFERENCES IN THE RELATIONSHIPS BETWEEN PHYSICAL ACTIVITY, SLEEP, AND MOOD IN FINNISH ADOLESCENTS

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Introduction: Physical activity, sleep, and mood are closely interrelated. Adolescents who participate in more physical activity are often found to have better sleep and better mood than their less physically active counterparts. Due to the close links between sleep and mood, our study seeks to investigate whether the impact of physical activity on mood is mediated by changes in sleep. We examined this potential mediating effect in a population-based cohort study in Helsinki, Finland.

Materials and methods: All adolescents born in the years 1999 or 2000, with a registered home address of Helsinki, Finland, and who spoke Finnish as their native language (n = 7,539, 50% male), were invited to participate in a 30 minute online survey. Valid responses were received from 1,367 adolescents (19% of initial cohort, 33% male, mean age = 16.84(0.58) years). Physical activity was measured by; the average duration of an exercise occasion, how often participants exercised in their free time, how often participants did physical activity after 6pm, and how often participants were very active in the hour before bedtime. Sleep was measured using the School Sleep Habits Questionnaire and Munich Chronotype Questionnaire to determine sleep onset latency (SOL), total sleep time (TST), and chronotype. Mood was measured by the Beck Depression Inventory II.

Results: Hayes' PROCESS bootstrapping method found that the proposed mediation models were significant for girls, but not for boys. As anticipated, more physical activity during free time was associated with longer TST, $B = 0.01$, $SE = .002$, $p = < .001$, which was associated with better mood, $B = -0.24$, $SE = .03$, $p = < .001$. However, more physical activity after 6pm was associated with shorter SOL, $B = -1.05$, $SE = .44$, $p = .02$, which was associated with better mood, $B = 0.01$, $SE = .002$, $p = < .001$. More physical activity after 6pm was also associated with earlier chronotype, $B = -0.10$, $SE = .03$, $p = .001$, which was associated with better mood, $B = 0.20$, $SE = .02$, $p = < .001$.

Conclusions: Sleep variables were found to significantly mediate the effect of physical activity on mood in girls, but not in boys. It was expected that evening physical activity would negatively impact sleep, however more evening physical activity was in fact associated with shorter SOL and earlier chronotype. It is possible that the beneficial effect of evening physical activity on SOL and chronotype seen in this sample reflects differences in physical activity intensity, timing, or between adults' and adolescents' response. The results of this study build upon existing research to show a more complex interrelationship between physical activity, sleep and mood. Future research could test these mediation models longitudinally to confirm directionality of the interrelationships. Future research could also seek to replicate the results in smaller sample sizes using objective measures of sleep and physical activity.

Chronobiology/Circadian Disorders
Board #081 : Poster session 2
SLEEP COACHING: A NON-PHARMACOLOGICAL TREATMENT OF NON-RESTORATIVE SLEEP IN SHIFT WORKERS - A FIELD REPORT

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Introduction: The objectives of this study were to examine subjective ratings of sleep quality and daytime sleepiness in shift workers employed in a railway company (OEBB: Oesterreichische Bundesbahnen) and how shift-related complaints can be addressed during a two-day sleep coaching seminar.

Materials and methods: In total, 182 employees (162 male; age: 22-58, M=45.89, SD=8.99) took part in the investigation. We used a pre-intervention questionnaire containing items of the PSQI and the ESS, questions about chronotype, personality factors and possible burnout risk factors. The questionnaire was followed by a two-day sleep coaching seminar. Sleep coaching by Holzinger & Kloesch™ (SC) is a new approach for non-pharmacologic treatment of non-restorative sleep and includes psychotherapeutic aspects, which enable clients to improve their sleep quality as well as their quality of life, by developing one´s own coping strategies which can be implemented in daily routine.

Results: The results showed that shift workers reported poorer sleep quality, prolonged sleep latencies, high sores of daytime sleepiness and a variety of daytime dysfunction as well as higher body mass indices.The two day SC seminar was beneficial by focusing on the sleep problems related to shift work.

Conclusions: SC seems to be a suitable treatment to improve sleep quality and reduce diurnal fatigue in shift working employees in comparison with former results. These findings can have particular relevance for employers who try to improve the well-being of their employees, providing assistance to improve sleeping behavior. SC by Holzinger & Kloesch provides a more profound basis for treating not only sleep but also wake behavior to guarantee a more comprehensive understanding of the underpinnings that consolidate sleep complaints. The findings of this study are important for future developments in the non-pharmacologic treatment of sleep complaints.

Chronobiology/Circadian Disorders
Board #064 : Poster session 1

FUNCTIONAL CIRCADIAN AND SLEEP PHENOTYPING OF TYPE 2 DIABETES PATIENTS WITH MELATONIN RECEPTOR 2 MUTATIONS AND CONTROLS: A PILOT STUDY

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Introduction: Previous genome wide association studies have provided evidence that mutations in the melatonin receptor 2 (MT2) are associated with increased type 2 diabetes (T2D) risk, and it has been hypothesized that impaired melatonin signaling, and potential downstream consequences on functional circadian and sleep phenotypes, may contribute to this risk. However, data on functional circadian and sleep phenotypes in carriers of rare MT2 mutation T2D patients are currently missing. Our goal was to determine whether functional phenotypes differ as a function of MT2 receptor and T2D status.

Materials and methods: In this case-control study among 43 individuals (15 healthy controls, 28 T2D patients, 50% with MT2 mutation; 40% male; 41-82 years old; age- and sex-matched), we collected 4-weeks of daily food logs and objective actigraphy for sleep and circadian phenotyping. We used linear and logistic regression models to estimate the mean differences and odds ratios (OR; with 95% confidence intervals; 95%CI) of sleep, circadian and caloric phenotypes across exposure status (control vs. T2D vs. T2D with a MT2 mutation).

Results: Compared to controls and T2D patients without MT2 mutation, MT2 mutation carriers had less regular sleep (assessed by sleep regularity index; $p=0.05$), later sleep onset ($p< 0.01$, a later mid-point of sleep (< 0.01), greater levels of behavioral circadian misalignment (assessed by composite phase deviations; $p< 0.01$), and more frequent caloric intake across the 24hr day ($p< 0.05$). They were also more likely to be a late chronotype ($p< 0.01$). Descriptive subgroup comparisons as a function of MT2 receptor mutation type (loss of function [n=4] *vs.* "neutral variants" [n=10]) showed that T2D patients with a neutral variant had a later mid-point of sleep, less regular sleep, a later time of last caloric intake, and a later mid-point of fasting. In contrast, T2D patients with a loss of function mutation had a shorter sleep duration and greater levels of behavioral circadian misalignment.

Conclusions: Overall, this pilot study suggests that MT2 mutation carriers have later and more irregular sleep and behavioral timing. Future prospective studies are warranted to elucidate the role of functional circadian and sleep phenotype in T2D risk exacerbation through MT2 receptor status.

Chronobiology/Circadian Disorders
Board #007 : Poster session 3
HACKING THE HUMAN CIRCADIAN SYSTEM WITH MICROFLASHES OF LIGHT

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Introduction: Studies in rodents and humans reveal that the circadian system is sensitive to a stimulus it would never have experienced in nature: sequences of flashing lights. Previous studies have demonstrated that humans can respond to sequences of light flashes and generate larger phase shifts than those observed after continuous light. To determine the limits of this sensitivity, we mapped the dose-response relationships between flash intensities and durations with subsequent phase shifts of the circadian pacemaker.

Materials and methods: Fifty-six healthy, young (18-35) men and women took part in two parallel studies. For 2 weeks, participants stabilized their circadian rhythms through maintaining a regular, self-selected sleep/wake cycle. They then attended the dimly lit laboratory for ~36 hours which included two evenings under modified constant routine conditions. On night 1, participants were awoken 2 hours after habitual bedtime to view light flashes administered via a custom-made eye mask. Flashes were presented every 15 seconds during an hour of enforced wake and varied either by duration (10 µs to 10 s; 2200 lux intensity) or intensity (3 lux to 9500 lux; 2 ms duration). No light mask was administered on night 2. Circadian phase shift was determined by the difference between salivary melatonin onset on nights 1 and 2. Melatonin suppression during the light flashes, and objective (auditory Psychomotor Vigilance Task) and subjective (Stanford Sleepiness Scale) sleepiness were sampled before and at the cessation of the light flashes.

Results: Flash intensity and phase shift have a sigmoidal relationship with a half-maximal shift at just 8 lux and 90% of the maximal shift occurring with only 50 lux. Light flashes as brief at 10 µs elicited phase shifts similar in magnitude to those observed with 10 s duration but with much higher efficacy (i.e., 6 log units shorter in duration or 1,000,000-fold less light to generate an equivalent phase shift). Presentation of the light stimuli did not acutely alter melatonin expression nor objective or subjective alertness.

Conclusions: The human circadian system is very sensitive to the temporal arrangement of light and can be phase-shifted by extraordinarily brief and dim light flashes. This study quantifies our sensitivity to light flashes, revealing new parameters with which to optimize lighting to promote sleep health through reinforcing circadian entrainment, stabilizing circadian rhythms and counteracting social jetlag.

CIRCADIAN LIGHTING STUDY AT A RESIDENTIAL TREATMENT PROGRAM

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Introduction: The quality of lighting in healthcare environments is an important factor contributing to patients' recovery and health. This is particularly relevant for populations that spend long periods of time indoors. Light is the dominant environmental cue for synchronizing the circadian clock to local time through an active process called entrainment. The timing and duration of light exposure, together with the intensity and colour temperature of the light source, determine the phase and stability of clock entrainment, and potentially the amplitude of the circadian oscillations. The human circadian clock system is specialized for a diurnal lifestyle, which assumes extended exposure to daylight each day. In the industrialized world, exposure to natural light has decreased, while exposure to artificial light after sunset has increased. Inadequate and inappropriate patterns of light exposure are particularly problematic in hospitals and extended care facilities, where people may reside for extended periods with minimal exposure to natural light. We examined the effects of circadian lighting (changing in intensity and colour temperature over the 24-hour day) on the sleep-wake cycle and psychological well-being of in-patients with complex concurrent disorders (co-occurring substance abuse disorder and mental health disorder) at a mental health and addictions center. We predicted that circadian lighting would enhance participants' 24-hour circadian entrainment (Hypothesis 1) and improve psychological well-being (Hypothesis 2).

Materials and methods: Every two weeks, the lighting system alternated between an experimental circadian schedule - changing in intensity (~40-700 lux) and colour temperature (3000K-5000K) over the 24-hour day - and the original facility lighting as the control condition. Participants (59 males and 14 females, age of 19-59) wore wrist accelerometers to continuously track activity, and filled out standardized questionnaires in both lighting conditions (N=20) to assess sleep quality and psychological well-being (*Pittsburgh Sleep Quality Index*, *Brief Symptom Inventory, Perceived Stress Scale, UPPS-P Impulsiveness Scale, Piper Fatigue Scale*). To test the effect of lighting condition on daily sleep-wake variables (*Acrophase*, *Relative Amplitude*, *Sleep Latency*, *Wakefulness at Night, Sleep Duration, Intradaily Variability*, *Interdaily Stability*) we fit multi-level models in R Software comparing conditions. The effects of condition on psychological well-being were analysed with mixed-design ANOVAs in SPSS comparing both conditions.

Results: None of the statistical analyses showed a significant difference between the circadian and control condition on residents' sleep-wake cycles and psychological well-being. With both conditions pooled together, the study sample showed severe sleep-wake disruptions characterized by advanced phase, excessive sleep, and irregular and fragmented sleep.

Conclusions: Although descriptive statistics suggest a trend in favour of circadian lighting, we did not find statistical evidence for a beneficial effect of circadian lighting on residents' sleep-wake cycles and psychological well-being. Our study had a number of limitations: 1) high turnover rate; 2) masking effects from medications, withdrawal from stimulant drugs, and structured social activities; 3) weak zeitgeber strength: the daytime light intensity and/or length of light exposure may have been insufficient to promote circadian entrainment. More research, preferably longitudinal-based studies using higher daytime intensity lighting is needed.

EFFECTS OF ILLUMINANCE ON NIGHT-TIME CRYING IN INFANTS

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Background and Aims: In Japan, about 50% of infants are reported to have a symptom called "yonaki". Yonaki is defined as crying at night without physiological causes (pain, overly warm, urination, etc.) in infants aged 6 to 18 months and is regarded as a type of sleep disorder that occurs during development. No appropriate parental management plan has been proposed. It has been reported that light stimulation contributes to the development of sleep rhythm in infants. However, there are no studies evaluating the effect of light stimulation on yonaki. This study therefore aimed to investigate the effects of illuminance adjustment on night-time crying duration.

Methods: Fourteen infants aged 7 to 19 months were included in this study (7 in the intervention group and 7 in the control group). Infants in the intervention group stayed in bright light from 06:00 to 20:00 and in dark conditions from 20:00 to 06:00. To keep a well-lit environment, a light was installed in the house, and infants stayed in a sunny place near a window. To maintain a dark environment, a shade curtain was installed, and lights were turned off in the room where infants stayed. The experimental period was 8 weeks: 2-week pre-intervention (no intervention), 4-week intervention, and 2-week post-intervention (no intervention). Infants in the control group lived as usual (without intervention) for 8 weeks. The illuminance of the living environment was measured using an illuminance sensor, and the duration of night-time crying (total duration of crying in one night) was measured using a camera. Mean values of the duration of night-time crying were calculated during the pre-intervention and post-intervention periods. Two-way analysis of covariance was used to test the intervention effect (intervention group vs control group), time effect (pre vs post), and interaction effect. P values less than 0.05 were defined as significant. This study was approved by the Research Ethics Committee of The University of Tokyo. Written informed consent was obtained from subjects' parents prior to the commencement of the study.

Results: There was a significant interaction effect ($p < 0.05$). In the intervention group, the duration of night-time crying decreased from 61.2 ± 8.4 min to 17.8 ± 3.0 min, while in the control group, it decreased from 54.8 ± 10.1 min to 48.9 ± 9.4 min.

Conclusions: These results suggested that high illuminance in daytime and low illuminance at night-time could improve yonaki in infants.

Chronobiology/Circadian Disorders
Board #087 : Poster session 3

VALIDATION OF THE JAPANESE VERSION OF THE BIOLOGICAL RHYTHMS INTERVIEW OF ASSESSMENT IN NEUROPSYCHIATRY-SELF REPORT FOR DELAYED SLEEP-WAKE PHASE DISORDER

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Objective: Delayed sleep-wake phase disorder(DSWPD) is the most commonly observed in circadian rhythm sleep-wake disorders(CRSWD). A sleep log or diary is indicated as the assessment of patients with CRSWD. On the other hand, there are few questionnaires used for assessment of CRSWD in a clinical setting. The Biological Rhythms Interview for Assessment in Neuropsychiatry (BRIAN) is an assessment tool used to clinically evaluate disturbance in biological rhythm. BRIAN consisted five factors that is indexes rhythm disturbance in sleep, activity, social and eating patterns. BRIAN has been used for assessment of the biological rhythm of mood disorder patients. However, there has been no study focusing on DSWPD evaluated by BRIAN. Therefore, the aim of this study was to examine the reliability and validity of the Japanese version of the BRIAN -self report (J-BRIAN-SR) for patients with DSWPD.
Methods: A total of sixty outpatients who were newly diagnosed as DSWPD at the Yoyogi Sleep Disorder Center (Tokyo, Japan) between October 1, 2016 and March 31, 2019. Sixty-four employed healthy controls matched for age were recruited. Construct validity was tested by factor analysis. Concurrent validity was tested by evaluating the association between the J-BRIAN-SR and the Morningness-Eveningness Questionnaire (MEQ). The cut-off score of J-BRIAN-SR was evaluated using receiver operating characteristic (ROC) curve analysis. SPSS 25.0 (SPSS Inc., Tokyo, Japan) was used to perform the statistical analysis.
Results: The J-BRIAN-SR scores in the patients group was significantly higher than that in the control group (47.2 ± 9.19 vs 35.0 ± 9.16, $p < 0.001$). The Cronbach's αfor the J-BRIAN-SR was 0.843. The J-BRIAN-SR was significantly correlated with the MEQ ($r=-0.382$, $p=0.003$). Area under the receiver operating characteristic curve (0.844; $p=0.003$) suggests diagnostic ability with $\geqq 40$ of the score as an optimal cut off value for the positivity of DSWPD.
Conclusion: The findings affirm that the J-BRIAN-SR has good construct validity and internal consistency. A significant suggesting that the J-BRIAN-SR can be used to screen of DSWPD, especially for patients with DSWPD.

THE EFFECT OF EVENING SLEEP FOLLOWING NIGHT SHIFTS ON SLEEP AND ALERTNESS IN NURSES WITH ROTATING SHIFT WORK SCHEDULE: REAL WORLD DATA

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Introduction: The aims of this study were to investigate the efficacy of changing sleep timing (fixed evening sleep) following night shifts in hospital nurses with three rapid rotating shift schedules

Materials and Methods: Hospital nurses with three rotating shift schedules were enrolled for two months of the study with 1-month pre-intervention and 1-month intervention. During 1-month intervention, sleep timing following night shifts was directed to evening sleep for 8-hour time-in-bed (TIB) after 1 PM, and an ad-lib sleep schedule for other shifts. Baseline and follow-up evaluation included sleep schedule, sleep duration, Epworth sleepiness scale (ESS), insomnia severity index (ISI) for each shift, Beck depression inventory (BDI), and Beck anxiety inventory (BAI). Sleep was assessed by sleep diary and actigraphy. Alertness during night shift was evaluated using Karolinska sleepiness scale (KSS) in the beginning and at the end of shift sent by texts on cell phone. After the study, participants were asked to give feedback about the evening sleep schedule after nightshifts and willingness to continue this intervention.

Results: A total of 25 nurses (30.7±8.5 years, female 24) finished the study among 27 subjects participating. Shift work duration was 4.3±5.2 years and mean Morningness-eveningness scale was 42.3±8.1(31-62). TIB following night-shift were 379.9±91.2 and 478.4±48.7 min for pre-intervention and intervention, respectively (p=0.001). Total sleep time (TST) was 328.0±91.0 vs. 361.0±70.4 min, respectively following night shifts (p=0.187, Cohen's drm = 0.467). BDI, BAI, ESS and ISI were significantly improved after intervention. KSS after intervention was not significantly different comparing to pre-intervention. Seven participants reported that they would continue the evening sleep schedule following night shift.

Conclusions: Evening sleep schedule following night shift is feasible for nurses with rapid rotating shift schedules. Evening sleep schedule modestly increased total sleep time following night shift, and overall mood, sleepiness and insomnia improved after the intervention although the alertness assessed by KSS did not change.

Chronobiology/Circadian Disorders
Board #065 : Poster session 1
CHANGES IN ACTIVITY AND LIGHT EXPOSURE RHYTHMS BY TIMED BLUE LIGHT THERAPY IN ALZHEIMER'S DISEASE PATIENTS

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Introduction: Circadian rhythm disturbance in Alzheimer's disease(AD) patients often leads to sleep disturbance. The rest-activity rhythms(RARs) are particularly disturbed in AD patients, and inadequate light exposure rhythms(LERs) have been implied as a cause of sleep fragmentation. Light therapy(LT) has been proposed to reduce sleep disturbance by stabilizing circadian rhythms in AD patients. We aimed to examine the changes in RARs and LERs by the timed blue LT in AD patients, and their relationship with the change in nocturnal sleep quality.

Materials and methods: We recruited mild to moderate AD patients with the Pittsburgh Sleep Quality Index(PSQI) score of 5 and greater, and/or with insomnia symptoms 3 and more times a week. The patients were randomly assigned to the treatment group(TG) and control group(CG). The MMSE in the Korean version of CERAD Packet(MMSE-KC), Clinical Dementia Rating Scale(CDR) were administered for each patient. Actigraphy(Actiwatch 2; Philips Respironics, Murrysville PA, USA) monitoring for 5 days was conducted at home before and after the LT(T0 vs.T1). The dim light melatonin onset(DLMO) was determined from seven hourly saliva samples obtained before sleep onset measured by actigraphy. Home-based one-hour blue-enriched LT was applied between 9 to 10h after DLMO for 2 weeks. The CG patients were kept to wear blue-blocked glasses during the LT. Thirteen patients of TG(77.5 ±6.0 years) and eight patients of CG(79.8±8.0 years) were included in this analysis. The changes in the interdaily stability(IS), intradaily variability(IV) and relative amplitude(RA) of RARs and those of LERs after the LT were compared with those at T0 in the TG and CG. Correlation analyses of the changes in sleep parameters and those in the IS, IV and RA of RARs and LERs between T0 and T1 were done in the TG and CG.

Results: There was a significant difference in gender distribution between the CG and TG(p< .01). There were no significant differences in the scores of the MMSE-KC, CDR and PSQI at T0 between the CG and TG. Although there were no significant changes in the IS, IV and RA of RARs and LERs between T0 and T1 in the TG, the IS of RARs in the CG was reduced with a near-significant trend(T0: 0.55±0.13 vs. T1: 0.47±0.16, p=.078) in the CG. There was a significant correlation between the change in the sleep efficiency and that in the IS of RARs(p< .05), and a significant correlation between the change in the total sleep time and that in the IS of LERs(p< .01) in the TG. There were not any significant correlations among these parameters in the CG.

Conclusions: We did not find significant improvements in the stability, fragmentation and robustness in the activity pattern and light exposure pattern after the timed LT in AD patients. However, we found that the increase in in the stability of activity pattern or light exposure pattern was somewhat associated with the improvement of nocturnal sleep quality by the timed blue LT.

THE RELIABILITY OF THE SCALE FOR SYMPTOM SEVERITY OF CIRCADIAN RHYTHM SLEEP-WAKE DISORDERS - A PRELIMINARY STUDY ON DRAFT VERSIONS

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Objectives: We newly developped a severity scale for circadian rhythm sleep-wake disorders (CRSWD; including delayed sleep-wake phase disorder [DSWPD], non-24-hour sleep-wake rhythm disorder [N24SWD], and irregular sleep-wake rhythm disorder), and examined the reliability of the draft version of the scale.

Methods and materials: The latest draft of the scale (version 9) consists of 10 items of questions with 4 or 6 anchor points, and the total score is in the range of 0 to 34 points. This questionnaire is described in Japanese, and the items include questions with regards to difficulty of sleep onset and awakening, the differences between the desired and actual sleep onset times and awakening times, social adaptation, daytime sleepiness, physical symptoms, depressive symptoms, sleep fragmentation, and free-running of sleep phase. In this study, the symptom severities of patients with DSWPD or N24SWD who visited Fujita Health University Hospital, including who were treated with some medications or had psychiatric comorbidity, were rated with the scale. Two independent raters performed rating of each patient on the same day. Inter-rater reliability was assessed using Intraclass Correlation Coefficient (ICC), and internal consistency was assessed using Cronbach's alpha.Factor analysis was conducted exploratorily. We also evaluated an older version (version 7), which has larger measuring intervals as for the differences between the desired and actual sleep onset times and awakening times, in the same procedure.
This study was approved by the Ethics Committee of the Fujita Health University, and the patients provided prior verbal and written informed consent. The study was registered at UMIN-CTR (identifier: UMIN000036053).

Results: 30 patients with CRSWD (29 DSWPD and one N24SWD) were rated. The severity of symptoms of the patients varied widely, and the total score ranged from 1 to 21 for version 9, and from 1 to 17 for version 7. ICC was 0.7642 for version9 and 0.8041 for version 7. Cronbach's alpha was 0.5412 for version 9 and 0.4866 for version 7. Factor analysis suggested four latent factors in both versions.

Conclusion: Inter-rater reliability was moderate for the both versions of the scale evaluated using ICC. However, internal consistency was low for the both versions; this might be because of the presence of items conversely changed in some certain situations (e.g., when a patient's sleep time was forcibly normalized, the items for sleep onset and awakening would have low scores whereas items for physical or mood symptoms would have high scores). Revisions including the addition of some items moderate such discrepancies could be considered, and then the reliability and internal consistency should be reassessed, along with the criterion validity.

INFLUENCE OF CHRONOTYPE ON SLEEP AND USE OF PORTABLE MEDIA DEVICES OF ADOLESCENTS

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Introduction:
Every year more portable media devices (PMD) conquer space in children´s rooms and are also in use before bedtime. Excessive evening use of PMDs influence the sleep-wake rhythm and sleep quality of adolescents. The causal relationship between the use of PMDs and social media at bedtime or after lights off, as well as the emergence of sleep deprivation and increased risk of sleep disorders have already been addressed in numerous studies.
Chronotypes and age may also play an important role in sleep regulation and influence evening usage of portable media devices.

Materials and Mehods:
Chronotypes were assessed by the Morningness-Eveningness questionnaire by Home and Oestberg (1976), which allows the definition of five chronotypes: strong/moderately evening types, intermediate chronotype and strong/moderately morning types.
Daily sleep log (evening and morning protocol) provided information about sleep quality, sleep timing, mood and affectivity as well as the time of PMD usage. The design of the diary has been adapted to adolescents to ensure usability (max 5 min.) and comprehensiveness.

Results:
Thirty-five Austrian adolescents aged 14-16 (mean age: 15.15 years, SD= 0.919, 21 females) were monitored consecutively for 14 days (n= 476 nights, NA= 15).
In the sample, only three chronotypes were present: moderately pronounced evening type, intermediate chronotype and moderately pronounced morning type (only present in the group of 14-year-old subjects). Trend of PMD usage increases with age while sleep duration tends to decrease. PMD usage was found to be longest in 15-year-old students classified as evening chronotype (422.53 min).
Sleep quality remained unchanged over the whole test period with a slight improvement towards the end of the test period. Mood and affectivity did not show any significant changes.

Conclusions:
Results show, that chronotypes and age may play an important role in the frequency and duration of PMD usage. Especially in evening chronotypes, limiting the time spent with PMDs before bedtime may have positive effects on their sleep duration and sleep quality.

Acknowledgements:

EVALUATION OF A PORTABLE BLUE/GREEN LIGHT DEVICE FOR PHASE ADVANCING THE CIRCADIAN MELATONIN RHYTHM IN NORMAL SLEEPERS

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Introduction: This study evaluated the effectiveness of a head mounted portable light device, Re-Timer, in phase advancing to an earlier time the circadian melatonin rhythm of healthy sleepers in a home setting. The Re-Timer was designed to address the limitations of traditional bright light boxes such as impaired portability and inefficiency of large white light boxes. The devices aimed to make it more practical and convenient to administer light therapy for a range of circadian sleep disorders.

Methods: Eighteen healthy participants underwent a within-subject design treatment protocol, consisting of seven consecutive mornings of using Re-Timer for one hour compared with the same procedure but not using Re-Timer with at least a week wash-out period and with order of conditions counter-balanced. Circadian phase was measured using salivary dim light melatonin onset (DLMO) pre- and post-treatment. Subjective sleepiness in the evening was also assessed as a complement to DLMO.

Results: After using the Re-Timer for seven mornings, a significant phase advance of 61 min in DLMO compared to a 10 min delay in the no light control condition was observed. However, subjective sleepiness did not differ over the seven mornings between the two conditions. A few minor and transient side effects were experienced by participants but no treatment was required.

Discussion: The Re-Timer is an effective and safe device for advancing the circadian rhythm of healthy sleepers at home. Future research on its clinical utility could make Re-Timer a practical and affordable way to self-administer bright light therapy for circadian rhythm sleep disorders such as delayed and advanced sleep/wake phase disorders, shift work disorder, jet-lag, and seasonal affective disorder.

IMPACTS OF SERUM VITAMIN D LEVELS ON SLEEP AND DAYTIME SLEEPINESS ACCORDING TO WORKING CONDITIONS

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Introduction: Vitamin D deficiency can cause sleep disturbances and shift work is known to be associated with lower vitamin D status and poor sleep quality. A previous study on this issue had some methodological shortcomings such as the lack of objective sleep measurements and no clear distinction between day and night shifts. Hence, we aimed to evaluate serum vitamin D levels and sleep quality in night-shift workers compared to daytime workers.

Materials and methods: We recruited 412 night-shift workers and 432 daytime workers at the Seoul National University Bundang Hospital for this study. All participants completed questionnaires regarding demographic and clinical characteristics and they underwent blood tests for serum vitamin D levels. Objective sleep data using actigraphy were obtained from 150 night-shift workers and 203 daytime workers in our study population.

Results: There was no significant difference in serum vitamin D levels between night-shift workers and daytime workers after controlling for possible confounders including age, sex, season of blood test and other blood parameters related to vitamin D metabolism. In night-shift workers, no significant association was observed between serum vitamin D levels and sleep parameters, depressive/anxiety symptoms, and quality of life. Meanwhile, we found that vitamin D deficiency was closely related to a higher risk of excessive daytime sleepiness (OR = 2.32, 95% CI = 1.38-3.89, P = 0.001) and short duration of total sleep time (OR = 3.44, 95% CI = 1.65-7.17, P = 0 .001) in daytime workers, after multivariate logistic regression analysis.

Conclusions: Vitamin D deficiency was associated with sleep problems in daytime workers while those of night-shift workers were not related with serum vitamin D levels. The adverse impacts of low vitamin D on sleep might be attenuated by shift work-related sleep disturbances in night-shift workers. Further studies might be needed to clarify the beneficial effects of vitamin D supplements for improving sleep quality and daytime sleepiness.

Acknowledgements: None

SHIFT SCHEDULES, HEALTH STATUS AND QUALITY OF LIFE OF SLEEP TECHNICIANS

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Introduction: Sleep technicians are at risk of shift work sleep disorder to test and treat others´ sleep disorder. Until now, there is no guideline for shift schedule of sleep technicians. We purposed to survey the current shift system of sleep technicians and its effect on health and quality of life.
Materials and methods: We performed nationwide survey of work schedules for sleep laboratories in Korea, by sending email questionnaires to sleep technicians. Questionnaire included shift schedule, control over the schedule, job satisfaction, preference for the schedules, Short Form-12 Health Survey (SF-12), Insomnia Severity Index (ISI), Epworth Sleep Scale (ESS), Hospital Anxiety and Depression Scale (HADS), Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10).
Results: 54 technicians from 30 sleep centers participated in the survey. Their shift schedule could be classified as rapid rotating system including night shift schedules mixed with day work on a weekly basis (n=5), slow rotating system which alternates from night shift to day shift works or vice versa every 3 months to 1 year (n=20), and permanent night shift (n=18). After adjusting for the other factors affecting health status, FOSQ-10 was lower in rapid rotating group and fixed night group, physical composite of SF-12 was lower in rapid rotating group and HADS-anxiety score was higher in fixed night group, compared with day shift group.
Conclusions: The current policies scheduling shift vary depending on institutions. Insomnia and health concerns were prevalent among sleep technicians. Physical fatigue for rapid rotating shift group, and anxiety for permanent night shift group were issues. Consensus guideline for optimal shift system of sleep technicians should be urged.

ANALYSIS OF TOTAL REST TIME AND URINARY MELATONIN SECRETION IN SCHOOL CHILDREN

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Introduction: Melatonin is a hormone produced by the pineal gland and its secretion is regulated by the suprachiasmatic nucleus in the hypothalamus. Pineal melatonin is secreted at night, provided it is dark, and its pattern of circadian production is crucial for the sleep-wake cycle regulation. 6-sulfatoxymelatonin is the main urinary metabolite of melatonin and its analysis is a less invasive method of evaluating the production of this hormone. In view of the importance of adequate sleep for school children and that melatonin is a hormone that promotes the onset of sleep in humans, the objective of this study was to analyze the total rest time and the 6-sulfatoxymelatonin levels of school children.

Casuistry and Method: This is a cross-sectional and descriptive study and all the procedures were approved by the Ethics Committee (n°370/2018) of the Federal University of São Paulo. Children from the 1st to the 4th grades of a private elementary school in São Paulo - Brazil had their activity-rest cycle monitored for 15 consecutive days by an actimeter (ActTrust®) that was positioned on the non-dominant upper limb. Data analysis was performed using the software ActStudio©. Nocturnal urine (between sunset and sunrise) was collected during the last night for the analysis of 6-sulfatoximelatonin by ELISA. Statistical analysis were performed using SPSS Statistics 2.0 using the mean, standard deviation and the GLzM test for analysis of non-parametric data, considering significant values for $p \leq 0.05$.

Results: We analyzed the total resting time and 6-sulfatoxymelatonin levels in 5 boys and 5 girls that were 7.4 (± 0.96) years old in average. The mean of total resting time among the children was 459.71 (±19.22) minutes and the mean level of 6-sulfatoxymelatonin was 13.90 (± 6.18) (ug) / period. Although the relationship was not significant (p=0.571), possibly influenced by the small sample size, it can be inferred that there is a proportional relationship between the variables, with a chance of occurrence of a greater total rest time when melatonin production is also higher (OR=1.737).

Conclusion: Higher levels of melatonin may be associated with longer total rest time in school children.

THERE IS MORE TO CHRONOTYPES THAN LARKS AND OWLS. EVIDENCE OF TWO ADDITIONAL CHRONOTYPES IN HUMANS FROM A LARGE SCALE COMMUNITY-BASED SURVEY

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Evidence is accumulating for more than two distinct human chronotypes, i.e., people would be neither morning ("Larks") nor evening ("Owls") types, or something inbetween. Most of these studies rely on either other species (fruit flies, mice), or were conducted small samples or using multidimensional instruments for self-assessment of diurnal preference. The current study takes an opposite approach by asking participants to predict, starting from the morning, the fluctuations of their sleepiness level on the 24-h time interval of permanent wakefulness, and to classify their sleepiness profiles along their main modes of variation. 1305 subjects participated in an online survey including a visuo-verbal judgment task to elicit 24-h sleepiness curves. Functional principal component (PC) analysis yielded 4 distinct chronotypes based on PC > 1, $-1 <$ PC < 1, and PC < -1 scores. Morning types (PC1 > 1) show patterns of low sleepiness in the morning and high sleepiness in the early night, while the opposite trend was expected by evening types (PC2 > 1). "Afternoon types" (PC3 > 1) are the least sleepy after the middle of the day and to be more sleepy not only in the early morning but also at midnight, whereas "napper types" (PC4 > 1) show the opposite pattern characterized by "afternoon dip" in combination with lower sleepiness levels both prior and after this deep. 396 participants were of neither or intermediate chronotype ($-1 <$ PC1-PC4 < 1) with a similar to the sample-averaged sleepiness curve. Similar typology was found both in males and females, day and night workers and in subjects younger and older than 25 years.

CIRCADIAN TAU DIFFERENCES AND RHYTHM ASSOCIATIONS IN DELAYED SLEEP-WAKE PHASE DISORDER AND NON-24-HOUR SLEEP-WAKE RHYTHM DISORDER

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Introduction: Delayed Sleep-Wake Phase Disorder (DSWPD) and Non-24-hour Sleep-Wake Disorder (N24SWD) are circadian-based sleep disorders. DSWPD patients exhibit circadian rhythms that are timed approximately > 3 hours later than normal and N24SWD circadian rhythms cannot be synchronised to the 24-h light-dark cycle thus resulting in free running sleep-wake cycles that are significantly longer than the 24-h day. Greater tendency to phase delay from longer than normal period lengths and abnormal relationships between the timing of circadian rhythms and sleep/wake cycles are also hypothesised to underpin the pathology of DSWPD and N24SWD. In this study we investigated biological, sleepiness and behavioural rhythm period lengths (i.e., *taus*) of DSWPD, N24SWD patients and healthy control sleepers. Cross-correlation analyses were performed between different rhythm variables to examine phase angle of entrainment. The aim was to explore if behavioural rhythms, in addition to the biological circadian rhythms contribute to misalignments of sleep timing symptomatic of DSWPD and N24SWD.

Materials and methods: Twenty-six DSWPD (17m, [Mean ± Standard Deviation] age: 21.85 ± 4.97 years), 4 full-sighted N24SWD (3m, age: 25.75 ± 4.99 years) participants who met diagnostic criteria, and 18 controls (10m, age: 23.72 ± 5.10 years) participated in an 80-hour modified constant routine. A forced-desynchrony ultradian protocol of 1-hour 'days' in dim light, controlled conditions alternated 20-minute sleep opportunities with 40-minute enforced wakefulness. Subjective sleepiness ratings were recorded prior to every sleep opportunity and median reaction time (vigilance) was measured hourly. Amount of sleep obtained (sleep propensity) was derived from 20-minute sleep opportunities to quantify hourly objective sleepiness. Hourly core body temperature was recorded, and salivary melatonin assayed to measure endogenous circadian rhythms. Rhythm data were curved using the 2-component cosine model.

Results: The timing of DSWPD patients' sleeping patterns and circadian rhythm measures (i.e., core temperature, melatonin, vigilance, and subjective and objective sleepiness) were significantly delayed by 2-3 hours compared to controls. A 3 by 5 repeated measures analysis of variance was used to investigate between- and within-groups *taus* of core body temperature, melatonin, subjective sleepiness, sleep propensity and vigilance. There were significant main effects of both groups ($F(43,4)=2.95$, $p=0.03$, $\eta^2=0.23$) and different rhythms ($F(43,4)=3.89$, $p=0.023$, $\eta^2=0.17$) but no significant overall interaction effect. DSWPD and N24SWD patients had significantly longer melatonin and temperature *taus* compared to controls. There were no significant *tau* differences between groups as measured by subjective sleepiness, sleep propensity and vigilance rhythms. However, DSWPD patients showed a greater delay of maximum sleep propensity from minimum core body temperature. Their sleep propensity rhythms lagged behind core temperature rhythms by an hour more compared to controls' sleep propensity and core temperature rhythms.

Conclusions: Delayed circadian rhythms in DSWPD may result from larger phase angles between core body temperature and sleep propensity. This relatively delayed sleep propensity rhythm may result in later sleep timing in DSWPD patients relative to their circadian timing thus delaying their light exposure during a time that is critical to phase-advancing the circadian system.

Chronobiology/Circadian Disorders
Board #185 : Poster session 1

READINESS TO CHANGE AND COMMITMENT AS PREDICTORS OF THERAPY COMPLIANCE IN ADOLESCENTS WITH DELAYED SLEEP-WAKE PHASE DISORDER

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Introduction: Delayed Sleep-Wake Phase Disorder (DSWPD) is a sleep disorder common in young people and is characterised by an inability to sleep and wake at a socially accepted time. Recent evidence indicates that adolescents' motivation to change sleep-wake patterns is low, despite significant impacts on many areas of daytime functioning. Lack of motivation might account for the inefficacy of current programs aimed at changing adolescents' bedtime. The present study was based on the original readiness to change model, which proposes that desire, ability, reason and need are predictors of commitment, and this in turn is a pathway for influencing behaviour change. The aim was to evaluate components of adolescents' motivation, and subsequent changes in behaviour.

Materials and methods: Fifty-six adolescents, aged 13-23 (Mean ± SD: 15.8±2.3y; 38% M) diagnosed with Delayed Sleep-Wake Phase Disorder underwent 3 bright light therapy sessions to phase advance sleep patterns. Adolescents were instructed to advance wake-up times by 30-minutes daily. Motivation ratings of desire, ability, need and commitment to change sleep patterns were taken at baseline, using a 11-point Likert-type scale for each motivation item. Sleep diaries kept during treatment weeks and sequentially earlier wake-up times in 30-min intervals were used to measure adolescents' compliance to therapy (i.e., behaviour change).

Results: At the outset of therapy, adolescents indicated strong desire (8.9±1.8; out of 10), reasons (8.9±1.1) and need (8.5±1.8), yet moderate ability (6.4±1.8) and commitment (8.0±1.2) to advance their sleep-wake patterns. Adolescents' sleep-onset times were significantly advanced, total sleep time increased and sleep latency decreased (all p< .05). Therapy lasted 6-27 days (13.9±4.5) and clients complied for approximately half the time (between 3-15 days; 8.8±2.7). Commitment was associated with ability (r=.66, p < .001) but not desire, reason or need (all p>.05). Adolescents' desire to change (r=.30, p=.03) and commitment (r=.30, p=.03) were positively correlated with behaviour change, but their need, ability and reasons were not. A mediation analysis showed that ability and desire were important in predicting behaviour change, by total effects through commitment (i.e., indirectly and directly).

Conclusions: Our findings suggest that the total effects of ability (i.e., confidence) and desire (i.e., want) to change related to adolescents' willingness to make a change, and actually comply with therapy instructions. Part of motivational interviewing is to explore a client's desire, ability, reasons and need to change their current behaviour. Our results suggest that clinicians may wish to focus on adolescents' modest ratings of confidence and to a lesser extent, desire. These findings are supported by similar clinical research in other areas (e.g., eating disorders and social anxiety disorder), where confidence to change (i.e., self-efficacy) is the strongest motivational predictor of change, when clients are ambivalent toward changing their behaviour.

Chronobiology/Circadian Disorders
Board #085 : Poster session 2

EVENINGNESS CHRONOTYPE IS ASSOCIATED WITH SLEEP DISTURBANCES AND DEPRESSIVE MOOD IN KOREAN WORKING ADULTS

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Introduction: Chronotypes and social jet-lag can affect the quality of sleep and health of workers. However, little is known about the distribution of chronotypes of Korean workers and the relationship between chronotypes and other health problems including sleep disturbance.

Materials and methods: The aim of this study was to identify chronotypes and their associations with health problems among Korean working adults. A total of 1397 participants who visited a tertiary hospital for medical check-up between January and April 2016 were enrolled. Among them, we excluded the following patients from this study: 177 patients who did not complete the questionnaire; 243 patients who did not have job; 87 shift workers. Subjects completed the self-reported questionnaires with demographic factors, health/medical history, sleep-related scales including the Korean versions of the Morningness-Eveningness Questionnaire (MEQ), Insomnia Severity Index (K-ISI), Epworth Sleepiness Scale (K-ESS), and Global Sleep Assessment Questionnaire (GSAQ). Associations of chronotype with sleep-related scales, underlying disease, and medical check-up results were analyzed.

Results: Among 890 participants aged 25-76 (mean 52.22 ±8.79) years, 572 (64.3%) were men. Chronotype was classified as morning in 33.5% of subjects, evening in 5.7%, neither morning nor evening in 60.8%. Evening-type, when compared with morning type, was significantly associated with short sleep duration ($\leq$ 6 hr, $p = 0.009$) and low sleep efficiency ($p = 0.043$). And the mean score of the ESS and ISI was significantly higher in evening-type ($p < 0.001$). A significant negative correlation was found between the scores of MEQ and ISI, and between scores of MEQ and ESS, demonstrating that the greater the eveningness, the worse the insomnia symptom and the more the excessive daytime sleepiness (ESS: $r=-0.153$, $p< 0.001$, ISI: $r=-0.196$, $p< 0.001$). Depressive mood from GSAQ was associated with evening-type ($p< 0.001$).

Conclusions: Evening-type was associated with sleep disturbance and depressive mood.

Acknowledgements: none.

ASSOCIATION OF SOCIAL JETLAG WITH SICKNESS ABSENCE AND COMMON COLD IN A LARGE SAMPLE OF JAPANESE DAYTIME EMPLOYEES

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Introduction: Although a number of studies have reported that poor sleep and insufficient sleep is a risk factor for sickness absence and common cold, almost no studies have focused on its association between 'social jetlag' and sickness absence / common cold. The aim of this study was to investigate the association of social jetlag, i.e., a mismatch between biological and social timing, with sickness absence and common cold in a large sample of Japanese employees.

Materials and methods: A total of 69,519 non-shift daytime employees (74.3% men, age 40 ± 11 years) representing various industries and occupations were surveyed by means of a self-administrated questionnaire during 2008 to 2012. In the questionnaire, participants answered questions regarding bedtime and wake-up times on weekdays (workdays) and on weekends (non-workdays) as well as number of sickness absence in the past year and frequency of common cold in the past 6 months in addition to various sociodemographic and health-related factors. Social jetlag was calculated as the difference in midpoint of sleep (in hours) between weekdays and weekends.

Results: The multivariable adjusted odds ratio (aOR) (95% confidence intervals (CI)) for > 2 hours, > 1 to 2 hours, > 0 to 1 hours of social jetlag for 'sickness absence (no vs. yes)' was 1.15 (1.06-1.24), 1.17 (1.09-1.25) and 1.09 (1.03-1.16), respectively, compared to those with ≤ 0 hours of social jetlag (reference group). Similarly, aOR for > 2 hours, > 1 to 2 hours, > 0 to 1 hours of social jetlag for 'common cold (no vs. yes)' was 1.23 (1.14-1.34), 1.26 (1.18-1.35) and 1.22 (1.14-1.29), respectively, compared to the reference group.

Conclusions: This study suggests that even a small amount of social jetlag may be a risk factor for sickness absence and infection to common cold, which may have profound impact on productivity and quality of working life.

NIGHTTIME LIGHT EXPOSURE AND THE INCIDENCE OF DIABETES MELLITUS: A LONGITUDINAL STUDY OF THE HEIJO-KYO COHORT

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Introduction: Light information received by the brain influences human circadian timing and metabolism; low-level light at night (LAN) significantly increased body mass and led to prediabetes in mice. We hypothesized that LAN exposure increases the diabetes risk in humans. The aim of the present study was to evaluate a longitudinal association between LAN exposure and the incidence of diabetes in a general population.

Materials and methods: In this prospective cohort study of 678 elderly participants without diabetes at baseline, bedroom light intensity was measured at 1-min intervals and the average light intensity recorded between bedtimes and rise times over two consecutive nights was used in the analysis.

Results: During follow-up (median, 42 months), 19 of the 678 participants (mean age, 70.6 years) developed diabetes. Poisson regression models revealed that the incidence rate for diabetes was significantly higher in the LAN group (avg ≥5 lux, n = 128) than the dark group (avg < 5 lux, n = 550) (incidence rate ratio, 4.79; 95% CI, 1.78-12.9; P = 0.002). Further propensity score adjustments in relation to LAN produced consistent results (incidence rate ratio, 3.06; 95% CI, 1.06-8.75; P = 0.037). When the cut-off value of LAN was increased to 10 lux, the relationship remained significant (incidence rate ratio 3.42; 95% CI, 1.09-10.7; P = 0.035).

Conclusions: Our findings suggest that LAN exposure increases the incidence of diabetes in a general elderly population. Further research involving a large cohort with new-onset diabetes is warranted to elucidate these findings.

Chronobiology/Circadian Disorders
Board #069 : Poster session 1

A CASE OF MOOD DISORDER WITH ALTERNATING LONG AND SHORT SLEEP: A CONSIDERATION OF INVOLVEMENT OF CIRCADIAN DISTURBANCE AND SLEEP HOMEOSTASIS

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Objectives: Psychiatric disorders, in particular mood disorders, are often accompanied by circadian sleep-wake disturbances. Although delayed sleep-wake pattern is the most common, various other patterns may also often be observed. Here we report a case of mood disorder accompanied by alternating long and short sleep every several days.
Methods and materials: A case report of a male patient in his 30s.
Results: The patient was referred to X hospital because of instable sleep pattern. He had been treated for his bipolar disorder in another hospital, and his mood had been almost stabilized with residual psychomotor retardation. At the time of referral, his sleep pattern was that he took very long sleep (e.g. 12 -16 hours a day) for several days, and subsequently took relatively short sleep (e.g., 2-7 hours a day) for following several days; this pattern was cyclically and continuously repeated. He was admitted to X hospital to stabilize his sleep pattern, and underwent bright light therapy for about one month. His sleep pattern, once normalized, was disturbed again with substantial circadian phase delay after discharge; however periodic appearance of very long sleep was no longer observed.
Conclusion: The course of this case was quite different from that of recurrent hypersomnia, including improvement with hospitalization and bright light therapy. Although this disruption of sleep pattern might be attributable to circadian dysregulation, this could not be classified as any type of circadian rhythm sleep-wake disorder in ICSD-3. It could be speculated that this "seesaw" pattern of sleep might be an excessive manifestation of altered process of sleep homeostasis beyond circadian rhythm. To consider its mechanism and proper treatment, further accumulation of similar cases would be warranted.
Acknowledgments: This patient provided written informed consent for this study. The authors have no conflict of interests to declare with regard to this study.

SLEEP-WAKE PATTERNS AND WHITE MATTER INTEGRITY INFLUENCE COGNITIVE CONTROL IN YOUNG ADULTS

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Introduction: Sleep-wake patterns (SWP) alterations have been related to lower cognitive performance. For cognitive control, neural responsiveness would be mediated by white matter integrity (WMI) through strengthening communication efficiency between brain regions. The external capsule (EC) is implicated in emotion and cognitive control. To the best of our knowledge, the effect of SWP and WMI on cognitive control remains poorly studied. The aim of this study was to assess the effect of SWP and WMI on cognitive control of young adults.

Methods: Participants were part of a cohort follow-up study since infancy. In adulthood, SWP were detected by an automated method applied to actigraphic data recorded for a week. Nighttime SWP studied for weekdays and weekend were: total sleep time (nTST) and total wake-up time (nTWT). These variables were categorized based on the median of their distribution. Diffusion tensor imaging sequence and tract based spatial statistics were performed to obtain fractional anisotropy (FA) data, a parameter of WMI. Masks of the left (LEC) and right EC (REC) were created using the JHUICBM-DTI-81 Atlas. Cognitive control was assessed using two oculomotor tests: (a) Antisaccade (AS) task: subjects had to avoid looking at visual stimuli and look in the opposite location (correct response); (b) Incentivized AS task: similar to AS task with the addition of incentives (neutral, loss avoidance and reward). Latency and percentage of correct responses (accuracy) were estimated for each task and incentive. Univariate GLM included sex and body mass index as covariates.

Results: Sixty-eight participants (45.5% female, 21.4±0.31y and 26.7±4.4 kg/m2) were assessed. Median for nTST and nTWT were: (a) weekdays: 7.5±1.6h and 0.5±0.4h; (b) weekend: 8.0±2.6h and 0.3±0.6h. Mean for REC and LEC FA were: 0.50±0.02 and 0.48±0.02. In the AS task, significant effects of nTST on weekdays ($p < 0.05$) and REC FA ($p < 0.05$) on latency of correct responses was evident, those with lower nTST on weekdays (296.4 vs. 272.8ms, $p < 0.05$) and decreased FA (β=-0.271, $p < 0.05$) showed longer latency. In the Incentivized AS task, main effects of nTWT on weekdays ($p=0.05$) and REC FA ($p < 0.05$) on accuracy in reward incentive was found, those with greater nTWT on weekdays (67.7 vs. 76.8%, $p < 0.05$) and lower REC FA (β=0.243, $p < 0.05$) showed decreased accuracy. There was a main effect of nTST on weekdays-weekend ($p < 0.05$) on accuracy in reward incentive, those with longer nTST on weekdays and shorter nTST on the weekend showed higher accuracy compared to those with longer nTST on weekdays and weekend (82.2 vs. 67.1%, $p < 0.05$) and those with shorter nTST on weekdays and weekend (82.2 vs. 65.1%, $p < 0.05$).

Conclusion: This study shows the influence of nocturnal SWP and WMI on cognitive. Participants with longer nTST on weekdays but decreased nTST on the weekend showed higher accuracy in reward incentive. These results provide support to the role of SWP variability on cognitive control in early adulthood. Decreased cognitive control in individuals with shorter nTST might be mediated by lower WMI.

Support: Fondecyt (CONICYT, Chile) 11160671 and NIH HD33487 grants.

STUDY OF THE EFFECTS OF A 5 HOUR AND 8 HOUR CIRCADIAN PHASE ADVANCE AS A MODEL OF JET LAG DISORDER

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Introduction: Jet Lag Disorder occurs when an individual's circadian rhythms become misaligned due to rapid change in time zone that occurs after rapid transmeridian travel. By simulating such a time zone change in a lab setting, the effects of phase shifting can be studied in the absence of confounders that occur during travel including variable sleep deprivation and light exposure.

Materials and methods: This observational study investigated the effects of a 5 hour and 8 hour sleep phase advance in 322 patients (5 hour: n=86; 8 hour: n=236). Patients went to bed 5 or 8 hours earlier than their usual bedtime and attempted to sleep for 8 hours, after a protocol of sleep hygiene. Overnight polysomnography was performed.

Results: Sleep efficiency (SE) was evaluated for each third of the night. A significant difference was demonstrated between the 5 hour and 8 hour phase advance in SE during each of the three thirds of the night: first third of the night SE (5 hour: 45.6%; 8 hour: 54.0%, p=0.02), second third of the night SE (5 hour: 53.4%; 8 hour: 24.2%; p< 0.0001), and third third of the night SE (5 hour: 76.8%; 8 hour: 33.6%; p< 0.0001).

Conclusions: This model of studying 5 to 8 hour phase advance as a model of Jet Lag was able to show significant differences in PSG-measured sleep efficiency between a 5-hour phase advance and an 8-hour phase advance during each third of the night. These results support this study design as a model to be used in developing therapeutics for the treatment of phase advance disorders including Jet Lag Disorder.

Chronobiology/Circadian Disorders
Board #095 : Poster session 3
TASIMELTEON EFFECTIVE IN TREATING JET LAG DURING TRANSATLANTIC TRAVEL

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Introduction: Jet Lag Disorder (JLD) affects millions of individuals annually who cross multiple time zones during their travel. JLD symptoms are more severe during eastward travel. It is reported that there are more than 30 million US resident trips each year to overseas destinations. Of these, 60% (approximately 20 million) travel to destinations in Europe, the Middle East and Asia.

Materials and methods: This was a two-phase transatlantic travel study, with an observational travel phase (baseline) followed by a treatment phase. 25 study participants traveled either 5 or 8 time zones from Washington, DC to London and San Francisco or Los Angeles to London, respectively. They stayed in London for 3 nights and 4 days, and during randomization they received tasimelteon 20mg for 3 consecutive nights prior to their bedtime. Efficacy was monitored by polysomnography (PSG) as well as sleep and wake questionnaire scales (PSQ).

Results: Tasimelteon significantly improved the primary endpoint in total sleep time of the first 2/3 (TST2/3) on Night 3 as measured by PSG (tasimelteon=76.2; placebo=41.4; p=0.0354). Tasimelteon also demonstrated significant improvement in the total sleep time at night 3 (tasimelteon=111.9; placebo=33.5; p=0.0225), sleep quality at night 3 (tasimelteon=1.31; placebo=0.36; p=0.0198), and sleep latency at night 3 (tasimelteon=-20.6; placebo=6.0; p=0.0347) as measured by the PSQ. In addition, Tasimelteon significantly improved the global function as measured by patient global impression of severity (PGI-S) (tasimelteon=-0.71; placebo=-0.07; p=0.0168).

Conclusions: The JET study successfully demonstrated clinically meaningful and statistically significant improvements in both objective and subjective sleep measures as well as global functioning after a real-world flight. These results suggest that tasimelteon can be an effective therapeutic tool to treat Jet Lag in the context of 5- and 8-hour time zone transatlantic travel.

TASIMELTEON SIGNIFICANTLY IMPROVES TIME TO 30 MINUTES OF REM (REM30) AS COMPARED TO PLACEBO IN THE JET8 STUDY

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Introduction: Jet lag disorder is a common circadian disorder frequently observed in millions of travelers who cross multiple time zones. Jet lag disorder is characterized by nighttime sleep disruption, a decrease in daytime alertness and impairment to social and occupational functioning. Time to 30 minutes of REM is an important indicator of overall sleep quality.

Materials and methods: In the JET8 study, 318 healthy volunteers were admitted to a sleep unit and were subjected to a circadian challenge of an 8 hours advance to their usual bedtime. The JET8 study design induced the circadian challenge experienced by travelers who cross 8 times zones, which leads to jet lag disorder. This clinical design allowed for the study of tasimelteon without the confounding effects of sleep deprivation and variable light conditions.

Results: Subjects in the tasimelteon group achieved time to 30 minutes of REM 54 minutes faster than subjects in the placebo group ($p < 0.0001$). Subjects in the tasimelteon group were 50% more likely to achieve time to 30 minutes of REM as compared to the placebo group.

Conclusions: Tasimelteon demonstrated statistically significant and clinically meaningful improvement in time to 30 minutes of REM. This data in conjunction with the overall improvement in clinically meaningful sleep, lends further support to tasimelteon as a novel circadian regulator for the treatment of jet lag disorder.

SLEEP BEHAVIOR IN THREE PRE-INDUSTRIALIZED COMMUNITIES IN THE MALAY PENINSULA

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Introduction: Assessment of sleep in pre-industrial communities provides a unique window to evaluate sleeping behavior under indigenous like conditions, allowing comparisons with sleep behavior in the modern 24-hour society. As more and more pre-industrial communities begin to adopt a lifestyle that more closely resembles an industrialized way of life, we were interested in characterizing sleep duration and aspects influencing sleep in three extant pre-industrial communities in the Malay Peninsula, two hunter-gatherer groups (Jahai and Semaq Beri) and one slash-and-burn agriculturalist group (Semelai).
Materials and methods: From an ongoing study, we here report sleep actigraphy data (ActTrust, Condor) from the first 23 adults (in the Semelai (S), Semaq Beri (SB) and Jahai (J) groups) wearing actigraphs between 5-7 days. The preliminary analyses, of 116 day/night periods, focused on the following basic sleep parameters: time in bed, total sleep time, wake after sleep onset, and sleep efficiency (%). Average data was derived for each group separately. Data on activity, distal skin temperature, light spectrum, daytime napping and factors influencing sleep will be analyzed in the next step.
Results: Average time in bed ranged between 7.1 - 8.5 hrs for the three groups, and total sleep times between 5.6 - 6.5 hrs (S: 6.5 ± 1,4; SB: 5.6 ±- 1.6; J: 5,7 ± 1,4). Wake after sleep onset was estimated to be between 56 min and 124 min (S: 56 ± 47; SB: 58 ± 36; J: 124 ± 60). Sleep efficiency ranged between 72 % and 84 % (S: 84 ± 12; SB: 78 ± 13; J: 72 ± 10).
Conclusions: In line with recent findings on sleep in other pre-industrial groups, the preliminary data yielded sleep durations not uncommon in modern conditions. The fact that average total sleep times, in all groups, were in the lower end of the typical spectrum is not in line with the notion that sleep duration is commonly reduced as a consequence of living in the industrialized society. Further analyses will focus on how light, temperature and sleep log data can explanation variations in sleep behavior. For example, environmental threats, reported a few nights, were related to severely disrupted sleep.

Chronobiology/Circadian Disorders
Board #070 : Poster session 1

THE EFFECT OF TOTAL SLEEP DEPRIVATION ON COGNITIVE PERFORMANCE DURING NIGHT-SHIFT FOR EARLY AND LATE CHRONOTYPES

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Introduction: A single night of total sleep deprivation (TSD) impairs cognitive performance. Many shift workers struggle to transition to night-shift and have been awake for at least 24 hours by the end of their first night-shift. Evidence suggests chronotype, an individual difference which reflects circadian phase, also affects cognitive performance during night-shift. The aim of this study was to examine the impact of chronotype on the effect of TSD on cognitive performance during night-shift. As early types are suggested to experience greater circadian misalignment during night-shift than late types, early types were predicted to perform worse than late types over the night-shift. However early types were predicted to outperform late types towards the end of the night-shift, due to increased alertness associated with their advanced circadian phase.

Materials and methods: Data was collected from 44 (21f, 23m) healthy adults aged 23.1 ± 3.7 years during a simulated night-shift study. Dim Light Melatonin Onset (DLMO) was derived from hourly saliva samples taken during the evening prior to the day of the night-shift. During the day of the first night-shift, participants were provided a sleep opportunity from 03:00-12:00, then were kept awake from 12:00-23:00. During the night-shift (23:00-07:00), participants completed five Psychomotor Vigilance Tasks (PVTs), with approximately 2 hours between tasks. Cognitive performance was assessed by mean PVT reciprocal response time (RRT).

Results: The sample (DLMO = 22:03 ± 1:15) was divided into thirds based on DLMO. The third of participants with the earliest DLMO were classified as early types (N = 15, DLMO = 20:52 ± 0:39); the third of participants with the latest DLMO were classified as late types (N = 15, DLMO = 23:20 ± 1:05). A 5 (PVT time) x 2 (chronotype) mixed factorial ANOVA was performed on mean RRT. The ANOVA revealed the main effect of PVT time ($F(1.96,54.74)$ = 39.33, p < .001), with worse performance on later PVTs. There was no main effect of chronotype ($F(1,28)$ = 0.14, p = .71), with similar performance for early and late types across the night-shift. There was also no PVT time*chronotype interaction ($F(4,112)$ = 0.51, p = .73), demonstrating that the effect of TSD on cognitive performance was not moderated by chronotype.

Conclusions: Contrary to predictions, the results suggest the effect of TSD on cognitive performance during night-shift was similar for early and late types. Possible explanations include: (1) the duration of wakefulness prior to the final PVT was 18.67 hours, but prior wakefulness of 24 hours or more may be necessary to reveal differences in performance between chronotypes; (2) only extreme early and late types may demonstrate differences in performance; or (3) some cognitive functions (e.g. memory) may be more affected by chronotype than others.

THE TIMING OF DAYTIME SLEEP, AND THUS THE TIMING OF DAYTIME LIGHT EXPOSURE, AFFECTS THE SIZE AND DIRECTION OF THE PHASE SHIFT INDUCED BY A WEEK OF NIGHT SHIFTS

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Introduction: The aim of the study was to examine how the timing of daytime sleep in the dark, and thus the timing of daytime light exposure, affects circadian adaptation to a week of simulated night shifts. It was hypothesised that night work would delay the circadian system - and the size of the delay would increase as the duration of exposure to light in the morning and early-afternoon decreased.

Materials and methods: So far, 43 adults (21F, 22M, aged 18-35 yr) have been randomly assigned to one of four conditions in a laboratory-based simulated shiftwork protocol. Each condition included seven consecutive 8-h night shifts (23:00-07:00h). The only difference between conditions was in the timing of the 7-h sleep opportunities in breaks between shifts, and thus the duration of exposure to morning and early-afternoon light (MAL) between 07:00 and 15:30h: Morning condition - sleep at 08:30-15:30h, with 1.5 h of MAL at 07:00-08:30h; Split#1 condition - sleep at 08:30-13:30h and 19:30-21:30h, with 3.5 h of MAL; Split#2 condition - sleep at 08:30-10:30h and 16:30-21:30h, with 6.5 h of MAL; Afternoon/Evening condition - sleep at 14:30-21:30h, with 7.5 h of MAL. Circadian phase was assessed using salivary dim light melatonin onset (DLMO) on the nights immediately before and after the week of night work. Light intensity was 75 lux during night shifts, 750 lux during a 20-minute simulated commute after work, < 0.03 lux during sleep, < 10 lux during DLMO assessments, and 350 lux at other times.

Results: The DLMO data were analysed using a mixed-design ANOVA with one within-subjects factor (time: pre/post) and one between-subjects factor (condition). There was a significant interaction (F = 10.6; df = 3,39; p < .0001) - the type and size of the phase shift differed between the conditions, i.e., morning (delay = 5.1 ± 2.1 h), split#1 (delay = 2.6 ± 2.5 h),
split#2 (delay = 1.3 ± 2.6 h), and afternoon/evening (advance = 0.7 ± 2.8 h).

Conclusions: These data indicate that the timing of daytime sleep, and thus the amount of exposure to morning and early-afternoon light (MAL), substantially affects the degree of circadian adaptation to a week of night work. In situations where a shiftworker wishes to maximise adaptation to night work, the most sleep should be taken in the morning. To minimise adaptation, sleep should occur in the late-afternoon and evening.

Chronobiology/Circadian Disorders
Board #090 : Poster session 2
CIRCADIAN PHASE, CHRONOTYPE AND SLEEP-WAKE CYCLE UNDER REAL-LIFE CONDITIONS: THE BAEPENDI HEART STUDY COHORT

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Introduction: Light is the most potent Zeitgeber in humans. The importance of studying communities at different stages of urbanisation and industrialisation is recognized as there is much yet to learn how timing and intensity of light affect the biological clock. We have previously described a strong shift towards morningness in the Baependi Heart Study, where urbanisation is still an ongoing process. Here, we compared the Dim light melatonin onset (DLMO), the most reliable measure of central circadian timing in humans, with chronotype, sleep, activity, and light exposure to circadian phase in the largest sample studied to date (N=75) under real-life conditions.

Materials and methods: The 75 participants (aged 36.8±11.1 years) included 33 men (aged 38.0±10.2) and 42 women (aged 35.8±11.9) completed the Munich Chronotype Questionnaire (MCTQ), Morningness-Eveningness Questionnaire (MEQ) and Insomnia Severity Index (ISI) questionnaire. A linear regression analysis of age and MEQ score was performed, and participants presenting MEQ scores 20% above the regression line were categorized as Morning type (M-type), those 20% below the regression line were Evening type (E-type) and those within 20% of the regression line were categorized as Neither type (N-type). The MCTQ parameters are mid-sleep on workdays (MSW), mid-sleep on free days (MSF), and mid-sleep on free days corrected for sleep debt on week-days (MSFsc). Sleep-wake cycle and light exposure was assessed by a wrist monitor for 14 days. Saliva samples were collected hourly between 1800h and 2300h in the study clinic in dim light (< 10 lx). Circadian phase was estimated by the time of the salivary dim-light melatonin onset (DLMO) using radioimmunoassay. Groups were compared using a General Linear Model adjusted by sex.

Results: Mean DLMO time (h), MEQ total score, MSW(h), MSF(h) and MSFsc(h) were 20:13:49±1:40:58, 58.88±9.34, 2:46±0:54, 3:42±1:10 and 3:18±1:04, respectively. DLMO time was significantly earlier in M-type compared with E-type (19:29±0:55vs. 21:52±1:47, F(2,56)=4.7; p≤0.01). DLMO correlated with MEQ score (r=-.34, p≤0.01), MSW (r=0.35, p≤0.01), MSF (r=0.34, p≤0.01), and MSFsc (r=.27, p p≤0.04). Compared with E-types, M-typed presented a more predominantly early sleep pattern as determined by MSFsc (2:04±1:32 vs. 4:18±0:32, F(2,56)=5.02; p≤0.01) and by sleep onset on free days (22:13±1:13 vs 24:54±1:02, F(2,56)=7.6; p≤0.01), and decreased insomnia complaints (F(2,52)=4.82; p≤0.01). We also found that DLMO time and MSFsc was negatively correlated with light exposure, mainly during the 3 main hours after 6a.m. (r -0.27, p≤0.03 and r -0.41, p≤0.01, respectively) and with daily activity (r -0.29, p≤0.02 and r -0.408, p≤0.01, respectively). Later MSW was also significantly correlated with insomnia (r=.0310, p≤0.01).

Conclusions: Our results corroborate that the shift towards morningness described in this community is associated with earlier circadian phase, as determined by DLMO. Exposure to bright light in the morning results in an advance of the circadian phase of melatonin and earlier chronotype in naturalistic conditions. We suggest that this difference is an environmental daily phase-advancing stimulus. Collectively, our results emphasize that circadian physiology adapts to differences in light exposure as well as social and work schedules.

Fellowship

Chronobiology/Circadian Disorders
Board #091 : Poster session 2

THE EFFECT OF NOCTURNAL MEAL TYPE "LIGHT" OR "HEAVY" ON THE QUALITY OF SLEEP, ATTENTION FUNCTION, MOOD, FATIGUE, AND MICROBIAL COMPOSITION

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Introduction: Nutrition and sleep are two essential functions for the physiological existence of the organism. Furthermore, both have an acquired cultural, educational and social-behavioral component. This study examined the effect of nocturnal meal type ("light" and/or "heavy") on the quality and quantity of sleep, attention function, fatigue, and mood the following morning. In addition, the microbial composition was examined.

Materials and methods: Twenty healthy subjects (10 men and 10 women), aged 25-33, with no background diseases (such as sleep disorders, gastrointestinal disorders, ADHD, Etc.) were invited to two non-consecutive nights at the Sleep Institute in the Academic College of Tel-Hai for polysomnography test and filling out questionnaires: KSS; ESS; and Brief Symptom Inventory (BSI), To identify self-reported clinically relevant psychological symptoms. For the examination of attention function, subjects carried out Continuous Performance Task (CPT-III) which assesses attention-related problems. In one evening, the subjects consumed two hours before bedtime a "light" meal based on vegetable ingredients (vegetables and vegetable proteins) with 342 calories that contained lentils, feta cheese, beet, and other vegetables. On the other evening, the subjects consumed two hours before bedtime a "heavy" meal based on carbohydrates, fats, and animal protein with 501 calories that contained hamburger and french fries. In addition, subjects were required to give a microbial test before and after meals.

Results: There was no significant difference in the various sleep parameters between the two nights after each meal type: efficacy (t=-1.51, p=0.15); sleep latency stage 1 (t=1.81, p=0.08); sleep latency stage 2 (t=1.00, p=0.33); REM latency (t=0.57, p=0.57); total sleep time (t=-1.57, p=0.13); number of awakenings (t=0.30, p=0.76); and more. Furthermore, no significant differences were found in the behavioral measures examined: fatigue (KSS) (t=-0.30, p =0.77); sleepiness (ESS) (t=0.76, p =0.45); mood (BSI) (t=0.87, p =0.39); and attention deficit (CPT-III) (t=-0.68, p =0.50). The type of night meal did not show a significant effect on the microbial composition in the short-term (H=0.059, p= 0.81).

Conclusion: The findings of this study show that, contrary to popular belief, "heavy" dinner did not affect the quality of sleep and functions measured in the study compared to a "light" dinner. In the current research, the population that was examined included only young and healthy subjects, therefore, the results may differ if the research in this field will extend and include other populations such as adults and subjects with different disorders. Since there is a gap in the knowledge that links the three main parameters: Sleep, nutrition, and microbiome, future studies are needed that will examine the relationships and effects of these three factors on each other.

ULTRA-LOW-DOSE EARLY NIGHT RAMELTEON ADMINISTRATION WOULD BE EFFECTIVE FOR THE TREATMENT OF DELAYED SLEEP-WAKE PHASE DISORDER (DSWPD; DSPS): A PHARMACOLOGICAL REVIEW WITH CASE REPORTS

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Introduction: Melatonin is widely used for treatment of circadian sleep-wake rhythm disorder, especially in Delayed Sleep-Wake Phase Disorder (DSWPD). Ramelteon is a melatonin receptor agonist and is a potential treatment option. However, there are few reports on the clinical occasion. According to the pharmacological profile, the usual dosage of ramelteon (8mg) will be too much to shift the sleep phase and lesser amounts of ramelteon administrated at early night would be beneficial for the treatment of DSWPD. This study presents the clinical experience of ultra-low-dose ramelteon use for DSWPD patients with pharmacological review and discussion.

Materials and methods: From 2015 Sep. to 2019 Apr., 30 patients have been prescribed low-dose ramelteon (1mg-0.16mg: 1/8 - 1/50 tables) at the early night at the sleep clinic in Japan. The patients were diagnosed as DSWPD from their sleep log. The weekdays and holidays sleep schedules were recorded and MSFsc were calculated. After 2-8 weeks, the sleep schedule, daytime function, and adverse events were examined. Some patients reduced their amount of ramelteon due to the acute sleepiness and the status was reexamined. This report was approved by the Ethics Committee of Neuropsychiatric Research Center, Tokyo, Japan.

Results: Among 30 DSWPD patients, 23 patients (76.7%) could be followed up and 7 patients (23.3%) were missing. The 23 patients comprised of 14 males and 9 females. The mean age was 23.5 (±9.4) years. The mean sleep schedule before the treatment was: On weekdays, sleep: 3:21 a.m. (±2:06), wakeup: 11:03 a.m. (±2:32), and total sleep time: 7h41m (±2h34m). On free days, sleep: 3:45 a.m. (±1:57), wakeup:12:30 a.m. (±1:29), and the total sleep time: 8h44m (±1h29m). The mean of MSFsc was 7:41 (±1:46). The average of the first dose amount of ramelteon was 0.653mg (=0.082 tables) (±0.216mg) and that of administration clock time was 18:10 (±1:05). The average of the final dose amount of ramelteon was 0.586mg (=0.073tables) (±0.216mg) and the administration clock times were not changed. After the treatment, the mean sleep schedule changed: on weekdays, sleep time: 0:17 a.m. (±0:59), wakeup: 8:43 a.m. (±1:14), and the total sleep time: 8h24m (±1h09m). On free days, sleep: 0:30 a.m. (±0:32), wakeup: 9:27 a.m. (±1:17), and the total sleep time: 8h57m (±1h29m). The mean of MSFsc was 4:46 (±0:54) and it has advanced significantly (p< .001; paired T-test).

Discussion and conclusions: Ramelteon is a melatonin receptor $MT_{1/2}$ agonist, and its active metabolite M-II is also an agonist. M-II has an agonist activity 0.6 times of melatonin to M_2 receptor which involved in circadian rhythm adjustment. C_{max} of M-II is ~54200 pg/mL while physiological melatonin ranges 0 to 120 pg/mL. $T_{1/2}$ of M-II is 2.1h, thus, 12 hours later of the administration, which will be midday, there will remain ~936pg/mL M-II and this concentration and receptor activity are quite higher than physiological melatonin activity at the midnight. According to the phase response curve of melatonin, ultra-low-dose and early night administration of ramelteon would fit to the phase advance range and it significantly advance the sleep-wake phase of DSWPD patients.

WHAT DETERMINES OUR LIGHT EXPOSURE PATTERNS AND HOW DO WE QUANTIFY THEM?

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Introduction: Light is the primary zeitgeber for the human biological clock. This means that our light exposure patterns entrain us to 24 hours and determine circadian phase. Later light exposure patterns lead to later circadian phase and later natural, biological, sleep timing. But what determines our light exposure patterns? Is it primarily exposure to the natural light/dark cycle so our biological rhythms follow "sun time"? Or is it our social schedules? And given that it matters both how much and at what time of day we see light, how do we quantify the effect of different light exposure patterns on our biological clock?

Materials and methods: We present results and further analyses from a repeated-measures observational study in 19 healthy students (18-20yr) in Surrey, UK (Shochat, Santhi et al in revision) . Light data were collected for two three-week periods, one in late autumn during standard time (ST) and one in late spring during daylight saving time (DST), allowing us to test the hypothesis that the timing of light was correlated with the natural light/dark cycle.

Descriptive statistics were calculated from the approx. 690 days of data, including measures related to quantity (e.g. number of daily hours in a given intensity range) and timing (e.g. time of the mid-point of half the daily light exposure). Different methods were compared. Since these individual measures may not capture the biological impact of light at different intensities across the day, light was also fed into a mathematical model for circadian phase that replicates human phase response curve data.

Results: The daily amount (ICC's< 0.02) and timing of light (ICC's< 0.25) varied substantially both within and between individuals. Overall exposure to bright light (> 500 lux) was low, averaging 40 minutes in the late autumn, rising to 130 minutes in the late spring in spite of the 7 hour increase in photoperiod.

The time of the midpoint of log light exposure spanned more than 7 hours, from shortly after midday to after 7pm. Furthermore, although solar noon occurs one hour later during DST than ST, the time of the mid-point of light exposure did not change significantly for any of the methods used to quantify light timing. The mathematical model predicted mean circadian phase ran counter to the solar noon change, with mean phase occurring approx. 40 minutes earlier during DST than during ST.

Conclusions: Our findings suggest that for this student population individual light exposure patterns are highly variable and largely conform to clock time. The implications are that changing class times and/or permanent DST will have little impact on their circadian alignment.

Students are known for keeping irregular schedules and light exposure patterns in other populations and/or geographic locations may follow sun time more closely. Our results underline the need for further research to understand the subtle interplay between lifestyle factors, local climatic conditions and biology and the need to develop further validated measures of the impact of light exposure patterns.

THE IMPACT OF HCN1 VARIATION ON HUMAN CHRONOTYPES

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Introduction: To ascertain the genetic risk factors for chronotypes as determined by the *MEQ* questionnaire we conducted a genome-wide association analysis using 316 whole genome sequencing samples.

Methods: Expression of chronotype (MEQ) is normally distributed in the population. We have directly tested the association between SNPs and MEQ (morning-evening questionnaire). For morning and night person comparisons, we computed association test results by linear regression assuming additive allelic effects as well as binary logistic model. We used covariates age, gender, and the top PCs to account for residual population structure.

Results: We detect a large region on chromosome 5 (more than ~400 adjacent SNPs in LD, spanning ~2mb) centered within HCN1, hyperpolarization-activated cyclic nucleotide-gated potassium channel 1. Regional enrichment yields a p-value < 1e-99. It is highly expressed in the brain and potentially modulates excitability in the brain playing a critical role in shaping the autonomous activity of single neurons and the periodicity of network oscillations. The association is persistent in a series of designs targeting the same question using a different morning/evening scales. The risk allele is effectively correlated with higher MEQ score. The locus has been shown to be a significant (1.6e-09) eQTL for HCN1 in GTEX. It has been shown previously in a double mutant mouse model that lack of HNC1 mediated feedback in rod photoreceptor cells prolongs rod responses and saturates the downstream retinal network during bright light stimulation.

Conclusion: HCN1 channel is responsible for the feedback on the rods regulating the dynamic range of light reactivity under dim or intermediate light conditions. We hypothesize that if this feedback is not functioning properly an individual may get saturated with even dim light resulting in misperception of the light conditions resulting in a circadian delay. This would suggest that HCN1 variations may directly impact the ME phenotype.

Chronobiology/Circadian Disorders
Board #098 : Poster session 3

THE DAWN OF SOCIAL JETLAG: SLEEP IN INDIGENOUS VILLAGES WITH AND WITHOUT ELECTRIC LIGHTING ON TANNA ISLAND, VANUATU

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Despite the importance of sleep and its ubiquity in life on Earth, the effects of industrialization on modern sleep, and the amount of sleep that is optimal for health and longevity, is controversial and poorly understood. In industrialized nations, it is hypothesized that sleep is in chronic deficit, in part because 24h on-demand electric light delays sleep onset and truncates sleep if morning work and school schedules are fixed. Nonetheless, recent study of some non-industrial hunter-gatherer and pastoralist societies found sleep durations that are surprisingly short, contrasting with epidemiological data that suggests industrialization reduces sleep. The degree to which these findings are specific to lifestyle or the ecology of a specific region, independent of access to electric light, is uncertain. To further understand the role of lifestyle, climate, and electrification in determining average daily sleep duration, we used actigraphy to measure sleep in indigenous Melanesians on Tanna Island, Vanuatu. Native adult residents living traditional subsistence horticultural lifestyles in villages with or without access to an electric grid, wore an Actiwatch-2 activity monitor (Phillips Respironics, Murrysville, PA) on their wrist for 7 days. Results show that although bedtime, wake time, and rise time were similar between villages, living with on-demand access to electric light is associated with delayed sleep onset and reduced sleep duration by almost 30 minutes daily. This effect was strongly driven by mothers with infants, who showed more nocturnal awakenings, and increased nighttime light exposure in villages with electricity. Compared to industrialized population norms, sleep duration was long and efficiency low in both electric and non-electric villages. Relatively long sleep on Tanna Island may reflect advantages of an environment in which food is readily available, climate benign, and predators and significant social conflict absent. Despite exposure to outdoor light throughout the day, an effect of artificial evening light was nonetheless detectable on sleep timing and duration, and may represent incipient 'social jetlag'. In addition to light exposure, lifestyle differences within and between societies appear to play a large role in determining human sleep duration. The present research contributes to a small but growing literature evaluating traditional sleep; evaluation of which has some urgency as rapid global industrialization is eradicating traditional lifestyles. Investigation of varying levels of industrialization will further uncover important impacts of related changes on sleep, and subsequently, health.

Chronobiology/Circadian Disorders
Board #212 : Poster session 2

FIELD OBSERVATIONS ON FACTORS CONTRIBUTING TO CURRENT PATTERNS OF SLEEP IN ADOLESCENTS

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Introduction: Sleep patterns in adolescents are changing. Data collected in a cross-sectional, multinational study show how mean sleep time has decreased from 8.5- 9 to 7.5 hours, independent of socio-economic status. While preliminary studies have linked decreased sleep time to social expectations, increased structured activities, technology, there is a paucity of data investigating the factors contributing to sleep dept in adolescent youth. In the current study, sleep workshops were conducted in multiple schools across Kingston, Ontario (population 123,800 with 15.4% earning < $20,000.00) to inform and educate students about the importance of sleep. During these workshops, qualitative data were collected to ascertain factors affecting the quality and quantity of sleep achieved by the young participants.

Methods: Interactive sleep workshops were conducted in primary, middle and high schools with students ranging from Grade 5-12 (9-17 years). Students were asked about their bedtimes, TST, and their overall state of well-being. Responses were gathered within one of four frameworks: i) contribution from students raising of their hands when prompted with questions; ii) one on one conversations with students; iii) open group discussions with the students on barriers they are facing to getting a good sleep; iv) feedback from the teachers about the impact of the sleep workshops through content submitted by students in "end of year reflections" received at the conclusion of the school year.

Results: A total of 405 students participated in the workshops. A higher proportion of Grade 5/6's had adequate sleep, based on the students' perception, which they attributed to parental supervision and the presence of a structured schedule. The amount of sleep decreased with grades 7-12, with only1-2 students per grade reporting receiving an adequate amount of sleep. Reasons for shortened sleep were delayed bedtimes related to structured activities, social media, environmental disturbances and early rise times. Delayed sleep onset and maintenance was related to pre sleep worries, social media, and over stimulation. Reports of depression, anxiety and frequent headaches were more common in female students than male students. Teachers reported that students responded positively to the interactive workshops, and that the students felt they had made a positive impact on their well being.

Conclusions: My observations in the field are consistent with the existing literature. Our lack of appreciation of the importance of good sleep is putting the physical and mental well being of our children at risk. The interactive sleep workshops made a positive impact on the well being of the students by making the science and importance of sleep accessible. The workshops also created an open dialogue among the students about the barriers they face in achieving adequate sleep and began to address the awareness and practical tools required in order to address these. Further workshops, aimed at students, teachers and parents, have been put in place in a number of schools across the region. The well being of our children is our collective responsibility and such requires collaboration on all sides.

Chronobiology/Circadian Disorders
Board #094 : Poster session 2

IMPROVING SLEEP HEALTH IN EARLY CHILDHOOD: PILOT RCT OF AN EDUCATOR PROFESSIONAL DEVELOPMENT PROGRAM TO IMPROVE SLEEP PRACTICES IN CHILDCARE SERVICES

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Introduction: Current evidence identifies early childhood as a critical period for intervention strategies to avert sleep problems and to establish positive lifetime health trajectories. Childcare is an integral part of a child's early life experience in contemporary society. Childcare environments have the potential to directly influence children's sleep health, through their provisions for daytime sleep, but also provide strategic points of access to diverse populations of children and families through which promotion of sleep health and early intervention for sleep problems can be facilitated. Emerging evidence identifies current childcare sleep practices as a potential disruptor of sleep development through practices that modify regularity of sleep patterns. Surprisingly, despite substantial investment in programs to promote child health through nutrition and physical activity interventions in childcare services, sleep health in childcare services has been largely overlooked. This study aimed to (1) examine the fidelity of conducting a gold standard RCT of an educator focused professional development sleep intervention program in childcare settings and (2) estimate the effects of this intervention program in reducing the sleep problems in young childhood.
Materials and methods: A pilot randomized control trial was undertaken. Recruitment was of 6 childcare services in Brisbane, Australia. The program, *Choosing Rest*, was developed in partnership with the Queensland Department of Education and included three components focused on building knowledge, process, and delivery of sleep practices in childcare. Program delivery was conducted by a trained facilitator and included an initial face-to-face facilitated professional development workshop, with follow-up support via phone consultation. Actigraphy was used to measure 24-hr sleep-wake patterns continuously across a 1-week period, was collected at baseline and again 6-weeks post-intervention, alongside direct in-situ observations of sleep practices in childcare and parent reported sleep difficulties. A wait-list control was employed. Actigraphy data was used to 1) better phenotype the nature of the reported sleep problem (duration, disruption), 2) check specifically for circadian rhythm sleep disorders (as per ICSD-II criteria & AASM clinical guidelines), and 3) assess change in these variables pre- and post-program intervention, with modelling of intra-individuality variability in sleep patterns to assess sleep regularity.
Results: 66 children wore actigraphy at baseline and follow up. The GGIR package in R was used to establish night time sustained inactivity periods (sleep) and 24 hour activity levels for circadian analysis using the nparACT package. Multilevel regression analysis was used to evaluate the effects of the professional development program on sleep and circadian variables.
Conclusions: Findings from the current study show high fidelity in conducting an RCT of a professional development program to improve sleep problems in childcare services. In scaling-up to a full RCT there is a need to consider existing knowledge, barriers to practice change and workload of educators within the childcare sector.

Chronobiology/Circadian Disorders
Board #071 : Poster session 1
SLEEP DISTURBANCE AND WORK STRESS IN BRAZILIAN FEMALE SHIFT WORKERS

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Introduction: Sleep disturbance have been studied, as one of the possible changes in behavior life in women's shift workers, in addition, the literature cites health problems, for example work stress[1, 2, 3, 4]. According to the International Classification of Sleep Disorders in the 3rd edition, the sleep disturbance is understood as a combination of symptomatic and pathophysiological symptoms[5]. Sleep Disorders have seven major categories: insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, CRSWDs, sleep-related movement disorders, parasomnias, and other sleep disorders[5]. The objective of this study were identify the prevalence of sleep disturbance in female shift workers, according to sociodemographic conditions, lifestyle and work stress.

Materials and methods: Cross-sectional study, with data collected in the Southern of Brazil. Sample composed of 442 female shifts workers. The PSQI defined the sleep disturbance (>10 points)[6] and the Job Stress Scale defined the work stress[7]. The data analysis has performed through STATA/SE 11.

Results: Sleep disturbance was present in 9,7% of the study. The sample consisted with aged 31 to 40 years (34.4%), white (69%), married (54.3%), with 9 to 11 years of schooling (76.7%), non-smokers (73.8%), workers of the day shift (41.6%), Physical Activity Practice Displacement (63.1%), Physical Activity Practice Recreation (22.4%), obesity (28.3%), abdominal obesity (44.3%) and work stress (24.2%). In the bivariate analysis, middle age (p-valor 0.04), night shift work (p-valor $\leq$ 0.001), ex-smoker (p-valor 0.033) and obesity (p-valor 0.05), were associated with sleep disturbance.

Conclusions: Significant association that the women's with middle age have greater prevalence of sleep disturbance. As in the night shift work, ex-smoker and obesity presented higher prevalence of the outcome. The results are in agreement with the current literature, however they are preliminary results, more analyzes will be carried out to clearly show the conclusions.

Chronobiology/Circadian Disorders
Board #099 : Poster session 3
SLEEP SPINDLES IN LATE CHRONOTYPES

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Introduction: The chronotype is a manifestation of underlying circadian rhythms and is partly determined by clock genes. Several behavioural aspects are associated with Late versus Early and Intermediate Chronotypes. Late chronotypes are associated with better cognitive abilities but also with mood disorders, substance abuse, and sleep disturbances. It is known furthermore that Early and Late Chronotypes differ also in some sleep electroencephalographic features (i.e. slow waves). The aim of this study was to explore whether circadian chronotypes are also associated with different spindles characteristics.
Materials and Methods: Each subject (n=43, 21 females, age: 24.40±5.22 years) underwent a night of polysomnographic recordings at home. Assessment of the circadian typology was performed through the Morningness-Eveningness Questionnaire (MEQ) or the reduced MEQ form (rMEQ). Two different circadian typologies were identified: Intermediate (n=22, 8 females; age: 24.43± 6.87) and Late Chronotypes (n=21, 13 females; age: 23.41±2.70). Slow (10-13 Hz) and fast (13-16 Hz) spindles were detected on the central (C3, C4) and frontal (F3, F4) electrodes during the N2 NREM stage. The sleep spindles parameters analyzed were: amplitude, duration, intensity (spindle duration x spindle amplitude) and density (spindles number/60s). For each spindle parameter a weighted average was calculated between homologous electrodes. Parameters related to sleep quality such as Sleep Efficiency (SE, total sleep time with respect to the time spent in bed), wakefulness after sleep onset (WASO), and sleep architecture variables such as REM Latency (time span between the sleep onset and the start of REM sleep) and sleep stages percent duration (N1-3%, REM%) were assessed. MANOVA analysis with age as covariate was used to detect significant differences in the sleep parameters (quality, architecture) and in the spindles characteristics between males/females and between Intermediate/Late Chronotypes. Partial correlation analysis was performed between spindles features removing the age effects.
Results: Significant differences were found between the Intermediate and the Late groups in the spindles characteristics. The amplitude and the intensity of the slow spindles in F3-F4 and C3-C4 are significantly higher in the Intermediate (F3-F4, Amplitude: 18.60±5.29, Intensity: 18.68±5.82; C3-C4: Amplitude: 13.26±3.87, Intensity: 12.80±3.98) with respect to the Late Chronotype (F3-F4, Amplitude: 15.58±3.29, Intensity: 15.08±3.70; C3-C4: Amplitude: 11.28±1.97, Intensity: 10.60±2.15). Moreover, slow and fast spindles properties are correlated with each other.
Conclusion: Our study is the first that investigated whether spindle characteristics are associated with circadian typology in young adults. We found a lower amplitude and intensity of slow spindles in Late Chronotypes as compated to the Intermediate ones. Our results in adult Late Chronotypes showed similar spindles features as described in adolescents; we speculate that the lower slow spindles amplitude could represent a "nocturnal" subject's predisposition to the depression risk.
Acknowledgments: We thank Dr. M. Di Galante for his valuable technical assistance.

A TWO YEAR FOLLOW-UP OF SHIFT WORK DISORDER AMONG NORWEGIAN NURSES

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Introduction: Shift work disorder (SWD) is characterized by excessive sleepiness and complaints of insomnia related to the work schedule. This study aimed to investigate work schedule aspects and associations with having or not having SWD over time.
Materials and methods: Data were collected among 1480 Norwegian nurses from a longitudinal cohort study, and reports findings based on data from wave 7 (baseline,2015) and wave 9 (follow-up,2017). SWD was assessed with 3 questions based on the minimal criteria from the ICSD-3.
Results: Mean age (at baseline) was 39.4 years (range 28-65), 90.4% females. The overall prevalence of SWD was 33.0% (baseline), and 33.1% (follow-up). We defined four groups based on having or not having SWD; 54.4% (n=653) of the nurses did not report SWD at baseline or at follow-up, 12.9% (n=155) reported SWD at follow-up but not at baseline (developing SWD), 12.4% (n=149) reported SWD at baseline but not at follow-up (losing SWD), and 20.3% (n=244) reported SWD at both assessments. Multinominal regression analysis with no SWD at baseline or follow-up and day work at both baseline and follow-up as reference groups showed that age was significantly associated with developing (OR 1.024, 95%CI 1.00-1.05) and having SWD at both assessments (OR 1.025, 95%CI 1.01-1.05). Start working nights between baseline and follow-up (OR 6.211, 95%CI 2.99-12.87) and working nights at both assessments (OR 5.608, 95%CI 3.66-8.60) were significantly associated with developing SWD. Stop working nights between baseline and follow-up (OR 11.437, 95%CI 6.47-20.22) and working nights at both assessments were significantly associated with losing SWD (OR 3.334, 95%CI 2.01-5.54). Stop working nights between baseline and follow-up (OR 2.640, 95%CI 1.32-5.29) and working night at both assessments (OR 9.013, 95%CI 6.19-13.13) were significantly associated with having SWD at both assessments.
Conclusions: Night work is significantly associated with SWD and whether such symptoms remain over time.

VALIDATION OF THE CHINESE VERSION OF THE REDUCED MORNINGNESS-EVENINGNESS QUESTIONNAIRE (RMEQ) IN HONG KONG CHINESE ADOLESCENTS

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Introduction: Chronotype is referred to as individual differences in one's preferred timing for rest and activities, which can be measured by self-report questionnaires, such as Morningness-Eveningness Questionnaire (MEQ). Previous studies have shown that chronotype preference is related to health-related behaviors, body mass index and mood symptoms in adolescents. The present study aimed to (1) examine the validity of the reduced Horne-Östberg Morningness-Eveningness Questionnaire in Hong Kong Chinese adolescents; and (2) investigate the association of chronotype with psychopathological symptoms as well as other daytime symptoms in adolescents.
Materials and methods: A total of 352 adolescent participants (age: 16.2±1.5 years, range: 12-19; female: 24.4%) completed a battery of self-report instruments that assessed their chronoytpe preference (rMEQ), psychopathological symptoms, pubertal status and other sleep and daytime symptoms. Sleep was subjectively assessed by rMEQ, Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI). Psychopathological symptoms were assessed by Depression Anxiety and Stress Scales (DASS). Other daytime symptoms were assessed by Pediatric Daytime Sleepiness Scale (PDSS), Chronic Sleep Restriction Questionnaire (CSRQ), and Multifactorial Fatigue Inventory (MFI). A subset of sample (n=122) additionally completed one-week actigraphic assessment for the objective measure of their sleep and activity.
Results: There were significant differences in the circadian patterns of motor activity in 24 hours as assessed by Actigraphy between the participants with morning-, intermediate-, and evening-type. Adolescents with evening-type significantly differed from their counterparts with morning-type and intermediate-type in terms of midpoint of sleep ($p < 0.01$) and sleep onset ($p < 0.01$). Adolescents with evening-type also had more fatigue symptoms (Multifactorial Fatigue Inventory, $p < 0.05$), a higher level of daytime sleepiness (Pediatric Daytime Sleepiness Scale, $p < 0.01$), and more symptoms of chronic sleep reduction (Chronic Sleep Restriction Questionnaire, $p < 0.001$) as compared to those with other chronotypes. In addition, adolescents with morning-type reported better sleep quality (Pittsburgh Sleep Quality Index, $p < 0.01$) and less depressive symptoms (Depression Anxiety and Stress Scales, $p < 0.05$) as compared to those with other chronotypes.
Conclusions: The present study showed that the rMEQ is an adequate measure of chronotype with good external validity in Chinese adolescents. Evening-type is associated with an increased risk for sleep disturbances, psychopathological symptoms and other daytime symptoms in adolescents. There is a need for future longitudinal research to delineate the reciprocal interplay between sleep, mood disturbances and circadian rhythm during adolescence.

Chronobiology/Circadian Disorders
Board #073 : Poster session 1

EVALUATION OF SLEEP QUALITY AND DURATION BY USING ACTIGRAPHY IN PETROLEUM INDUSTRY SHIFT WORKERS

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Introduction: Nowadays increasing work time is inevitable because of shift working in some occupational settings, which is considered to be a harmful ergonomic factor. Based on studies conducted in developed countries, approximately 20% of the labor forces are shift workers. This phenomenon has left devastating effects on the workers' quality of life and sleep. Studies related to the impact of shift schedules on different aspects of life shown that shift working especially night work has negative outcomes on individuals and their families.

Materials and methods: In this cross-sectional study, 43 workers of the National Iranian Drilling Company offshore enrolled. Subjects were asked to fill in a questionnaire package consisting Epworth Sleepiness scale (ESS) and Pittsburg sleep quality index (PSQI). Measuring changes in sleep pattern over time were performed by using actigraphy. After training of the workers, Actigraph was set on the non-dominant wrist. At the end of two weeks, analysis and interpretation of the data were performed on different shift schedules (Fixed Day, 7Days- 7 Nights, Fixed Night and standby shift).

Results: The average age of the participants was 35.9 ± 7.9 years and the average work experience was 10 ± 6.8 years. The mean total sleep time (TST) was 353±58 minutes. The 7Days- 7 Nights shift workers had less TST than other three groups of shift workers. The mean PSQI and ESS score were 6.77±3.1 and 7.49±4.3, respectively. Twelve (27%) of shift workers had been diagnosed with shift work disorder in current study and 31 (72%) of all participants had poor sleep quality according to PSQI score (≥5).

Conclusions: Because of lower sleep duration and quality in oil rig shift workers, screening and treatment of sleep disturbances would be useful for better productivity and performance.

EXCESSIVE DAYTIME SLEEPINESS: INCIDENCE AND DETERMINANTS IN A PROSPECTIVE POPULATION-BASED COHORT

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Introduction: Although the Epworth Sleepiness Scale (ESS) is widely used to assess excessive daytime sleepiness (EDS) in clinical and research settings, few studies have assessed its evolution and its determinants.

Materials and methods: At baseline and after a five years follow-up period, 2751 participants (46.1% men, mean age 56.0 ± 9.8) from the population-based Colaus-HypnoLaus cohort completed the ESS, the Pittsburgh Sleep Quality Index (PSQI) and had a full clinical work-up. Ambulatory full polysomnography (PSG) was also performed at baseline in a sub-sample of 1404 participants (49.4% men, mean age 56.2 ± 9.9). Hypoxic load, was calculated as the sum of area under the curve of ≥3% oxygen desaturation / total sleep time. The risk of incident EDS (ESS>10) at 5 years was analyzed using multiple logistic regression models adjusted for baseline age, sex, BMI, ESS score, alcohol, coffee consumption, smoking status, hypertension, diabetes and depression.

Results: A total of 2314 participants (84.1%) had no EDS (ESS< 11) at baseline and at follow-up. The 5 years incidence of EDS was 5.1% (n=124). Of the 312 (15.9%) participants with EDS at baseline, 56.1% (n=175) showed persistent EDS at follow-up and 43.9% (n=137) showed a remission. Depression (adjusted odd ratio = 2.98; 95% confidence interval 1.89-4.70), reported short sleep duration (≤ 5h vs. 7-8h) (OR: 2.04; 1.01-4.11), subjective poor sleep quality (PSQI >5) (OR: 1.91; 1.24-2.95), obstructive sleep apnea (apnea-hypopnea index >15 vs < 5: OR: 2.92; 1.30-6.56) and a high hypoxic load at baseline (quartile 4 vs. 1: OR: 3.00; 1.21-7.44) independently increased the risk of incident EDS. In addition, a 10% increase in body weight over the 5-years follow-up was associated with a 2.19 OR (1.20-4.02) of incident EDS. Conversely, older age (≥ 55 y) (OR: 0.56; 0.39-0.96), hypertension (OR: 0.34; 0.16-0.71) and moderate coffee consumption at baseline (1-3 cups/day vs. no: OR: 0.46; 0.23-0.92) were protective factors for the development of EDS.

Conclusions: Five years EDS incidence was 5.1% in our middle to older age general population cohort. Depression, short sleep duration, OSA and hypoxic burden were the most important risk factors of incident EDS.

QUALITY OF SLEEP, DAYTIME SLEEPINESS AND USED OF STIMULATING SUBSTANCES IN PATIENTS WITH OROFACIAL MUSCULOSKELETAL PAIN

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Introduction: The aim of investigation was to evaluate the quality of sleep, daytime sleepiness and used of stimulating substances in patients with musculoskeletal orofacial pain.

Materials and methods: A cross-sectional study was carried out. Data of patients at the TMD and Orofacial Pain Clinic of the Universidad de La Frontera was evaluated, (2010 to January 2019). The variables reviewed were: sex, age, type of TMD, quality of sleep, daytime sleepiness, use of stimulating substances and type of substance. The data that did not show all the variables was excluded. Descriptive statistics was calculated. To estimate the association between variables, chi-square and T-test were applied (p value < 0.05). Software SPSS/Mac 23.0, SPSS, Chicago, IL was used.

Results: In the study 225 clinical records were included, 82.9% was women (average age of 28.3 years, SD 15.7). 93.4% of the patients presented poor sleep quality, without statistically significant differences according to gender and age (p = 0.505 and 0.195 respectively). 61.4% had some degree of daytime sleepiness, with mild diurnal sleepiness being more frequent. There were no statistically significant differences according to gender and age (p=1,000 and 0.186 respectively). More than half of patients used some type of stimulating substance (54%, n=136), without differences respecting sex or age. Coffee, tea and mate were the substances used most frequently. Patients with muscular and mixed pain had higher rate of stimulating substance use (p=0.032, OR=2.34, CI 1.13-4.86).

Conclusions: Poor sleep quality and daytime sleepiness are frequent in patients with orofacial musculoskeletal pain, presenting a homogeneous distribution among different genders and age groups. Also, patients with muscular and mixed orofacial pain presented increased use of stimulating substances, indicative of a potential risk factor. It is important to research this habit which is associated with poor quality sleep, and has been increasingly observed in general population. There is an important need in modern day society to maintain wakefulness during daytime, and the action of these stimulating compounds could possibly contribute to, or perpetuate pain in these patients.

Acknowledgements: Temporomandibular Disorder and Orofacial Pain Specialization Program, Universidad de La Frontera, Chile.

INDIRECT TREATMENT COMPARISON OF THE EFFICACY AND SAFETY OF SOLRIAMFETOL, MODAFINIL, AND ARMODAFINIL FOR THE TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Excessive daytime sleepiness (EDS) associated with obstructive sleep apnoea (OSA) affects 9%-22% of continuous positive airway pressure (CPAP)-treated patients. Solriamfetol (formerly JZP-110) has been evaluated against placebo to treat EDS associated with OSA; however, the comparative efficacy and safety versus other wake-promoting agents (WPAs) has not been investigated in head-to-head studies. A network meta-analysis (NMA) was performed to compare efficacy and safety of solriamfetol with modafinil and armodafinil in patients with EDS associated with OSA.

Materials and methods: A systematic literature review (SLR) was performed to identify randomised controlled trials (RCTs) investigating WPAs in patients with EDS associated with OSA. The NMA was conducted in WinBUGS using a Bayesian fixed-effects model approach. Efficacy outcomes were analysed separately for results reported at 4, 8, or 12 weeks. Efficacy inputs were mean within-arm change from baseline for Epworth Sleepiness Scale (ESS), 20-minute Maintenance of Wakefulness Test (MWT20), and Functional Outcomes of Sleep Questionnaire (FOSQ), and at least minimal improvement in Clinical Global Impression of Change (CGI-C), reported as odds ratio. Safety assessments of incidence of any treatment-emergent adverse event (TEAE), serious TEAEs, discontinuation due to TEAEs, and incidence of individual TEAEs occurring in at least 5% of any study arm (anxiety, diarrhoea, dry mouth, headache, insomnia, and nausea), reported as risk difference, were also evaluated.

Results: The SLR identified 6 parallel-arm, placebo-controlled RCTs that randomised 1714 subjects total to placebo, solriamfetol, modafinil, or armodafinil for up to 12 weeks. Solriamfetol 150 mg provided greater improvement in the following efficacy outcomes at 12 weeks: ESS (mean difference, 95% credible interval [CrI] versus armodafinil 150 mg [-2.12, -3.64 to -0.61], armodafinil 250 mg [-1.95, -3.71 to -0.20], modafinil 200 mg [-1.70, -3.27 to -0.14], and modafinil 400 mg [-1.70, -3.32 to -0.08]); MWT20 (mean difference, 95% CrI versus modafinil 200 mg [2.61, 0.72 to 4.50] and modafinil 400 mg [2.71, 0.75 to 4.68], comparison against armodafinil not possible due to large baseline differences); and CGI-C (odds ratio, 95% CrI versus armodafinil 150 mg [3.32, 1.49 to 7.85], modafinil 200 mg [3.80, 1.54 to 9.79], and modafinil 400 mg [2.69, 1.08 to 7.02]). No difference was found between solriamfetol and other WPAs on the FOSQ.

Solriamfetol 150 mg was associated with an 11% (95% CrI: 3%-64%) higher risk of diarrhoea versus modafinil 400 mg; in all other analyses of TEAE incidence, risk appeared to be similar across the treatments evaluated. Serious TEAEs and discontinuation due to TEAEs were relatively rare across all trials, and for most safety outcomes, a small sample of studies informed the network; hence results should be interpreted with caution.

Solriamfetol 300 mg demonstrated similar results as 150 mg versus modafinil and armodafinil across most efficacy and safety outcomes.

Conclusions: Compared to modafinil and armodafinil, 12 weeks of treatment with solriamfetol 150 mg produced a greater improvement in ESS, MWT20, and CGI-C than modafinil and armodafinil. Safety comparisons were limited by the data informing the ITC analysis and low event rates.

Excessive Daytime Sleepiness (not Narcolepsy)
Board #101 : Poster session 3
A QUESTION IS WORTH A THOUSAND WORDS: AN ATTEMPT TO ESTIMATE THE PREVALENCE OF EXCESSIVE SLEEPINESS IN CHILDREN

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Introduction: Excessive sleepiness is common in adults (5%-25%) and adolescents (15%-50%) and is associated with compromised cognitive, behavioral, metabolic, and emotional functioning. The prevalence of sleepiness in prepubescent children is much less quantified/understood, especially in terms of how sleepiness is defined (e.g. fatigue vs. sleepiness vs. "excessive sleepiness", etc.) and age/global variance. The goals of this study were to quantify the prevalence of sleepiness in early-middle childhood across (1) various measures/questions and (2) country.

Materials and methods: PubMed, PsycINFO, and Google Scholar searches were conducted using permutations of the following keywords: "sleepiness", "pediatric/child", and "epidemiology/prevalence". Studies were selected if the sample included children $\leq$ 12 years of age. Studies were excluded if age, sleepiness question/definition, prevalence, or sampling method was unclear. Prevalence estimates by age were extracted from each study, if available.

Results: A total of N=130 datapoints from 36 studies were included in the final analyses. Although sleepiness data were available for 19 countries, the US, Sweden, and China accounted for 44% of published data. No data were available for Africa, South America, Australia, Russia, Canada, and most island nations. Six distinct sleepiness definitions emerged from the literature and were associated with remarkably different prevalence estimates and age-related trends (interaction p< .001): (1) "*falling asleep in school/inappropriate situations*" (median = 1.5%), (2) "*sleepiness*" (median = 4%), (3) "*fatigue/tiredness*" (median = 10.5%), (4) "*falling asleep watching TV*" (median = 10.9%), (5) "*difficulty waking in AM*" (median = 16.1%), and (6) "*falling asleep in a car*" (median = 40.8%). The prevalence of sleepiness increased linearly with age (r=.14), most notably at 8 years of age, and especially for "*difficulty waking in AM*" (21% age>8 yr vs. 12.5% age< 8 yr). The prevalence of falling asleep in inappropriate situations remained consistently low (< 2%) across age and country. Controlling for age, China consistently had the highest rates pediatric sleepiness, especially "*difficulty waking in AM*" (33.1% vs. ~16% for US/Sweden; p=.01) and "*fatigue/tiredness*" (17% vs. ~10% for US/Sweden; p=.03).

Conclusions: Median prevalence of sleepiness in school-aged children is 9.1% and varies with definition. The abrupt increase in sleepiness at/after age 8 may indicate sleep/circadian challenges associated with school demands. The assessment of '*falling asleep in school/inappropriate situations*' displayed remarkable age and geographic consistency (~1.5%), suggesting a possible CNS hypersomnia phenotype. Better geographic representation is needed to adequately assess sleepiness global sleepiness differences; however, China's high prevalence of pediatric sleepiness has been reported previously and is a call for action.

Excessive Daytime Sleepiness (not Narcolepsy)
Board #102 : O19: Excessive daytime sleepiness and hypersomnia
TAU-PET SIGNAL ELEVATION IN SELECTIVE BASAL FOREBRAIN NUCLEI IS ASSOCIATED WITH EXCESSIVE DAYTIME SLEEPINESS IN COGNITIVELY UNIMPAIRED MIDDLE AGED AND OLDER ADULTS

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Introduction: Recent studies suggest that older adults with excessive daytime sleepiness (EDS) are at increased risk for amyloid accumulation and dementia. It is unclear whether EDS in this population is only a manifestation of poor sleep quality or could be secondary to Alzheimer's disease (AD)-related pathological changes of wake-promoting centers. The aim of this study was to assess whether self-reported EDS in cognitively unimpaired (CU) middle aged and older adults was associated with higher levels of tau in the locus coeruleus and basal forebrain - areas thought to be involved early in AD.

Materials and methods: From the population-based Mayo Clinic Study of Aging, we identified 435 CU middle aged and older adults >=50 years old with both AV-1451 tau-PET and amyloid-PET scans and who had completed sleep questionnaires, including the Epworth Sleepiness Scale (ESS). EDS was defined as ESS score >=10. We used previously validated stereotaxic probabilistic maps based on histological data to create our regions of interest (ROI), which were the locus coeruleus and the basal forebrain divided in two distinct nuclear groups: 1) medial septum/diagonal band of Broca complex and 2) nucleus basalis of Meynert. The cerebellar crus was selected as a reference region to generate a standardized uptake value ratio (SUVR). In this cross-sectional analysis, we fit a linear model to assess the association between EDS and tau SUVR in each ROI, while controlling for age, sex, years of education, body mass index, hypertension, hyperlipidemia, diabetes, reduced sleep, witnessed apneas, and regional amyloid (in the same ROI).

Results: Of the 435 CU participants, 49 (11.3%) reported EDS. In regression models, EDS was significantly associated with tau level elevation in the medial septum/diagonal band of Broca ($\beta=0.037$ [95% CI 0.005 to 0.068], $p=0.022$), but not in the nucleus basalis of Meynert or locus coeruleus. A case-control sensitivity analysis matched for age, sex and global PiB-positivity revealed similar results. The average tau PET SUVR in the medial septum/diagonal band of Broca was higher in participants with EDS (1.11 vs. 1.06, $p=0.024$, t-test). An additional voxel-based sensitivity analysis using the same case-control sample also yielded similar results, with a voxel cluster (threshold set at $p< 0.001$) within the medial septum/diagonal band of Broca region, but not involving other ROI.

Conclusions: We identified a significant association between EDS and elevated tau PET signal in the medial septum/diagonal band of Broca complex. This region has been involved in maintenance of attention and arousal and is an important output of wake-promoting orexin neurons in the hypothalamus. Thus, among CU, EDS may be related to tau-related neurodegeneration of wake-promoting centers. Due to the exploratory nature of this study, further work assessing postmortem pathological data should be done to confirm these findings.

ASSOCIATION OF NEGATIVE AFFECT VERSUS COGNITIVE SYMPTOMS OF THE ZUNG SELF-RATED DEPRESSION SCALE WITH EXCESSIVE DAYTIME SLEEPINESS IN MALE ADULTS WITH OBSTRUCTIVE SLEEP APNEA ON CPAP TREATMENT: A SECONDARY ANALYSIS OF THE SLEEPY RICCADSA COHORT

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Introduction: Obstructive sleep apnea (OSA) is a common in adults with coronary artery disease (CAD), and may induce excessive daytime sleepiness (EDS), which is the most common treatment indication for continuous positive airway pressure (CPAP). OSA may also cause depression.
We have recently demonstrated significant reductions in Zung Self-rating Depression Scale (SDS) scores in nonsleepy OSA patients randomized to CPAP compared with those in the no-CPAP group in the RICCADSA trial. Moreover, there was an even higher benefit in the sleepy OSA phenotype following one year of CPAP treatment. In the current subanalysis, we aimed to explore the relationship between EDS and negative affect *vs* cognitive symptoms of the Zung SDS questionnaire, and response to CPAP treatment in the sleepy male population of the RICCADSA cohort.

Materials and methods: In all, 138 male CAD patients with sleepy OSA were included. The OSA diagnosis was based on an apnea-hypopnea index (AHI)≥ 15 events/hr on a cardiopulmonary polygraphy at home, and sleepy OSA patients were the ones with an Epworth Sleepiness Scale (ESS) score ≥10, who were offered CPAP treatment. The level of depression among the participants was measured by using the Zung SDS.
To model subcategories of depressive symptoms, negative affect vs cognitive symptom scores were calculated based on a study by Perez Adel et al in 2013, that was conducted among a male CAD population undergoing coronary-artery by-pass grafting. In brief, a two-level growth modeling approach was used to test the effect of CPAP on the ESS scores. The scores of the negative affect (depressed mood, crying spells, sleep problems at night, higher heart beat sensation, feeling tired and feeling more irritable) and cognitive symptoms (positive self and life evaluations, normal psychomotor activity and getting pleasure from life, eating and sexual activity) were added into the model as covariates.

Results: The mean age of the study cohort was 62.3 (7.4) yrs, mean BMI 29.4 (4.1) kg/m^2, mean AHI 31.0 (15.3) events/hr, and mean ESS 12.2 (2.7) at baseline, and mean CPAP adherence was 3.4 (2.6) hrs/night for the whole group. The average negative affect score was 12.0 (2.9) out of max 28, and the average cognitive symptom score was 18.8 (5.0) out of max 40.
ESS score decreased over time by about 3.5 points ($P< 0.001$). In the final model, the decline in the negative affect score, but not in the cognitive symptom score, was a significant predictor of decline in the ESS score ($P=0.002$ *vs* $P=0.302$, respectively).

Conclusions: Our results suggest that improvement in negative affect symptoms of depression, but not changes in negative thought content of depression, is related to the improvement in EDS. Persistent negative affect symptoms may influence the patient's compliance with CPAP treatment, and lead to less benefit for EDS. As a future direction, clinicians should screen for negative affect subscale components of depression in OSA and target these symptoms for a better improvement in EDS scores.

Foundation, and ResMed Foundation.

NAPPING AND ENHANCED WEEKEND SLEEP SCHEDULE AMONG PRESCHOOLERS WITH INSUFFICIENT WEEKDAY SLEEP

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Introduction: Sleep is essential to the development in children. Sleep deprivation has been found to be associated with emotional problems, poor cognitive and academic performance, and social problems. However, due to the change of life style in modern society, curtailed nocturnal sleep is common in children and is often compensated by daytime napping and/or enhanced sleep duration in the weekend. It is however unknown whether these strategies are effective or not. Hence, our study aims to explore association between these strategies and children´s behavioral and sleep problems in preschoolers with insufficient nocturnal sleep during the weekdays.

Methods: 2,967 parents of preschoolers (age= 4.91± 1.069, Male: Female = 1490: 1477) completed a questionnaire regarding their children´s sleep schedule, and the Children's Sleep Habits Questionnaire (CSHQ) and Strength and Difficulties Questions (SDQ). The preschoolers with a reported nocturnal sleep less than 9 hours were considered as sleep deprived based on the recommended sleep duration by the American National Sleep Foundation; those who sleep longer than 10 hours were defined as having sufficient sleep.

Results: Among 2,967 preschoolers, 654 children (22.0%, age=5.09±1.076 ,M:F=323:331) reported sleeping less than 9 hours on weekdays (sleep-deprived), 1,060 children (35.7%, age=4.99 ±1.037,M:F=522:538) reported sleep between 9 and 10 hours, and 1,253 children (42.2%, age= 4.74±1.069, M:F= 645:608) reported sleep for longer than 10 hours weekday night sleep (sufficient sleep). T-tests showed significant differences between the sleep-deprived and sufficient-sleep children on the total score (t=2.428, p< .05) and the hyperactivity subscale (t=2.388, p< .05) of the SDQ, as well as the daytime sleepiness (t=7.526, p< .001), parasomnia (t=-2.186, p< .05), bedtime resistance (t=4.182, p< .001), sleep duration (t=11.731, p< .001), sleep anxiety (t=2.858, p< .01), and night waking (t=-3.293, p< .01) subscales of the CHSQ. No significant differences were obtained on the rest of the subscales on SDQ and CHSQ.

All the sleep-deprived preschoolers were reported to nap habitually, with 441 children (67.4%) napping longer than 1 hour during weekdays, and 344 children (52.6%) napping longer than 1 hour during weekends. When comparing the children with and without longer daytime naps, T-tests showed significant higher score on daytime sleepiness scale of the CHSQ (t=2.342, p< .05) among preschoolers with shorter weekend nap, but no significant differences on the rest of the measures. 196 children (29.9%) were reported to enhance their weekend sleep schedule for longer than an hour. T-tests showed significant higher score on daytime sleepiness scale (t=-4.492, p< .001) and lower score on night waking subscale (t=2.888, p< .01) of the CHSQ among preschoolers with longer weekend sleep schedule, but no significant differences on the rest of the measures.

Conclusions: Our results support the past research finding that insufficient sleep are associated with more behavioral and emotional problems as well as sleep problems in preschoolers. Daytime napping and enhanced weekend sleep duration do not seem to be helpful for improving their difficulties while a longer weekend nap might reduce daytime sleepiness. The findings suggest sufficient and regular nocturnal sleep schedule should be emphasized for the wellbeing of preschoolers.

Excessive Daytime Sleepiness (not Narcolepsy)
Board #096 : Poster session 2

SOCIOECONOMIC AND HUMANISTIC BURDEN OF ILLNESS OF EDS ASSOCIATED WITH OSA IN THE EU5: ANALYSIS OF NATIONAL HEALTH AND WELLNESS SURVEY DATA

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Introduction: Excessive daytime sleepiness (EDS) is an important symptom in many patients with obstructive sleep apnoea (OSA). Past studies have focused on the burden of OSA as a whole but have not evaluated the additional influence of EDS on OSA. This study evaluates the burden of EDS among OSA patients using European survey data to describe differences in quality of life, health care resource utilization, and work productivity.

Methods: This retrospective, observational study used 2017 National Health and Wellness Survey (NHWS) data from the EU5. This survey is an internet-based, self-administered questionnaire for adults ($\geq$18) that uses a stratified random sampling technique to represent the general population of each country. All cohorts were defined based on OSA/EDS status and excluded patients self-reporting a narcolepsy diagnosis. Those self-reporting not ever experiencing OSA comprised the non-OSA group. Patients who self-reported both experiencing OSA in the last 12 months and a diagnosis for this condition were categorized based on their score on the Epworth Sleepiness Scale (ESS). OSA patients with a score >10 comprised the OSA with EDS cohort, while those with a score $\leq$10 comprised the OSA without EDS cohort. Number of healthcare provider and ER visits were examined to evaluate healthcare resource use. All metrics of the work productivity and activity impairment (WPAI) questionnaire were calculated. The short form 12 (SF-12) was used to evaluate the aggregate and individual measures of quality of life. Bivariate analysis was performed to examine the difference based on OSA/EDS status. Multivariable analysis using generalized linear models (GLM) was used to control for potential confounders, which were set to average study population values.

Results: The analysis included 59,453 patients (OSA with EDS: n = 661; OSA without EDS: n = 1,347; non-OSA: n = 57,445). After adjusting using GLM, number of traditional healthcare visits per 6 months was 8.10 for patients with OSA and EDS and 6.71 for patients with OSA but no EDS (p=.002). Compared to OSA patients without EDS, adjusted presenteeism was higher among those with EDS (33.34% vs. 24.82%, p=.009), as was activity impairment (39.65% vs. 34.22%, p=.007). Adjusted SF-12 mental component summary score was lower for OSA patients with EDS compared to those without EDS (40.93 vs. 44.02, p< .001), as was the physical component summary score (45.04 vs. 46.69, p< .001). OSA patients with EDS scored lower than those without EDS on the vitality (41.91 vs. 45.97, p< .001), social functioning (44.88 vs. 47.15, p< .001) and role physical (39.92 vs. 43.44, p< .001) subscales in the unadjusted analysis. All p-values were nominal.

Conclusion: From the perspective of the patient, healthcare system and employer, these results suggest patients with OSA and EDS have a higher socioeconomic burden of disease compared to patients with OSA but no EDS. OSA patients with EDS had a higher frequency of health-related visits, were less productive in and outside of the workplace, and scored lower on both the physical and mental components of the SF-12, even after adjusting for potential confounders.

EXCESSIVE DAYTIME SLEEPINESS, METABOLIC SYNDROME AND OBSTRUCTIVE SLEEP APNEA: TWO INDEPENDENT LARGE CROSS-SECTIONAL STUDIES AND ONE INTERVENTIONAL STUDY

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Introduction: Obstructive sleep apnea (OSA) is believed to be a risk factor for the development of metabolic syndrome (MetS). However, whether excessive daytime sleepiness (EDS), a cardinal feature of OSA, contributes to MetS remains unclear. The aim of this study was to assess the association between MetS and EDS in two independent large-scale populations, and in subjects who underwent upper-airway surgery.
Materials and methods: A total of 6,312 patients without self-reported depression and 3,578 suspected OSA patients were consecutively recruited, during health screening examinations and from our sleep center, respectively. A total of 57 subjects with OSA who underwent upper-airway surgery were also included. Daytime sleepiness was assessed using the Epworth Sleepiness Scale, where a score of > 10 indicates EDS. Demographic, anthropometric, biochemical, and polysomnographic data were obtained.
Results: In the health screening examination group, 233 (9.23%) women and 350 (10.93%) men had complaints of EDS. A total of 229 (7.04%) women and 1,182 (36.88%) men met the criteria for MetS. In the OSA group, 147 (21.18%) women and 1,058 (36.69%) men reported EDS. In addition, 93 (13.4%) women and 1,368 (47.43%) men reported MetS. In the health screening examination group, EDS did not contribute significantly to MetS (OR = 1.125, 95% CI: 0.907-1.395; p = 0.283). In the OSA group, EDS significantly contributed to MetS (OR = 1.249, 95% CI: 1.063-1.468; p = 0.007); however, the results were not significant after adjusting for sleep variables (OR = 1.071, 95% CI: 0.905-1.268; p = 0.423). In the OSA group, confirmatory factor analysis showed that obesity and insulin resistance were important components of MetS in OSA with or without EDS. EDS significantly predicted obesity after adjustment (OR = 1.230, 95% CI: 1.034-1.463; p = 0.020). Upper-airway surgery did not affect cardio-metabolic variables in OSA patients with or without EDS.
Conclusions: EDS was not associated with MetS in two independent large-scale cohorts. In addition, upper-airway surgery did not affect components of MetS in OSA patients with and without EDS.
Acknowledgements: The authors acknowledge the help of all doctors and nurses in Department of Otolaryngology Head and Neck Surgery & Center of Sleep Medicine, Shanghai Jiao Tong University Affiliated Sixth People's Hospital.

SLEEP PATTERNS, GLYCOLIPID METABOLISM DISORDERS AND PROSPECTIVE COHORT STUDIES

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Introduction: The effect of diverse joint patterns of night sleep and daytime napping is still to be illuminated. These studies were aimed to verify the relationship between diverse sleep patterns and the risk of metabolic syndrome (MS), insulin resistance, long-term blood glucose control and stroke incident by prospective cohort studies in China.

Materials and methods: A prospective cohort study were performed for the association between sleep patterns and insulin resistance and long-term blood glucose control, a total of 5845 diabetes-free subjects were followed up by an average 4.5 years. On the relationship between sleep duration and the risk of MS in men and women, subjects without MS at baseline were followed-up. To verify the relationship between sleep pattern and stroke, a large sample cross-sectional study with 7887 individuals were conducted, and 1928 individuals were selected for the cohort study with an average of 4.94 years follow-up. Detailed sleep information collected by the self-reported questionnaire and Pittsburgh Sleep Quality Index, blood biochemical indicators.

Results: The combination of sleep deprivation with no naps or >30 minutes napping and the combination of no sleep deprivation with >30 minutes daytime napping were all associated with an HbA1c level >6.5% (HR=2.08, 95% CI: 1.24-3.51; HR=4.00, 95% CI: 2.03-7.90; and HR=2.05, 95% CI: 1.29-3.27, respectively). No sleep deprivation combined with >30 minutes daytime napping correlated with a high risk of elevated HbA1c and HOMA-IR index (HR=2.12, 95% CI : 1.48-3.02; and HR=1.35, 95% CI:1.10-1.65, respectively). Both short and long sleep durations increased the incidence of MS and elevated the fasting blood glucose (FBG) in mixed-gender population (MS: HR = 1.43, 1.25, and 1.45, respectively; elevated FBG: HR = 1.61, 1.65, and 1.98, respectively) and males (MS: HR = 1.87, 1.73, and 1.96, respectively; elevated FBG: HR = 2.27, 2.28, and 3.16, respectively). Consistent with the results in the cross-sectional study, HRs (95% CI) of stroke were 1.94 (1.21-3.13) and 2.24 (1.05e-4.79) for daytime napping ≥1h and nighttime sleeping ≥9h in the cohort study. For no naps combined with < 7h of nighttime sleeping, the HR (95%CI) was 2.61 (1.17-5.82). For ≥1h of naps combined with < 7h, 7-8h, 8-9h, and ≥9h of nighttime sleeping, HRs (95% CI) were 2.16 (1.03-4.51), 2.36 (1.07-5.20), 2.41 (1.11-5.20) and 3.37 (1.05-10.81), respectively.

Conclusions: Daytime napping >30 minutes was associated with a high risk of an elevated HbA1c level and high HOMA-IR index. No sleep deprivation combined with napping >30 minutes carries a risk of abnormal glucose metabolism. Sleep deprivation combined with brief daytime napping < 30 minutes was not associated with a risk for an elevated HbA1c level and high HOMA-IR index. Both short and long sleep durations were associated with a greater incidence of MS. Individuals with 7-8h of night sleep combined with no daytime naps or less than 1h of daytime napping were at low risk of stroke.

UTILITY OF ACTIGRAPHY AND POLYSOMNOGRAPHY PRIOR TO CONDUCTING THE ADULT MULTIPLE SLEEP LATENCY TEST

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Introduction: The multiple sleep latency test (MSLT) is a well-validated objective measure used to evaluate hypersomnia, with high test-retest reliability. However, results can be affected by several factors including age, insufficient sleep, other untreated sleep, psychiatric or medical disorders and medications. The American Academy of Sleep Medicine recommends performing MSLT after the completion of actigraphy ± sleep logs for 1 week, polysomnography (PSG) the night prior and without the use of REM-suppressing medications, when possible. Our primary aim was to assess the association between objectively determined sleep time using actigraphy and PSG and 1. mean sleep latency (MSL) 2. sleep-onset REM periods (SOREMs) on MSLT.

Materials and methods: A retrospective chart review was completed on 200 patients aged $\geq$18 years who underwent MSLT at Mayo Clinic Center for Sleep Medicine between 2014-2018. Data on demographics, clinical characteristics, medications, urine drug screen, actigraphy, PSG and MSLT results were manually abstracted from the electronic medical record. Statistical analyses examining univariate and multivariate correlations of MSL and number of SOREMs to demographic/clinical characteristics and actigraphy and PSG-related parameters were performed.

Results: Mean age of the cohort was 40±15.5 years (69.5% female). Mean Epworth Sleepiness Scale score (ESS) was 14.5±5.1, MSL 9.65±5.3 min, mean number of SOREMs 0.4±0.96; 44% had a MSL $\leq$ 8 min, with an additional 7.5% having $\geq$2 SOREMs.

On univariate analyses, total sleep time (TST) and time in bed (TIB) on actigraphy and sleep latency on PSG positively correlated and ESS and sleep efficiency (SE) negatively correlated with MSL. TST and REM latency on PSG and MSL negatively correlated with number of SOREMs. Additionally, REM-suppressing antidepressants use was associated with decreased ESS and arousal index, but showed no correlation with MSL or number of SOREMs, while depression was associated with decreased ESS, arousal index and PSG REM latency. (All p< 0.05.)

Upon multiple regression analyses accounting for age and sex, TIB on actigraphy continued to be associated with increased MSL (p=0.0012).

Conclusions: In this retrospective review, TIB on actigraphy influenced MSL. Use of antidepressants was not associated with changes in MSL or number of SOREMs. Clinicians should account for TIB while interpreting MSLT results.

WORK RELATED FATIGUE AND SLEEPINESS AT WORK AMONG INTERN HOUSE OFFICERS OF FOUR HOSPITALS IN SRI LANKA

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Introduction: Intern house officers (IHOs) are expected to work long duration shifts with frequent on-calls. It had been shown that lack of adequate sleep due to prolonged duty hours and night shifts increases sleepiness at work,medicalerrors, risk of depression and reduces professional judgment. This issue first came to light in 1984 after the death of Libby Zion, an 18 year old woman, as a result of inappropriate treatment by a sleep deprived resident doctor. United States and European countries have imposed guidelines to restrict duty hours of IHOs, however no such restrictions are implemented in Sri Lanka. The objective of this study was to evaluate fatigability and sleepiness at work of IHOs of four main hospitals in Sri Lanka.

Materials and methods: IHOs of Colombo South Teaching Hospital, National Hospital Sri Lanka, Lady Ridgway Children's Hospital and De Soysa Maternity Hospital were recruited during the year 2016. Duty rosters were analyzed for the length of duty shifts and night on-calls. Questionnaires were used to record fatigability, sleepiness at work and medical errors. To categorize the risk at work the Australian Medical Association (AMA) national code of practice fatigue risk assessment model and to assess daytime sleepiness Epworth sleepiness scale (ESS) were used.

Results: Out of 94 IHOs, 73% worked more than 100 hours and 32 % worked more than 125 hours a week. Notably, 38% did three night on-calls per week and 31% did more than three. Subjective fatigue level at work was reported as "most of the time" and "always"by more than 80% of IHOs. ESS scores showed, 31.9% had severe and another 19.1% had moderate excessive daytime sleepiness. Fatigue risk assessment scores indicated that 97% IHOs were in the high-risk group. Female IHOs were found to be more fatigued. One third of doctors reported medical errors due to fatigue and sleepiness, which was significantly high in medicine rotation.

Conclusions: IHOs are found to be over working. Majority of them reported sleepiness at work and were fatigued. Female IHOs were more fatigued at work. Number of medical errors reported during internship was high. Based on these findings we recommend establishing local rules and regulations on working hours of doctors and especially having protected working hours for IHOs.

Acknowledgements: No

THE ESTIMATION OF EXCESSIVE DAYTIME SLEEPINESS IN POST-STROKE PATIENTS - A POLYSOMNOGRAPHIC STUDY

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Introduction: Excessive daytime sleepiness (EDS) has been reported in stroke patients. EDS in acute stroke was studied repeatedly,but there is a modest amount of data in post-stroke patients. The aim of this study was to assess the frequency of EDS and characterize sleep architecture in patients>3 months after stroke and identify factors which may affect EDS.

Materials and methods: 66 patients were enrolled, of which 33 had experienced stroke. All underwent a standardized overnight, diagnostic single night polysomnography, including electrocephalogram (EEG) leads, electrooculograms (EOG), chin electromyogram (EMG), and electrocardiogram (ECG). Epworth Sleepiness Scale (ESS) was used to measure subjects' level of daytime sleepiness.

Results: We observed similar total ESS score, total sleep time (TST), sleep efficiency, as well as respiratory disturbance index /apnea-hypopnea index (RDI/AHI), oxygen desaturation index (ODI) and mean heart rate in both groups. We observed positive linear correlation between EDS and mean heart rate in the stroke group (r=0.46, p < 0.05) as well as between EDS and REM duration (r=0.23, p < 0.05). In the non-stroke group EDS didn't correlate with the heart rate or with the REM duration. In the non-stroke group EDS correlated positively with RDI/AHI and ODI index (r=0.46; p= < 0.05 r=0.41, p < 0.05 and maximal desaturation (r=0.55, p < 0.05), this correlation was not observed in post-stroke group. In the both groups we observed negative linear correlation between BMI and saturation (stroke group - mean as well as minimal saturation (r=−0.458, p < 0.05; r=−0.578, p < 0.05), non stroke group - minimal but not mean saturation rate (r=−0.544, p < 0.05). We also noticed in both groups positive correlation between BMI and both AHI and ODI index (stroke group respectively: r=0.430, p < 0.05; r=0.451, p < 0.05; non-stroke group - BMI and ODI: r=0.405, p < 0.05). The positive BMI correlation with RDI/AHI was not significant in the non-stroke group. We noticed that BMI correlates with non-REM sleep N1 (r=0.760, p < 0.05) in post-stroke group, while it correlates negatively with REM sleep (r=-0.709, p < 0.05). There was no such correlation in the non-stroke group.

Conclusions: In stroke patients subjective daytime sleepiness is associated with heart rate, but not with the severity of OSA. Thus ESS (Epworth Scale Score) may be not as useful as a marker of obstructive sleep apnea (OSA) presence or severity in post stroke patient as in the general population.

THE EFFECT OF SLEEP DISORDERED BREATHING AND EXCESSIVE DAYTIME SLEEPINESS ON THE RISK OF MOTOR VEHICLE CRASH: THE TOON HEALTH STUDY

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Introduction: Although excessive daytime sleepiness (EDS), which is one of the diagnostic criteria for sleep apnea syndrome (SAS), several studies indicated presence of SAS patients without subjective EDS; which we proposed as "Non Sleepy Sleep Apnea (NoSSA)". Moreover, thought SAS is a major risk factor for motor vehicle crash (MVC), there are few studies on the association between NoSSA and MVC. Therefore, we examined the effect of subjective EDS on the association between sleep disordered breathing (SDB) and MVC in a prospective cohort study among Japanese community residents.

Materials and methods: There were 1,049 Japanese male and female participants aged 30-79 years who participated in the Toon Health Study, a prospective cohort study that sought novel risk factors for cardiovascular disease prevention in a community setting, at baseline survey from 2009 to 2012. Respiratory disturbance index (RDI) was assessed by a single-channel airflow monitor, and SDB was defined by RDI≥10 events /hour. EDS was assessed by the Japanese version of the Epworth Sleepiness Scale (JESS), and JESS scores ≥11 was defined as having EDS. A follow-up questionnaire approximately five years after baseline ascertained driving habits and history of MVC for five years. Sex-specific multivariable logistic regression analysis was used to calculate odds ratio (OR) and 95% confidence interval (CI) for MVC during the five years after baseline according to RDI categories at baseline after stratification by the presence of EDS. The interaction of SDB with the presence of EDS in relation to MVC were tested using cross-product terms of these variables in the logistic regression model. Confounding factors were age, BMI, drinking and smoking habit, use of sleeping medication, and sleep duration.

Results: The multivariable-adjusted ORs (95% CIs) of RDI ≥10 events/hour group for MVC were 0.91 (0.49-1.67)in males and 1.63 (1.02-2.60) in females respectively, compared with RDI < 10 events/hour group. When stratified by the presence of EDS, a significant association between SDB and MVC was found only among females without EDS(ORs (95% CIs) were 1.85(1.01-3.40)), but not among those with EDS (P for interaction = 0.07). We did not find any significant associations among males.

Conclusions: We found the significant association between SDB and MVC among females, and this association was more evident among those without EDS than those with EDS. In order to mitigate SAS related MVCs, we should focus on the presence of "NoSSA," and SAS screening is needed regardless of EDS.

PAIN AND HYPERSOMNOLENCE: A LONGITUDINAL STUDY

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Introduction: Hypersomnolence (self-reported excessive sleepiness) is highly prevalent in the general population. Whether it is self-inflicted or the result of a specific disorder, hypersomnolence comes at a high price: many people struggle with sleepiness when they should be fully awake. Cross-sectional studies have shown that hypersomnolence can be associated with various medical conditions and psychiatric disorders. However, little is known about the role of chronic pain in the appearance and chronicity of hypersomnolence.

Materials and methods: The initial study was carried with 15,929 individualsfrom 15 US States. The longitudinal study was carried on in eight of these states. A total of 12,218 subjects were interviewed by phone during the first wave (W1) and 10,930 at the second wave (W2) three years apart. The analyses were carried on the subjects who participated in both interviews (N=10,930). Hypersomnolence symptoms were defined according to DSM5 criteria. Chronic pain referred to a pain lasting at least three months.

Results: Hypersomnolence, occurring at least 3 days per week for at least 3 months despite a sleep duration of at least 7 hours, was observed in 15.6% (15.0%-16.2%) of the sample at W1. At W2, 22.1% (21.9%-23.4%) reported hypersomnolence. The incidence per year was 5.7%. Hypersomnolence was chronic in 36.7% of cases, i.e., 5.7% of the sample. Chronic pain, i.e., lasting at least 3 months, was reported by 40.7% at W1 and 29.7% at W2. Incidence per year was 4.6% and pain present at both W1 and W2 was reported by 15.7% of the sample. At W1, 52.7% of individuals with hypersomnolence reported chronic pain. At W2, 43.5% of subjects with hypersomnolence had chronic pain. As many as 32.6% of individuals with chronic hypersomnolence reported chronic pain on both assessments. Incident hypersomnolence was predicted by continuous pain from W1 to W2 (RR: 1.6), incident pain at W2 (RR: 1.4), medical condition alone (RR: 1.4), psychiatric disorder alone at W2 (RR: 1.5) and comorbid medical condition and psychiatric disorder at W2 (RR:2.3). Chronic hypersomnolence was predicted by continuous pain from W1 to W2 (RR: 3.2), incident pain at W2 (RR: 1.7), comorbid medical condition and psychiatric disorder at W1 (RR:2.0) and W2 (RR: 1.9) and psychiatric disorder alone at W2 (RR: 1.7).

Conclusions: Chronic pain appears to be an important predictive factor in both the appearance and the chronicity of hypersomnolence. Furthermore, long-lasting pain appears to be a strong predictor of the chronicity of hypersomnolence.

ASSOCIATION OF OBJECTIVE SLEEPINESS WITH MOTOR VEHICLE CRASH AMONG JAPANESE COMMUNITY RESIDENTS.: THE TOON HEALTH STUDY

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Introduction: Daytime sleepiness due to sleep deprivation is a known risk factor for motor vehicle crashes (MVCs). Because subjective assessment of daytime sleepiness may underestimate or overestimate the severity of daytime sleepiness, objective assessment of sleepiness is important. However, there are few studies on the association between objective sleepiness and MVCs. Therefore, we examined the association between parameter of Psychomotor Vigilance Task (PVT) as an objective assessment of daytime sleepiness and MVCs in a prospective cohort study among Japanese community residents.

Materials and methods: In this study, 911 participants (354 men and 557 women) aged 30-79 years old were enrolled in both baseline (from 2009 to 2012) and five-year follow-up (from 2014-2017) study in the Toon Health Study, a community based prospective cohort study. Participants performed PVT at baseline survey, and mean of 1/reaction time (RT) and total number of lapses (RTs $\geq$ 500 ms) were categorized into quartile groups. History of MVCs during the following five years from baseline was assessed by a self-administrated questionnaire at follow-up survey. Subjective daytime sleepiness was assessed by the Japanese version of the Epworth Sleepiness Scale (JESS). We defined JESS score $\geq$11 group as those who had excessive daytime sleepiness (EDS). Multivariable adjusted logistic regression analysis was used to evaluate the association of mean 1/RT and number of lapses with MVCs after adjustment for age, sex, body mass index, drinking status, smoking status, respiratory disturbance index, use of sleep medication and sleep duration. We also examined association after stratification by the presence of EDS.

Results: In this study, 138 people had experienced MVCs (15.2%). The multivariable-adjusted odds ratio (OR) and 95% confidence intervals (CI) of MVCs among the highest quartile group of mean 1/RT was 0.32 (0.18-0.59), compared to the lowest quartile group of mean of 1/RT (p for trend< 0.01). The respective OR (95% CI) among the highest quartile of number of lapses was 1.85 (1.11-3.09), compared to the lowest quartile group of number of lapses (p for trend< 0.01). These associations were observed among both those with or without EDS (P for interaction >0.05).

Conclusions: In this study, we found that objective sleepiness assessed by PVT might be a risk for MVCs among community residents, and this association was also observed regardless of the presence or absence of EDS. The screening for objective sleepiness assessed by PVT may be useful for mitigating MVCs.

PAIRING OF A SELF-ADMINISTERED EPWORTH SLEEPINESS SCALE (ESS) WITH AN EPWORTH SLEEPINESS SCALE SCORING BY A CLOSE RELATION (CR) REVEALS GENDER, RACE, AND FAMILY UNIT DIFFERENCES

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Introduction: Evaluation of daytime sleepiness is essential in clinical sleep practice. The ESS is a self-administered questionnaire traditionally used for this purpose, although recent data suggests its results may vary dependent on the mode of test administration. The subjective experience and objective burden of sleepiness might be further influenced by patient's race, gender, and age. Using ESS not as a self-administered test, but rather, paired with ESS score from CR offers more insight into disease.

Materials and methods: 164 patient-CR pairs were asked to complete ESS questionnaires. Descriptive summaries were frequencies and percentages for categorical data, and medians and quartiles for continuous variables. Differences within pairs were evaluated using Wilcoxon´s Rank Sum Test. All analyses were done in SAS for Windows 9.4.

Results: Out of 164 patient-CR pairs, 69.5% were Caucasian. Among patients, 54.2% were male, and 34.8% were older than 65. Among CRs, 79.8% were spouses, and 20.2% were first degree relatives (12.2% children and 8% parents). No significant difference was noted between Caucasian and Racial Minority (RM) patients for the total ESS scores obtained. However, significant difference was demonstrated for Question 7 "Sitting quietly after a lunch without alcohol", with RM patients that presented with their spouses scoring higher than their Caucasian counterparts (p= 0.0417). CRs of the RM patients reported higher sleepiness than CRs of Caucasian patients for scenario in Q6 "sitting and talking to someone" (p=0.039). Spouses did appear to be more observant CRs than first degree relatives, with increased sleepiness observed for scenario Q3 "sitting inactive in public place". Gender analysis demonstrated that female patients had significantly higher self-reported ESS scores than male patients, with female patients presenting with their spouses having the highest ESS scores (mean=12.72, SD=5.5, n=50) and male patients presenting with first degree relatives demonstrating the lowest ESS scores (mean=8.25, SD=4.3, n=8). Furthermore, female patients self-reported to be more somnolent than males in a few specific scenarios (Q3, Q6, and Q4 "passenger in a car for an hour"). In contrast, analysis of CRs´ responses revealed that female patient experienced more sleepiness then was observed by CR in all scenarios except for Q5 "lying down". CRs´ responses also suggested that its the male patients who are in fact more somnolent than they feel in all scenarios of the questionnaire, as well as based on total ESS score. Reporter CRs´ noted higher somnolence in male compared to female patients for scenarios Q1 "sitting and reading" (p=0.001), Q2 "waching TV"(p=0.0006), Q3(p=0.0005), Q7(p=0.001) and total ESS score (p=0.0005). In contrast to self-reported data, spouses of male patient´s reported the highest ESS scores while spouses the female patients reported the lowest scores (mean 13 vs.9.4 diff 3.6, t=4.221, p< 0.0001).

Conclusions: Significant differences between genders and races were noted when self-ESS and CR-ESS were compared. Preforming ESS as a two stage (i.e. self administered and CR-administered) questionnaire offers further information on patients' level of sleepiness when compared to ESS as a stand alone test.

EPWORTH SLEEPINESS SCALE AS A SCREENING TOOL FOR SLEEP MEDICINE PATIENTS

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Introduction: The Epworth Sleepiness Scale (ESS) is one of the most common used instruments to evaluate daytime sleepiness in sleep medicine, namely for the screening of Obstructive Sleep Apnea (OSA). Being a short self-answer tool, it is often used in large epidemiological studies, however it evaluates paradigmatic behavioral situations which are quickly changing with societal changes. The aim of this study was to evaluate ESS as a screening tool of excessive daytime sleepiness, at present time, in Portuguese populations in clinical (Insomnia and OSA) and nonclinical populations of shift workers (airline pilots and aeronautical mechanic technicians) using a group from the general population as control.
Materials and Methods: We applied the ESS to 1166 individuals. 138 from the general population (GP) aged 39.9±13.6, 66.7% were male; 456 airline pilots, disruptive schedules shift workers (DSW) aged 38.3±8.3, 96.9% were male; 297 aeronautical mechanics, rotative shift workers (RSW) aged 40.2±8.2, 97.0% were male; 189 OSA patients 52.6±13.2, 57.1% were male; and 86 insomnia (IN) patients aged 44.0±14.0, 40.7% were male. Both patients' groups were diagnosed according to the ICSD3 criteria, performed a PSG Type 1/2 and were clinically evaluated by a Sleep Medicine specialist. Mean comparison (ANOVA) for the ESS scores was performed for the different groups, with post-hoc Bonferroni test. Also, chi^{2}test for the different groups and a logistic regression model were performed for daytime sleepiness (ESS>10) and without daytime sleepiness (ESS£10). All tests were considered as statistically significantly for a p< 0.05. Analysis were performed with SPSS v.25 for Mac.
Results: The average ESS score for GP was 9.1±4.5, DSW 10.4±4.5, RSW 11.7±4.4, OSA 9.3±5.2 and IN 8.4±5.0. For the mean comparison groups, GP was significantly different from DSW (p=0.03) and RSW (p< 0.01), presenting the last two the highest scores. OSA was significantly different from RSW (p< 0.01) and IN from RSW (p=0.03) and DSW (p< 0.01). The frequencies of individuals with daytime sleepiness per groups were: GP 49 (35.5%); DSW 226 (49.6%); RSW 179 (60.3%); OSA 76 (40.2%); and IN 25 (29.1%) (chi^2= 43.9; p< 0.01). For the logistic regression model, the only variable with a predictive value for daytime sleepiness was groups (p< 0.01); age and gender were not significant.
Conclusion: The main conclusion is that the prevalence of daytime sleepiness is very high in shift workers, in clinical populations and in the controls, ranging from 29.1% to 49.6%) and therefore ESS is a useful tool in adults. Shift workers were the ones with significantly higher scores in comparison to the GP and patients. ESS in OSA and in IN patients were not significantly different from the general population. In insomniacs this result is in line with the hyperarousal mechanism. In OSA the relatively low ESS scores are eventually in line with the lower severity and faster diagnosis.

Excessive Daytime Sleepiness (not Narcolepsy)
Board #100 : Poster session 2
ASSESSMENT OF THE DIGITAL VERSION OF THE SLEEP-WAKE ACTIVITY INVENTORY (SWAI) ON PROSPECTIVE SLEEP CLINIC PATIENTS

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I**Introduction:** The assessment of wake-time sleepiness represents one of the cardinal activities in Sleep Medicine. In this context, the use of self-reported measures of sleepiness has become a conventional clinical practice with the Epworth Sleepiness Scale being the most widely used questionnaire. The SWAI was also validated among Sleep Clinic populations but its multi-factorial structure makes it cumbersome to score and thus has seen only limited use. The advent of a digital version makes it easy to administer and is scored automatically. We report on a feasibility study to assess its use in prospective sleep clinic patients and to assess the relevance of the data derived from the SWAI.

Materials and Methods: A convenience sample of patients due to have initial consultation at the sleep clinic were asked to complete the SWAI prior to their office visit. Subjects were directed to the web address hosting the SWAI and were provided a password to enable them to take the survey in a HIPAA compliant platform; patients were asked to provide demographic data, identify their chief complaint (CC) and completed the SWAI, which is a 59 item Likert-type questionnaire yielding scores on 6 validated scales (Sleepiness [EDS], Nocturnal Sleep [NS], Psychic Distress [PD], Social Desirability [SD], Energy Level [EL] and Ability to Relax [AR]). Patients completing the SWAI (N= 251; Females: N=82 / Males: N=169; average age 49 ± 10) who identified CC of Sleepiness (EDS; N=24), Fatigue (F; N=33), Snoring (S; N=152) or Insomnia (I; N+42) are presented. ANOVAs with post-hoc comparisons where appropriate were used to assess the scores on the SWAI as it relates to reported CC. Note lower scores on the EDS scale reflect higher sleepiness while lower scores on NS, EL and AR denote better sleep, energy and ability to relax.

Results: Patients reported no difficulties with the digital version of the SWAI. Main effects were documented for the EDS ($p< 0.01$), NS ($p< 0.001$), EL ($p< 0.001$) and AR ($p< 0.05$). On the EDS scale, patients with CC of sleepiness scored with significantly higher sleepiness ($p< 0.01$) (41 ± 17) vs. CC of S (52 ± 15) and I (56 ± 18). On the NS scale patients with CC of I scored with significantly higher difficulty sleeping ($p< 0.01$) (20 ± 7) vs. F (13 ± 6), EDS (15 ± 8) and S (13 ± 6). Significantly lower ($p< 0.01$) EL was documented for F (26 ± 6) vs. I (20 ± 6) and S (21 ± 6) and for EDS ($28+7$) vs. I and S. On AR only significantly lower ability to relax ($p< 0.01$) was shown for F (17 ± 5) vs. S (15 ± 6).

Conclusions: The patients' chief complain yielded differential profiles on the SWAI. The data confirms previous reports using the EDS and NS scales and suggests that Energy Level and, to a lesser extent, Ability to Relax represent potentially additional domains that have not been explored among sleep-disordered populations. The multi-factorial nature of the SWAI provides such information within one single clinical instrument.

THE IMPACT OF SUBJECTIVE EXCESSIVE DAYTIME SLEEPINESS ON COGNITION IN PARKINSON DISEASE

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Introduction: Excessive daytime sleepiness (EDS) is a common complaint in individuals with Parkinson´s disease (PD), affecting 20 to 60% of them. Whereas some studies in PD suggest that subjective EDS is associated with lower cognitive performance, others have not corroborated this association. This controversy may be explained by several factors including heterogeneity in clinical profiles, lack of complete cognitive assessment and absence of screening for sleep disorders. The aim of this study is to assess the effects of subjective EDS on cognitive functions in individuals with PD using a using extensive neuropsychological evaluation.

Materials and methods: One hundred and thirteen participants with PD (75 men and 38 women; 65.9 ± 8.8 y.o.; Hoehn and Yahr status : 2.3) were included in the present study. They completed a comprehensive neuropsychological assessment that included attention, executive function, episodic memory and visuospatial testing. They filled out self-reported questionnaires measuring insomnia, EDS, anxiety and depressive symptoms. All participants underwent a polysomnographic evaluation of their sleep. They also completed the Unified Parkinson ´s Disease Rating Scale (UPDRS-III) to assess motor impairment. The participants were separated into two groups on the basis of the presence or absence of an EDS via a score higher than 11 on the Epworth Sleepiness Scale (ESS; 42 participants with EDS, and 71 participants without EDS). Variances analyzes were subsequently performed to measure any group difference.

Results: PD participants with EDS and without EDS did not differ in age, sex, level of education and duration of PD. Medication use, REM sleep behaviour disorder and Apnea-Hypopnea Index weren't different from participants with EDS nor without EDS. No significant difference was observed between the two groups on neuropsychological tests. In contrast, compared to subjects without subjective sleepiness, subjects with EDS had a higher score at UPDRS-III, suggesting a higher motor impairment.

Conclusions: Although PD participants with EDS report more severe motor impairment, complaints of subjective daytime sleepiness do not appear to discriminate objective cognitive performance. While EDS still remains a major complaint in PD, the use of a self-reported questionnaire such as the ESS may not accurately reflect the impact of EDS on cognition. Thus, an objective evaluation of EDS can help in giving more insights to burden of EDS in PD. Future studies could objectively evaluate EDS, in order to better understand its possible impact on cognition.

CHARACTERISTICS OF SUBJECTS EXCLUDED FORM AN IDIOPATHIC HYPERSOMNIA RANDOMIZED CLINICAL TRIAL (ARISE[2])

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Introduction: Research of the safety and efficacy of new treatments is conducted via randomized controlled trials (RCTs). Rigorous inclusion and exclusion criteria are standard practice in high-quality RCTs. Inclusion criteria define the target population investigated while exclusion criteria identify participants with characteristics that could increase risk for a negative outcome. To establish a diagnosis of Idiopathic Hypersomni (IH), patients must have daytime sleepiness, impairment in daytime function, normal or extended sleep and exclusion of other hypersomnolence causes. The present report sought to identify the frequency and primary reasons subjects were excluded from ARISE[2], a Phase 2 RCT in IH.

Methods: Potential study participants with a preliminary diagnosis of IH were screened by a committee of 3 independent sleep diseases experts (authors, AA. LR, TR). The final decision regarding eligibility was determined by a consensus of the committee working with the following pre-specified guidelines: 1. Sleep history consistent with a diagnosis of IH and inconsistent with other causes of hypersomnolence (e.g. SRBD, narcolepsy, insufficient sleep), 2. Historical PSG adequately documenting, TST, SE, sleep stage distribution and an AHI and PLMAI < 15, 3. Historical MSLT showing a mean sleep latency < 8.0m and < 2 REM onsets, 4. Historical and current medication use focusing on potential REM suppressing medications, 5. Current sleep diary demonstrating average $\geq$ 7 hours in bed nightly over the past week, 6. Current ESS >10, 7. Current Mental fog score from Idiopathic Hypersomnia Symptom Diary (0 to 10 scale) of $\geq$6 over the preceding week.

Results: Thus far, 134 subjects were reviewed by the committee. Of these, 94(68%) were excluded. The major reasons were : historic MSLT>8 (22), discontinued interest (20), failed to show mental fog score> 5 (12), failed to demonstrate >7 hours mean nocturnal sleep time (10), unable to comply with study restrictions (prohibited concomitant medication washout, alcohol, nicotine, caffeine) (12), ESS< 10 (6), other diagnosed causes of hypersomnolence (5), circadian rhythm sleep disorders (2), abnormal clinical labs (2), BMI>35 (1), CPAP use (1), and elevated suicidality score (1).

Conclusion: A majority of patients with a preliminary diagnosis of IH failed study screening due to inability to meet inclusion criteria necessary for the IH diagnosis. Other major reasons include patients withdrawing consent due to inability or unwillingness to commit for the duration of the study as well as inability to comply with protocol (i.e., use of alcohol, nicotine, caffeine or concomitant medications). It is possible that the subjects enrolled are not fully representative of the general IH population or IH may be overly diagnosed in the community setting. Polysomnographic and MSLT data may help enhance the specificity of IH diagnosis when it is coupled with the clinical history. Alternative methods such as all-comer studies and open label clinical case series may be needed to contextualize the results of the more rigorous clinical studies.

ARE REPORTS OF MENTAL FOG FROM PATIENTS WITH IDIOPATHIC HYPERSOMNIA MEDIATED BY OBJECTIVE MEASURES OF DAYTIME SLEEPINESS?

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Introduction: Objective evidence of pathological sleepiness (i.e. MSLT < 8) is required for an Idiopathic Hypersomnia (IH) diagnosis. Aside from EDS, IH patients report mental fatigue and inability to concentrate. The relation between these two symptoms is not well understood.

Method: To address this issue we produced a correlation matrix using blinded data from all 21 subjects who, to date, completed the IH202 trial (ARISE[2]). This is a Phase II, double blind, randomized 2-period crossover study in evaluating the safety and efficacy of an oral GABA antagnoist (BTD-001). Patients are randomized to either two weeks of active treatment followed by 2-week washout and then two weeks of placebo or placebo followed by washout and then active treatment. Included in the analysis were Idiopathic Hypersomnia Symptom Diary (IHSD) 4 items, the PGIC, SF-36, reports of sleepiness (ESS) and objective measures of sleepiness (MWT and PVT). We produced 2 correlational matrices (Pearson Correlation Coefficients) using data from the 21 subjects who completed both treatment periods in the ARISE[2] study. We produced this matrix using blinded pooled data from treatment period 1 as well as treatment period 2. Importantly, approximately half the subjects in treatment period 1 were on drug and the other half were on placebo. In treatment period 2, those previously on placebo were on active treatment and those previously getting active were on placebo. The advantage of this approach is the ability to identify correlates of patient's evaluation of improvement in a double-blind manner. As there were multiple correlations performed, we treated treatment periods 1 and 2 correlations as replicates and are considering only those that were significant in both matrices.

Results: There were 55 correlations calculated in each treatment period. Across 55 correlations, 24 were not significant in either treatment periods, 19 were significant at one of the treatment periods, and 12 were significant in both treatment periods. Patient evaluation of improvement (i.e. PGIC) correlated on both occasions with only Mental Fog and Exhausted scales Scale of the IHSD and the vitality sub-scale of the SF-36. Neither measure of the 2 objective assays of sleepiness (MWT and PVT) correlated even once with subject's estimate of improvement. Interestingly, neither of the 2 objective assays of sleepiness correlated even once with the patient report of sleepiness (i.e. ESS). This suggests, as authors have stated previously that the reports of sleepiness in IH relate more to mental fatigue rather than physiological sleepiness *per se*. In contrast the mental fog scale, correlated with all 3 of the other IHSD subscales, the subjective sleepiness (ESS) as well as patients´ judgments about efficacy (PGIC).

Discussions: These data support the positions that: a) mental fog is independent of objective assays of sleepiness and b) objective assays of sleepiness may not be appropriate efficacy endpoints in IH clinical trials.

Excessive Daytime Sleepiness (not Narcolepsy)
Board #106 : Poster session 3
PREVALENCE AND MORBIDITY OF SLEEPINESS AMONG SLEEP APNEA PATIENTS IN AN ONLINE COHORT

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Introduction: Excessive daytime sleepiness (EDS) is a common presenting symptom among patients with sleep apnea (SA). EDS is widely expected to improve with positive airway pressure (PAP) therapy, however, 9-22% of patients in clinic who are PAP-adherent report persistent sleepiness. Given that EDS is a critical outcome for patients with SA, we aim to understand the prevalence and risk factors of EDS, and health-related quality of life (HRQoL) outcomes associated with EDS among a non-clinical, "real world" sample of patients engaged in a SA online support, education, and research web-portal.

Methods: We conducted a cross-sectional survey among patients with SA through the Sleep Apnea Patient Centered Outcomes Network (SAPCON) website, MyApnea.Org. Survey measures assessed demographics, comorbidities, SA treatment, and the following HRQoL outcomes: work productivity and activity impairment (WPAI, 4 scores), physical and mental health (Short-Form Health Survey; SF-12v2, PCS and MCS), functional outcomes of sleep (FOSQ-10), insomnia (Women's Health Initiative Insomnia Rating Scale; WHIIRS), depression (World Health Organization Well-being Index; WHO-5), and drowsiness-related driving events. We examined HRQoL outcomes by EDS status (Epworth Sleepiness Score, ESS>and≤10) using descriptive statistics. We examined differences in outcomes by EDS status using multivariable linear regression models, adjusting for demographics and clinically relevant comorbidities. A sub-sample analysis was performed on those with self-reported PAP-adherence averaging ≥6 hours/night.

Results: Respondents were mostly from the US, however also included individuals from Canada, the United Kingdom, and other countries. Of the respondents (n=344), 48.0% were female, 66.9% were ≥55 years, 92.1% were non-Hispanic/White, the average body mass index was obese (32.5 kg/m^2, standard deviation: 7.8), and 38.4% reported sleeping ≤6 hours/night on average. EDS was identified among 31.4% of respondents (ESS>10) and 21.2% reported sleepiness as a precipitating factor for seeking initial treatment. EDS was more prevalent in SA respondents who were ≥55 years old (p=0.02) and those who identified as a racial/ethnic minority (p=0.02). Compared to those without EDS, those with EDS had poorer HRQoL outcomes overall, including poorer mental and physical health (SF-12), lower disease-specific functional quality of life (FOSQ-10), more activity and work impairment (WPAI), more drowsy driving events, higher depressive symptoms (WHO-5), and more insomnia symptoms (WHIIRS) (p< 0.01, respectively; all nominal). Associations persisted after adjusting for demographics and comorbidities using multivariable linear regression. In sub-sample analyses among 260 (75.6%) self-reported PAP-adherent patients (≥6 hours/night), 77 (29.6%) reported EDS and similar associations between EDS and HRQoL outcomes were observed.

Conclusion: These "real-world" data suggest that patients seeking online SA support and engagement experienced a high prevalence of EDS. EDS was associated with poorer HRQoL outcomes, including functionality, work, mental and physical health, and higher prevalence of depression, insomnia, and drowsy driving events. The associations persisted among respondents with high self-reported PAP-adherence, potentially driving these individuals to

seek on-line support for problems with sleepiness-related HRQoL. Support seeking may also be driven by potential gaps in care.

Support: Jazz Pharmaceuticals

Excessive Daytime Sleepiness (not Narcolepsy)
Board #107 : Poster session 3
THE FACTORS DETERMINING THE QUALITATIVE FEATURES OF DAYTIME SLEEPINESS IN PARKINSON´S DISEASE

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Introduction: Excessive daytime sleepiness (EDS) in Parkinson´s disease (PD) may manifest in some patients as feeling sleepy during normal activities and sudden-onset sleep (SOS), abrupt episodes of unexpected sleep that occur during normal activities. The aim of the study was a clinical and polysomnographic comparison of PD patients with various manifestations of EDS.

Materials and methods: We analyzed data from 28 PD patients with subjective sleepiness on 2-3 stage Hoehn-Yahr (2.5 ± 0.4), mean age 66.4 ± 7.9 years, PD duration - 9.8 ± 4.2 years, taking dopaminergic drugs (levodopa drugs and dopamine agonists) in a stable dose (928,1±256,5 mg).

Assessment: Unified Parkinson's disease rating scale (UPDRS parts II, III in "on" state, Parkinson Disease Sleep Scale I, Epworth Sleepiness Scale , Beck Depression Inventory, State-Trait Anxiety Inventory, Scopa-Cog; Apathy Scale Starkstein ; nocturnal video-polysomnography, MSLT. The information about SOS and DS was obtained on the basis of a survey of patients and their relative's.

We used the Statistica 10 package.

Patients were divided into three groups: patients with SOS , which not be aware of daytime sleepiness (SOS, n = 9); patients with feeling excessive daytime sleepiness (DS) without SOS (DS, n = 9), patients with an association of sudden onset sleep with feeling excessive daytime sleepiness (DS-SOS, n = 10).

Results: The mean ESS score was 11,6±5,5 points. In MSLT the average MSL of all patients was 8,3±5,8 min, out of 5 patients (18%) had an MSL below 10 minutes and 13 patients (46,4%) had MSL below 5 min. Almost 75% (n=21) of the patients had a sleep efficiency < 80%. The mean sleep efficacy index was 67.8 ± 15.3%. Sleep architecture was fragmented by the increased percentage of NREM1 sleep (11,2 ± 7,6), NREM2 sleep (43±13%), decreased REM sleep (11.4 ± 6.9), slow wave sleep (8.7 ± 8.4%) compared to the age dependent normal values, the frequency of awakenings 20.8 ± 11.7 times.

Patients with the combination sleepiness (DS-SOS) compared with patients with isolated SOS had significantly larger Hoehn-Yahr stage (2.7 ± 0.4 versus 2.3 ± 0.4, p < 0.05), most expressed apathy (13.6 ± 4.2 vs 9.6 ± 3.3, p < 0.05). Patients of this DS-SOS group compared with patients with DS showed greater sleepiness (ESS score 15.6 ± 4.5 vs 10.2 ± 5.2, p < 0.05; MSL 4.5 ± 2.3 vs 8.4 ± 5.8 min on MTLS, p < 0.05).

Patients with SOS had significantly lower duration of wake after sleep onset (21.5 ± 9.3% vs 32,6±10%, p=0,02), and they had higher trait anxiety (52.8 ± 4.7 vs 45.1 ± 7.9, p < 0.05) compared to patients with DS without SOS.

Conclusions: EDS in PD is a clinically heterogeneous disorder. The severity of DS increases with the progression of PD. The clinical features of EDS are partially determined by the quality of night sleep. The risk factor for the development of more severe DS-SOS excessive sleepiness is apathy, while increased trait anxiety is one of the protective factors for the formation of feeling daytime sleepiness.

ADDITIVE EFFECT OF VISUAL FIELD DEFECT AND DAYTIME SLEEPINESS ON MOTOR VEHICLE CRASHES AMONG JAPANESE TAXI DRIVERS

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Introduction: Daytime sleepiness, which is one of the most common clinical findings of obstructive sleep apnea (OSA), is a known risk factor for motor vehicle crashes (MVCs). Recent studies have reported that OSA may be one of the risk factors for glaucoma, and visual field defect (VFD) of glaucoma is also a cause of MVCs. However, no study has elucidated the association of VFD and daytime sleepiness on MVCs. Therefore, we examined the association of VFD and daytime sleepiness on MVCs among Japanese taxi drivers.
Material and methods: Participants of this cross-sectional study consisted of 1,414 Japanese taxi drivers aged 22 to 74 years old. VFD was assessed by Clock Chart®, a multi-stimulus-type self-check visual field screening sheet, and a self-administrated questionnaire regarding visual field related near-misses while driving. In this study, the presence of VFD was defined as one or more VFDs as assessed by Clock Chart® and VF-related near-miss experiences. The Epworth Sleepiness Scale (ESS) was used to assess daytime sleepiness, and total ESS scores were categorized into quartile groups. We defined the highest quartile group of ESS scores as those who had daytime sleepiness. History of MVCs during the past five years was assessed by a self-administrated questionnaire. Multivariable adjusted logistic regression analysis was used to examine the association of VFD and daytime sleepiness on MVC after adjustment for age, sex, body mass index, drinking status, smoking status, working years, driving distance per year, and working hour per day.
Results: In this study, the proportion of MVCs experience was 61.3%. The multivariable-adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) of MVC among the highest quartile group of ESS scores was 1.73 (1.26-2.38), compared with the lowest quartile group of ESS score. The multivariable-adjusted OR (95% CI) of MVC among participants with VFD was 2.00 (1.25-3.03), compared to those without VFD, and the significant association was still observed even after adjustment for ESS scores. We further examined the additive effect of daytime sleepiness and VFD on MVCs. The multivariable-adjusted OR (95% CI) of MVCs among participants with daytime sleepiness and VFD was 3.55 (1.31-9.64), compared to those without daytime sleepiness and VFD.
Conclusion: This study showed that VFD and daytime sleepiness were significantly associated with MVC experience, and the combination of the two health conditions may have substantial impact on MVCs. Further prospective cohort as well as biological studies are needed to elucidate the mechanism of the additive effect of VFD and daytime sleepiness on the increased risk of MVC.

GENOME-WIDE ASSOCIATION ANALYSIS OF SELF-REPORTED DAYTIME SLEEPINESS IDENTIFIES 42 LOCI THAT SUGGEST BIOLOGICAL SUBTYPES

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Introduction: Excessive daytime sleepiness (EDS) is a heritable trait affecting 10-20% of the population. EDS is a chief symptom of chronic insufficient sleep as well as of several primary sleep disorders, such as sleep apnea, narcolepsy, and circadian rhythm disorders. EDS is associated with an increased risk for motor vehicle crashes, work-related accidents and loss of productivity, cardio-metabolic disorders, psychiatric problems and mortality. Experimental studies have shown that there is significant individual vulnerability to EDS following sleep restriction, suggesting a role for host characteristics in modulating individual liability to EDS. Prior studies have identified few genetic variants for EDS, likely reflecting the heterogeneous and multi-factorial etiology of the phenotype and low statistical power. This study aimed to identify genetic variants and molecular pathways underlying EDS and define shared biological mechanisms and causal links with other diseases.

Materials and methods: We performed a genome-wide association analysis (GWAS) of self-reported daytime sleepiness as a continuous variable derived from a 4-point scale using 452,071 individuals of European ancestry in the UK Biobank. A linear mixed regression

model was applied adjusting for age, sex, population structure and technical covariates. The heterogeneity effects of genome-wide significant loci were further investigated by clustering the associations with 7-day accelerometry-derived data and other self-reported sleep traits in the UKB. Follow-up analyses of fine-mapping, gene-based, tissue and pathway enrichment, partitioned heritability, summary-level genetic correlation and Mendelian Randomization to other common traits were performed.

Results: We identified 42 loci for self-reported daytime sleepiness in GWAS, with enrichment for genes expressed in brain tissues and in neuronal transmission pathways. We confirmed the aggregate effect of a genetic risk score of 42 SNPs on daytime sleepiness in independent Scandinavian cohorts and on other sleep disorders (restless legs syndrome, insomnia) and sleep traits (duration, chronotype, accelerometer-derived sleep efficiency and daytime naps or inactivity). Individual daytime sleepiness signals varied in their associations with objective short vs long sleep, and with markers of sleep continuity. The 42 EDS variants primarily clustered into two predominant composite subtypes - sleep propensity and sleep fragmentation. Strong genetic correlations were also seen with obesity, coronary heart disease, psychiatric diseases, cognitive traits and reproductive ageing. Mendelian randomization analysis indicated that higher BMI is causally associated with EDS risk, but EDS does not appear to causally influence BMI.

Conclusions: We conducted an extensive series of analysis from a large-scale GWAS and identified the heterogeneous genetic architecture of daytime sleepiness. This work will advance understanding of biological mechanisms relating to sleepiness and underlying sleep and circadian regulation, and open new avenues for future study.

NOCTURNAL SLEEP FRAGMENTATION AND CSF OREXIN LEVELS IN HUMANS: SLEEP AND WAKE BOUTS

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Introduction: The orexin (ORX) system is thought to stabilize sleep-wake regulation, by sustaining long periods of wakefulness. In the present study, we aimed to evaluate the relationships between cerebrospinal fluid (CSF) ORX-A levels and markers of nocturnal sleep fragmentation assessed by polysomnography (PSG), in a large cohort of adults and children with a complaint of hypersomnolence.

Materials and methods: Nocturnal PSG data of 300 drug-free subjects evaluated at the French National Reference Center for Narcolepsy (55% men, 29.9±15.6 years old, ORX-A levels 155.1±153.8 pg/mL) were collected and analyzed. Demographic and clinical characteristics were assessed for all participants. Several markers of nocturnal sleep fragmentation were considered: wake bouts (WB) (continuous sequence of wake epochs from 30 seconds to > 2 minutes), sleep bouts (SB) (continuous sequence of sleep epochs), transitions from sleep to wake, wake to sleep, and instability of stages of sleep. Groups of patients were categorized according to CSF ORX-A levels in tertiles, then in 2 categories (≤110, >110 pg/mL), and in 4 categories (undetectable,]10;110],]110;200], >200 pg/mL). Groups were compared using logistic regression models, and results were adjusted for age, gender and body mass index (BMI).

Results: Patients with ORX deficiency (≤110 pg/mL, n=164) were younger, more frequently men, with higher BMI, shorter total sleep time (TST) and longer wake time after sleep onset (WASO), than patients with ORX>110 pg/mL (n=136). They had significantly more microarousals, a higher number of WB (43 vs 25.5, $p < 0.0001$), regardless of their duration (from 30 s to 2min). Results were further confirmed when the population was categorized in 4 groups, with a dose response effect of ORX levels on WB parameters, and on the other markers of sleep fragmentation. All results remained unchanged and highly significant in crude and adjusted statistical models ($p < 0.0002$).

Conclusions: This study provides a strong evidence of the direct effect of ORX on nocturnal sleep stabilization in humans. Sleep and wake bouts turned out to be new reliable markers of sleep fragmentation, strongly correlated to CSF ORX levels, in a dose dependent way.

A CASE OF EXCESSIVE DAYTIME SLEEPINESS WITHOUT SLEEP APNEA IN OBESE BOY WITH PRADER-WILLI SYNDROME

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Introduction: Prader-Willi Syndrome (PWS) is a genetic disorder that has various clinical features. Young patients with PWS often suffer from symptoms due to sleep disorders including Obstructive sleep apnea, narcolepsy and manifestation of PWS itself and experience excessive weight gain at the same time. It is difficult to discriminate which sleep disorder is the cause of their excessive daytime sleepiness (EDS) in obese patients with PWS. We present a case that an obese 11-year-old boy with PWS who experienced excessive weight gain and EDS concurrently.

Case presentation: The patient has been visited his family clinic regularly for PWS and borderline intellectual disability. In 10-year-old his weight gained gradually from 32.5kg (Body mass index [BMI] 19.8kg/㎡) to 37.7kg (BMI 21.3kg/㎡). When he visited his family clinic at 10 years and 11 months old, he suffered from the symptoms of EDS including falling asleep in the morning classroom. His attending doctor confirmed his endocrine functions affecting sleepiness were normal respectively. Therefore, he was referred to his family doctor for evaluation of sleep apnea by polysomnograph (PSG) test. At 11 years and 2months old, the performed PSG test was showed excellent sleep efficiency and no any sleep apnea (Apnea hypopnea index [AHI] was 0 event per hour). Following multiple sleep latency test was performed at 11years and 5 months. The sleep latencies on four respective naps were following: 10min 30sec; 13min 30sec; 7min30sec; 7min 40sec. The overall mean sleep latency was 9min 45sec. None of sleep onset rapid eye movement period was noted.

Conclusion: As those results, we concluded that his symptom of EDS was due to a manifestation the PWS itself.

Acknowledgements: Especially in young patients with PWS, it is difficult to discriminate the cause of their symptoms of EDS. We experienced the case that recognized us the importance of sleep studies for the patients with PWS.

IDIOPATHIC HYPERSOMNIA SYMPTOM DIARY (IHSD): DEVELOPMENT OF A NEW PATIENT REPORTED OUTCOME (PRO) MEASURE

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Introduction: Idiopathic hypersomnia (IH) is a rare neurological disorder characterized by a constellation of symptoms related to daytime functioning. We present initial findings on the development of a new PRO, the Idiopathic Hypersomnia Symptom Diary (IHSD), based on qualitative research with individuals with IH.

Materials and methods: Concept elicitation (CE) interviews were conducted with individuals with IH to identify the most important symptoms and impacts experienced by this population. Interview results were analyzed, and the most frequently-reported issues identified were used to develop the IHSD. The draft IHSD contained 4 items assessing the worst severity of common symptoms and impacts including mental fogginess/confusion, exhausted/tired, difficulty remembering things, and difficulty completing tasks or activities, and an overall severity of hypersomnia question.

The IHSD was then cognitively debriefed (CD). Individuals with IH were asked to complete the IHSD and were then asked questions about the meaning of instructions, items, and response options, the clarity and relevance of each item, and appropriateness of the recall period. Input from clinical experts in IH was also obtained.

All interviews were conducted in the US by telephone with individuals diagnosed with IH using semi-structured interview guides, developed specifically for this study. Verbal consent was obtained.

Results: Seven individuals completed the CE interviews (86% female, mean age=37). The most commonly-reported symptoms and impacts were feeling tired (100%), difficulty completing daily activities (86%), brain fog/mental fogginess (71%), sleepiness during the day/desire to sleep (71%) and difficulty remembering things (71%). Saturation, the point at which no new issues were mentioned in subsequent interviews, was reached by the 5th interview.

Four individuals with IH (100% female, mean age=37) completed the 1st round of CD interviews. All individuals were able to accurately paraphrase each IHSD item, and most (75%) found it easy to complete. The draft IHSD was revised based on these interviews to include 2 versions of the questionnaire: one to be asked in the morning and the other to be asked in the early evening. Other revisions included reordering the items and revising some text for clarity. After the 2nd round of interviews (n=2) were conducted, very minor revisions were made to the IHSD for clarity. Clinicians reviewed the IHSD, and no further revisions were recommended. The final versions of the IHSD, to be completed twice each day, contain 4 items assessing the worst severity of mental fogginess/brain fog, difficulty starting or completing tasks or activities, difficulty remembering things, and feeling exhausted/tired, and an overall severity of hypersomnia question.

In general, the full range of responses was used for each item, and the mean time to complete the IHSD was 3 minutes.

Conclusions: This is the first IH-specific PRO measure developed for use in this population. Future research will focus on conducting additional CE and CD interviews in order to confirm the content validity and clarity and relevance of the IHSD. Its measurement properties will be evaluated in upcoming studies.

AUTONOMIC SYMPTOMS ARE COMMON IN IDIOPATHIC HYPERSOMNIA

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Introduction: Autonomic nervous system (ANS) impairment has been reported in narcolepsy, however there are limited data on ANS impairment in idiopathic hypersomnia (IH), another central nervous system hypersomnia.
Materials and methods: Two-hundred and fifty patients and 146 controls were recruited through the website of the Hypersomnia Foundation, a US-based patient advocacy group. Twenty-five confirmed patients were selected by the study investigators as a comparison group. All participants completed a battery of online sleep, autonomic, and quality of life questionnaires including the Composite Autonomic Symptom Score 31 (COMPASS 31).
Results: Compared to controls, patients reported higher COMPASS-31 scores (44.4 [32.9-53.6] vs 18.4 [12.3-28.2], p< 0.001), with the greatest symptom burden in the orthostatic and vasomotor domains. Patients reported more sleepiness (ESS 16 [13-19] vs. 6 [4-8], p< 0.001), and fatigue (CFQ 30 [24-33] vs. 14 [13-17], p< 0.001), which was positively correlated with COMPASS-31 scores. Patients reported lower quality of life as reflected by lower scores across all domains of the RAND-36, which was also positively correlated with COMPASS-31 scores.
Conclusions: Autonomic symptoms are common in IH. In addition, ANS symptom burden correlates with greater levels of sleepiness and fatigue and lower quality of life.

BASELINE CHARACTERISTICS OF IDIOPATHIC HYPERSOMNIA SUBJECTS ENROLLED IN A CLINICAL TRIAL (ARISE[2])

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Introduction: Idiopathic hypersomnia (IH) is a rare neurological sleep disorder recognized under the International Classification of Sleep Disorders (ICSD) as a central disorder of hypersomnolence. However, the nature of IH is not well defined. Here we report the baseline characteristics of patients enrolled in (ARISE[2]), a Phase 2 study evaluating a pharmacological intervention for IH.

Methods: Subjects were screened by a committee of 3 independent sleep researchers/clinicians with experience with IH (authors, AA. LR, TR). Although the final decision regarding eligibility was determined by a consensus of the committee, they were working with the following pre-specified guidelines: 1. Historical sleep history consistent with a diagnosis of IH and inconsistent with other causes of hypersomnolence (e.g. SRBD, narcolepsy, insufficient sleep, other psychological disorders); 2. Historical PSG adequately documenting Total Sleep Time(TST), SE, sleep stage distribution, an AHI ≤15 and PLMAI≤10/hr; 3. Historical MSLT showing a mean sleep latency ≤8.0m and < 2 REM onsets (including a SOREM on the PSG); 4. Historical and current medication use focusing on potential REM suppressing medications; 5. Current sleep diary demonstrating an average of at least 7 hours in bed nightly over a 7 day period; 6. Current ESS≥11 and 7. Current Mental fog score from Idiopathic Hypersomnia Symptom Diary (IHSD) of ≥6 over the preceding week.

Results: 134 subjects were screened and 39 (27%) were enrolled. In terms of demographics, 33 were women (85%), mean age was 37.2, sd 12.2. The age of onset was 17.6, sd 4.4. All subjects reported at least one medical or psychiatric comorbidity. On the historic PSG mean TST was 417.2, sd 19.9, sleep latency was 17.3, sd 19.9, WASO 27.3, sd 18.9 REM latency 116.1, sd 74.0 mean PLMAI 1.2, sd 2.5 and mean AHI 1.6, sd 1.7. On study entry PSG, the subjects showed a mean TST 421.7, sd 33.4 with a sleep efficiency of 91%, sd 6.0% The mean sleep latency on the historic MSLT was 4.6, sd 2.1 with an average of 0.1 REM onsets. Interestingly on the MWT performed at enrollment, the mean sleep latency was 19.6, sd 12.4. On the current sleep diary subjects reported a mean bed time of 19:40, sd 3h44m, TIB of 8h39m, sd 1h17m, and a sleep efficiency of 91.1%, sd 7.3%. In terms of daytime symptoms the ESS mean was 16.8, sd 2.9 and on the IHSD completed for one week (11-point scale) showed a mental fog score of 7.2, sd 1.6, exhaustion 7.9, sd 1.2 difficulty remembering 6.9, sd1.8 and difficulty completing tasks 7.1, sd 1.6

Discussion: On the pre-treatment MWT, the mean sleep latency was 19.6 minutes (median was 18.1). Despite the requirement for historical MSLT of sleep latency < 8 minutes, subjects showed an essentially normal MWT. This relatively normal MWT is in contrast to the high ESS. This suggests that the subjective perception of sleepiness might relate better to daytime impairment as documented on the symptom diary rather than objective measures of alertness.

Acknowledgment: the authors acknowledge the gracious patient referral from CoRDS registry

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THE STUDY OF THE DYNAMIC CEREBRAL AUTOREGULATION IN PATIENTS WITH NARCOLEPSY AND OSAHS

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Introduction: To study the dynamic cerebral autoregulation (dCA) changes in patients with narcolepsy and obstructive sleep apnea hypopnea syndrome (OSAHS) and to discuss the possible pathophysiological mechanisms.

Materials and methods: According to the result of PSG and MSLT,20 cases with the narcolepsy and 60 cases with OSAHS (including 20 patients with mild, moderateand severe OSAHS) and 20 healthy controls .The Epworth sleepiness scale（ESS） was used to evaluate the subjective sleepiness.STOP-BANG scale（SBQ）was used to assess the risk of OSAHS risk. TCD and continuous fingertip blood pressure monitorwere used to record thebilateralmiddle cerebralarterial blood flow velocity and arterial blood pressuresynchronously.Transfer function analyses (TFA) were used to analyze the autoregulatory parameters:phase difference and gain. Statistical analysis was performed on the obtained data to evaluate changes in dCA. 20 patients with narcolepsy were treated with dCA after standardized treatment for 1 month and compared with pre-treatment. And moderateand severe OSAHS were treated with ESS,AHI and dCA after effective continuous positive airway pressure（CPAP）for 1 month and compared with pre-treatment.

Results and conclusions:

1. ESS scores in patients with narcolepsy were higher than milde, moderate and severe OSAHS; The ESS score is linearly related to the arousal index;

2. The STOP-BANG scale score in OSAHS patients was linearly correlated with AHI

3. The dCA dyfunction was happened in patients with narcolepsy, moderate and severe OSAHS;

4. The ESS score and dCA were improved in patients with narcolepsy after 1 month of drug treatment;

5. The ESS score and AHI of patients with moderate to severe OSAHS decreased, but the dCA did not improve significantly after 1 month of effective CPAP treatment;

6. AHI, mean SaO2, minimum SaO2, < 90% oxygen reduction percentage were associated with impaired dCA function in OSAHS patients, and AHI was an independent risk factor for impaired dCA function in OSAHS patients.

7. Sleep latencydecreased, sleep efficiencydecreased, N1 sleep timeprolonged, N3 sleep timeshortened, arousal indexincreased and accompanied RBD in patients with narcolepsy; sleep efficiencydecreased, N1 sleep timeprolonged, N3 sleep timeshortened, arousal indexincreasedin patients with OSAHS.

GENETIC EPIDEMIOLOGY OF INSOMNIA IN THE BAEPENDI HEART COHORT STUDY

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Introduction: Insomnia significantly impacts lifetime morbidity and thus has substantial socioeconomic costs. In developed, high-income countries, where sleep is impaired by light pollution, advancing technology and stress, insomnia prevalence is increasing. However, little is known about insomnia in less urbanised, lower income populations. Baependi is a small rural town in the Brazilian heartland, which has been known to maintain day-night sleep cycles according to natural daylight availability, in spite of electrification. We aimed to investigate the environmental and genetic components of insomnia in the family-based Baependi population, using the Brazilian Portuguese version of the Insomnia Severity Index (ISI) questionnaire.

Materials and methods: Descriptive analysis was performed on data collected from the Baependi population ($n = 1,202$ for descriptive analysis and 811 for heritability and GWAS) using R software. Heritability analysis was calculated using polygenic mixed modelling. Genome-wide association analysis (GWAS) was subsequently performed on the Baependi data, in order to interrogate for associations with polymorphisms previously related with insomnia symptoms.

Results: Descriptive regression analysis categorised 7.6% of the participants as suffering from 'clinical insomnia' based on their ISI scores, with an average total score of 6.5±5.0 (SD). 7.2% of females exceeded the threshold clinical insomnia score (15/28) compared to 5.5% of males. Heritability of ISI score, based on the best-fit model adjusted for sex, age, education, and depression, was 19%. GWAS yielded four associations of genome-wide significance with single-nucleotide polymorphisms (SNP) *rs869481*, *rs62037617* and *rs3747579,* which are located in the *CORO7* gene and *rs3789038*, located on the neighbouring *HMOX2* gene on chromosome 16.

Conclusions: This is one of the first studies of ISI score distribution in a general population. The heritability value observed is consistent with previously published literature, which have used different measures of insomnia symptoms. In addition, this is the first reported GWAS analysis for ISI score, identifying the first significant genome-wide genetic associations of ISI score. Thus, this study confirms the reliability and suitability of ISI as a measure for genetic studies in population.

WHAT DO SLEEP DIARIES TELL US ABOUT PATIENTS DIAGNOSED WITH CHRONIC INSOMNIA?

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Introduction: The Sleep Diary is a very important tool that allows clinicians to assess insomnia from a patient's perspective (Edinger *et al.*, 2016) and is recommended before and during CBT-i by the AASM (Schutte-Rodin, et al., 2008). Despite its importance, the sleep diary is not widely used on research. Our aim was to analyse the sleep patterns of insomnia patients during the initial consultations at a Sleep Centre (referred to the clinical psychology somnologist), as reported by them on sleep diaries.

Materials and Methods: It was used a clinical sample of 103 participants (45.4% women; 18-85 years old, M=49.04 ± 14.14) meeting ICSD-3 and DSM-5 criteria for Chronic Insomnia Disorder, as assessed by clinical interview conducted by a sleep medicine specialist, having insomnia for 1-45 years (M=12.90±11.10), 43.7% medicated, referred to a Sleep Medicine Centre of a Central University Hospital (outpatients considered: 2015-present). Patients displaying untreated comorbid sleep disorder were excluded. Participants completed the Sleep Diary's (Morin, 1993; adapt. Pt: Clemente, 2006) as part of routine clinical assessment procedures, before starting CBT-I. Only diaries displaying complete data for a minimum of 4 nights (3 weeknights and 1 weekend night) were considered, and the analyses included a maximum of 7 nights (5 weeknights and 2 weekend nights).

Results: Mean sleep-wake patterns were later on weekends than weekdays, albeit that difference was only significant for "wake up time" and "rise time": 4 minutes for "bedtime" (23h38m±1h10m; 23h34m±1h15m; p=.301); ~22 minutes for "wake up time" (7h38m± 1h46m; 7h17m±1h33m; p< .05); and ~27 minutes for "rise time" (8h37m±1h19m; 8h09m±1h13m, p< .05). Total sleep time was 6h10m±1h30m on weekdays and 6h14m±1h24m (p=.613) on weekends, time in bed was 8h34m±1h12m on weekdays and 8h56m±1h21m on weekends (p< .05). Sleep efficiency was 71.5% on weekdays and 69.6% on weekends. In median, participants took 27 minutes to fall asleep. In mean, they awaked 2 times per night, rated their sleep as "average" in terms of quality and felt "tired" in the morning. Men's age was associated with higher number of awakenings per night (r=.328, p< .05), more time awake after sleep onset (r=.408, p< .05), earlier wake up (r= -.339, p< .05) and rise times (r= -.368, p< .05) on weekends, and lower total sleep time on weekends (r= -.321, p < .05). Women's age was correlated with weekends earlier wake up time (r= -.260, p< .05). When age's effect was controlled for, women felt less rested in the morning, slept more, awaked later on weekdays and spent more time in bed on weekends (p< .05), as compared to men. Finally, there were no significant difference between sleep medicated and non-medicated patients' sleep diaries.

Conclusions: Since chronic insomnia is a disorder characterized by subjective complaints, diary data seem of great relevance to completely portraying sleep in insomnia patients.

HOW SEVERE INSOMNIA IS (AS MEASURED BY THE INSOMNIA SEVERITY INDEX) DEPENDING ON WHETHER PATIENTS ARE USING *VERSUS* NOT USING SLEEPING MEDICATION?

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Introduction: Insomnia represents a worldwide prevalent sleep problem in adults, still remains untreated (Carney & Postner, 2016) and there is a continuous trend toward an increase in its prevalence (Kronholm et al., 2016). Although CBT-I is regarded as the first line treatment (Riemann et al.,2017),and despite ongoing concerns regarding the effects of dependence and tolerance of sleeping pills, its prescription has continued to rise over time (Bertisch et al., 2014).
The present study aimed to compare insomnia severity among medicated and non-medicated insomniac patients for sleep, previously to CBT-I.
Materials and methods: A total of 310 adult patients meeting criteria for chronic insomnia disorder (ICSD-3; DSM-5) from the Sleep Medicine Centre of CHUC were enrolled. Participants were excluded if they presented other untreated sleep disorders. This clinical sample was divided into two groups based on sleeping medication use. Group 1 ("Insomnia Medicated") comprised 178 patients taking sleep medication, 72M, 106F, mean age=50.11±13.45, and Group 2 ("Insomnia Non-medicated") comprised 132 patients who were not taking sleep medication, 70M, 62F, mean age=49.17±14.43. All participants completed the ISI (Morin, 1993), Portuguese version (Clemente et al, 2017).
Results: Group 1 obtained a significant higher ISI total score, when compared to Group 2 (M=17.97±4.25 vs. M=16.66±4.26; t=2.686; p< .01), however the magnitude of this difference was small (Cohen's d=0.308). Group 1 had significantly more difficulties falling asleep (p< .05), higher interference over daily functioning (p< .05), considered that the impairment due to sleep problem is more noticeable by others (p< .05), and showed a higher level of worry about sleep (p< .05), than Group 2. Women took significantly more sleeping medication than men (59.6% vs 40.4%; χ2=4.833; p< .05), even if there isn't a significant difference in ISI total score between gender neither in Group 1 (t$_{(176)}$=-1.586; p=.115) nor in Group 2 (t$_{(130)}$=-.455; p=.650). Besides, we did not find significant differences between young, middle-aged adults and elderly insomniacs (p=.655) regarding the use of sleeping medication and only the middle-aged patients from Group 1 showed a significant higher ISI total score (ANOVA,p< .05). Furthermore, there was a significant higher number of medicated patients with insomnia lasting more than 11 or 20 years (χ2=16.558; p< .01), but ISI total score was not significantly associated with the duration of insomnia, neither in Group 1 (ANOVA;p=.694) nor in Group 2 (ANOVA;p=.831).
Conclusions: Previously medicated patients suffering from chronic insomnia disorder have more severe symptoms than non-medicated patients evaluated by ISI. Medicated patients have more severe difficulties in falling asleep, and daytime symptoms and, moreover, express greater concern about their insomnia problem. Women with insomnia use more sleeping medication than men, although their insomnia disorder is not significantly more severe, and there seems to be no relationship between taking medication and age, based on the severity of insomnia. Since Portugal is one of the OECD countries with the highest

consumption of psychotropic substances (2017), it is urgent to reevaluate health policy and change the paradigm of treating insomnia.

ACUPRESSURE TO TREAT INSOMNIA: A SYSTEMATIC REVIEW

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Background: Insomnia is a global epidemic. International entities with ever-reaching breadth to the solitary student have examined this common, indiscriminate sleep disorder that tortures individuals and burdens society. Current standard treatment guidelines employ the use of psychological approaches and pharmacotherapies; each option carries its own risks and benefits along with not being a viable option for many. Acupressure, a form of Traditional Chinese Medicine (TCM), is non-invasive rhythmic stimulation of specific points (acupoints) that effect target organs and systems that enhance mechanical, bioelectrical, and/or biochemical signaling transmitted through the interstitial connective tissue. The biomedical model for acupressure has not yet been fully established, studies have shown the mechanism of effect includes functional peripheral and central nervous system changes, release of endorphins, and alterations in the circulation of cytokines and neurotransmitters, including serotonin.

Objectives: The purpose of this systematic review is to evaluate the effectiveness, barriers and benefits of using acupressure to treat insomnia in adults.

Methods: A literature search was performed via Simmons University Library and two databases: CINAHL and Medline using terms "Acupressure", "sleeping disorder", or "insomnia for articles written in English. Risk of bias was assessed regarding randomization, allocation sequence concealment, blinding, incomplete outcome data, selective outcome reporting, and other biases.

Results: 13 articles were included in this review consisting of eight randomized controlled trials, three quasi-experimental trials, and two systematic reviews for a total of 5009 participants all with insomnia. The trials also included a varying subcategory of interest to the researchers; these included ICU patients, pregnant women, postpartum women, menopausal women, postmenopausal women, chronic low back pain, middle-aged and elderly patients with hypertension, residents of long-term care facilities, and end stage renal disease on hemodialysis. One study specifically measured the efficacy of auricular acupressure, another measured the efficacy of reflexology. Three studies utilized a sham group, one study also measured efficacy of Pilates-based exercise as insomnia intervention. All studies utilized self-reported questionnaire for data collection; 12 of 13 studies employed the Pittsburgh sleep quality index (PSQI) questionnaire. All reviewed studies yielded a global improvement in sleep quality utilizing acupressure to treat insomnia without adverse effects. Sub-categorical data revealed reduction in systolic blood pressure, decreased pain, increased efficacy of acupressure versus Pilates based exercise.

Conclusion: Methodologic challenges and risk of bias present limitations to presented results as the majority of participants were not blinded and data collected was primarily subjective. All reviewed studies demonstrate multiple indicators that acupressure is an effective treatment of insomnia without adverse effect. Potential barriers may include concern of skin irritation, cultural belief, application and knowledge deficits. Benefits of acupressure to treat insomnia include improved sleep quality, decreased systolic blood pressure, decreased chronic low back pain, improved quality of life, reduction in economic burden.

Such compelling results warrant further research with more standardized treatment protocols, objective data measurement (actigraphy or direct observation), increased blinding to participants and researchers, and more stringent inclusion/exclusion criteria.

DO INSOMNIA PATIENTS IN INSOMNIA CLINICAL TRIALS ENDORSE DAYTIME SLEEPINESS?

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Introduction: Recent understanding regarding the pathophysiology of insomnia disorder suggests that insomnia is a problem of hyper-arousal expressed as excessive wakefulness at bedtime, hindering sleep onset, or during the nocturnal sleep period, hindering return to sleep. It is believed that the wake system is hyperactive continuously and that therefore excessive daytime sleepiness (EDS) in insomnia patients would be unlikely. This question was tested in a population of potential insomnia patients presenting for screening for 2 Phase 3 clinical trials of lemborexant, a dual orexin receptor antagonist currently under development for the treatment of insomnia and Irregular Sleep-Wake Rhythm Disorder.
Materials and methods: Individuals who believed that they would meet insomnia disorder criteria, desired to participate in the treatment studies for lemborexant (SUNRISE-1 [NCT02783729; E2006-G000-304]; SUNRISE-2 [NCT02952820; E2006-G000-303]), and who signed consent were administered a set of screening assessments (Epworth Sleepiness Scale [ESS], Insomnia Severity Index [ISI], and STOPBang) prior to confirming their insomnia diagnosis via sleep diary. The ESS comprises 8 items describing situations where patients may fall asleep inadvertently. Item scores range from 0 (would never doze) to 3 (high chance of dozing). ESS total score 0-5 indicates lower normal daytime sleepiness; 6-10, higher normal; 11-12, mild excessive; 13-15, moderate excessive; and 16-24, severe excessive. The STOPBang questionnaire identifies patients at risk for sleep-disordered breathing (SDB). An ordinal logistic regression model was used to calculate the change in odds for a unit increase in ESS total score associated with the risk levels for the STOPBang score.
Results: Across the Phase 3 studies, 5381 subjects were screened and completed the ESS. Most subjects were female (77.6%). Median (range) age was 61 (18 to 92) years. Mean ESS score was 5.78, in the normal range. Most subjects were in the low (57.8%) or high normal (25.4%) ranges, but 5.6% scored in the mild, 6.0% in the moderate, and 5.2% in the severe EDS ranges. The most common situations for which subjects reported either a moderate or high chance of dozing were "watching television" (4.2%) and "lying down to rest" (4.4%). ESS scores did not correlate with severity of insomnia, as assessed by the ISI. However, as expected, ESS scores were correlated with risk of SDB, as identified on the STOPBang. Subjects with low risk on the STOPBang were 4.6 times more likely to report lower ESS scores than subjects with high risk. Moderate risk subjects were 2.3 times more likely to have lower ESS scores than high risk subjects. Low risk subjects were twice as likely to have low ESS scores than those with moderate risk.
Conclusions: Results of these analyses suggest that a small percentage of subjects who sought treatment for insomnia in a clinical trial context endorsed excessive daytime sleepiness (16.8%), likely due to the presence of clinically significant SDB. Future clinical trials in insomnia without polysomnography may benefit from including an assessment such as the STOPBang to help exclude subjects with high likelihood of SDB.

THE ROLE OF SLEEP IN ASSESSING AND TREATING PSYCHIATRIC CONDITIONS

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Introduction: Most psychiatric disorders are associated with sleep disturbances and the relationship is often bidirectional. In addition, approximately 40% of primary insomnias are associated with a comorbid psychiatric disorder. Yet the treatment of psychiatric disorders typically does not include concurrent sleep evaluations. The reason for this is unclear but may include the lack of user-friendly sleep quality assessment tools. Here, we report an in-house sleep diary (SD) that we have employed to adequately and rapidly assess sleep quality in patients.
Materials and methods: Our self-rated sleep diary (SD) consists of 11 columns for data entries on the following:
1) Medications;
2) Date;
3) Time in bed;
4) Time fell asleep;
5) Number of times awakened;
6) Total time awake after falling asleep;
7) Time of final awakening;
8) Totally unrested to totally rested scale;
9) Time after waking before fully alert;
10) Hours asleep; and
11) Column for reporting events such as anxiety, nightmares, headaches, and pain.
Back page provides a table to list medications being taken. Each patient is instructed to complete the SD upon awakening from sleep in the morning. Time in bed and time to start the day is verified by checking the clock. The other parameters are estimated retrospectively. The collected is used to calculate the following: Sleep onset latency (SOL), wake after sleep onset (WASO), restorative and non-restorative sleep, sleep inertia and hours asleep. Sleep onset latency < 30 minutes, WASO < 30 minutes, and sleep inertia < 5 minutes and 7 hours total sleep are considered acceptable.
Results: In the past year the SD has been completed by 151 patients presenting with varied psychiatric conditions. There has been a high acceptance of 90% by patients asked to maintain SD for 7 continuous days initially and weekly subsequently, depending on their progress. The results revealed that 80-90% of participating psychiatric patients presented with moderate to severe insomnia at diagnosis of the mental disorders. As therapy proceeded the majority of patients demonstrated significant improvements in their sleep patterns (i.e., 80-90% of patients). Interestingly, improvements in sleep quality measured with the SD corresponded with significant improvements in quality of life (QOL) and clinical outcomes (i.e., 80% as measured by improvements in Montgomery-Asperg Depression Rating Scale, Generalized Anxiety Disorder, and Mood Disorder Questionnaire surveys). By contrast, psychiatric patients who failed to adhere to recommendations on behavior modifications guided by SD profiles also failed to show improvements in QOL; these patients presented with poor therapeutic outcomes. Overall, concomitant use of the SD instrument facilitated evidence-based modifications to improve sleep quality in the patients.
Conclusion: Chronic insomnia is a multifaceted and complex problem that may be associated with psychiatric, neurological, circadian rhythm, and pain disorders. The SD is an extremely simple and useful instrument which can be a valuable adjunct to assessing, treating and monitoring psychiatric conditions.

Insomnia
Board #100 : Poster session 1

THE FUTURE OF INSOMNIA THERAPY: A PROPOSITION OF IMPLEMENTATION AT SCALE

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Introduction: Epidemiological studies report up to 20% of the general population suffer from insomnia disorder in industrialized countries. Cognitive-behavioral therapy for insomnia (CBT-I) is the current first-line treatment for insomnia disorder, recommended by all international therapeutic guidelines. Digital versions of CBT-I have been developed and validated to address the need for implementation at scale. Nevertheless, digital CBT-I programs suffer from poor compliance and engagement, partly due to the challenges involved with following the recommended practices (e.g., daily self-report sleep diaries, sleep restriction) and the lack of personal support and encouragement. Therefore, the aim of this open-label, uncontrolled Real-World Study (RWS) was to assess the engagement and efficacy of a next-generation CBT-I 6-weeks program (Dreem Insomnia Therapy Program), including: i) personalized feedback and daily content presented by a mobile app based on the objective data measured by a reduced-montage ambulatory PSG device (rmPSG) (the Dreem headband) and, ii) relaxation and sleep induction techniques.

Materials and methods: 849 subjects were included in the analysis between Nov 11th, 2018 and April, 15th 2019. The main inclusion criteria were suprathreshold insomnia symptoms (Insomnia Severity Index; ISI ≥ 15), and completion of at least one week of the Dreem program. The primary outcome was the engagement calculated at week 4 and the secondary outcomes were i) the change in ISI score, ii) the change in wake after sleep onset (rmPSG-WASO, n = 84) time and iii) the change in objective number of awakenings (rmPSG-Awakenings, n = 84) between baseline (i.e. during the screening period of 1 week) and the end of the program (i.e. Week 6)

Results: The retention during this RWS was 70.7% (Pre: n = 849 and Week 4: n = 600). The program led to a clinically significant decrease of 7.48 points on the ISI (baseline: 19.06 ± 2.8; post-intervention: 11.58 ± 5.19, $p < 0.001$). The rmPSG-WASO was reduced by 19% (baseline: 35.6 ± 31.71 min; post-intervention: 28.8 ± 24.2 min, $p < 0.01$),and rmPSG-Awakenings were reduced by 8.5% (baseline: 5.27 ± 2.8; post-intervention: 4.82 ± 2.94, $p < 0.05$).

Conclusion: The results of this Real Word Study suggest that the Dreem Insomnia therapy program has a high engagement compared to other digital CBT-I programs and is as efficacious as traditional in-person CBT-I. This new generation of Insomnia therapy combining hardware and software serves as an efficient and engaging treatment implementable at scale.

Insomnia
Board #101 : Poster session 1
THE ROLE OF HYPERACTIVATION, STRESS AND HOT FLASHES IN INSOMNIA AMONGST MENOPAUSAL WOMEN

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Introduction: The incidence of insomnia increases during menopause. Biological (e.g. sex and age) and psychological factors (e.g. stress and hyperactivation) may contribute to this increased incidence. Additionally, vasomotor features specific to menopause, such as hot flashes, need to be taken into account for understanding insomnia in the context of menopause. This study aimed to explore the relationship between stress, activation and hot flashes in women with insomnia during the menopausal transition.

Methods: Participants were 63 peri and postmenopausal women aged between 45 and 55 years-old (Mean age = 51.32). They were grouped in one of three conditions: good sleepers (n = 20), with premorbid (n = 21) or recent onset insomnia (n = 22). Women with insomnia met DSM-5 criteria for insomnia disorder. The onset of their insomnia had to either precede by at least three years (premorbid insomnia duration = 17 years) or coincided with their perimenopausal transition (recent onset duration = 2.5 years). Participants completed a daily sleep and hot flash diary, as well as activation (Pre-Sleep Arousal Scale) and stress (Daily Stress Inventory) questionnaires during one week. They wore an actigraph 24-hour per day during the same week. Repeated measures analyses of variance (mixed models) were performed on sleep parameters (SOL, WASO, TST, SE) derived from the diary and actigraphy, and on activation (somatic, cognitive), stress (frequency, incidence), and frequency of hot flashes variables.

Results: There was no significant Time or Group X Time interaction effects on any variables. Significant group effects were obtained on diary SOL ($p < 0.001$), WASO ($p = 0.002$) and SE ($p = 0.002$), as well as on actigraphy-measured SOL ($p = 0.006$) and SE ($p = 0.001$). Group differences on diary data were observed between women with insomnia (premorbid and recent onset) and good sleepers (p < 0,001), but not between the two insomnia groups. Significant effects on actigraphy data were found between women with recent onset insomnia and good sleepers, as well as between the two groups with insomnia ($p = 0.001$ and $p = 0.018$, respectively). The two groups with insomnia also reported a greater impact of daily stress ($p = 0.015$), more somatic ($p = 0.004$) and cognitive activation ($p = 0.009$), and higher frequency of light ($p = 0.001$) and moderate ($p = 0.004$) hot flashes at night than good sleepers. There was no significant difference on activation, stress and hot flashes between women with premorbid and recent onset insomnia.

Conclusion: Women with menopausal insomnia reported higher perceived stress, greater somatic and cognitive activation at bedtime, and more hot flashes compared to aged-matched good sleepers. The relative onset of insomnia (before or during menopausal transition) did not affect the severity of sleep disturbances or the degree of reported daily stress or bedtime activation. Further studies are needed to investigate the mechanisms of insomnia during menopause in order to improve management of this sleep disorder during menopause.

EFFECTS OF BENZODIAZEPINE USE IN CHRONIC INSOMNIA ON COGNITIVE FUNCTION AND EEG

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Introduction: Chronic insomniacs worry about their cognitive decline due to long-time use of benzodiazepines, but an association between benzodiazepine use and cognitive decline in insomnia patients has been conflicting. The aim of this study was to explore whether long-term exposure of benzodiazepine would be associated with changes of cognition and electroencephalography (EEG) in chronic insomnia.

Materials and methods: Information of demographic characteristics, sleep- or mood-related questionnaires such as Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), and Beck depression inventory (BDI), neurocognitive function tests and quantitative EEG in wake state were obtained. Excluding 24 subjects whose BDI ≥ 20 or AHI ≥ 20 or EEG with artifacts, participants in final analyses were divided into three groups: insomniacs with chronic benzodiazepine use (n=29), drug-naïve insomniacs (n=27), and age- and sex-matched controls (n=28).

Results: Insomniacs with benzodiazepine use showed less severe symptom of insomnia compared to drug-free insomniacs (ISI=11.66±7.13 vs 18.11±5.13, p< 0.001). In neurocognitive function test insomniacs with benzodiazepine use showed decreased executive function in trail making test A (0.73±0.66 vs 1.27±0.38 vs 1.09±0.47, p< 0.001) than drug-free insomniacs and controls and in categorical fluency (-0.01±0.99 vs 1.26±0.97 vs 0.77±1.08, p=0.016) than drug-free insomniacs after adjusting BDI, ESS and exposure of other medication. In spectral analysis, insomniacs with benzodiazepine use showed low relative theta power and high relative beta power in frontal region than controls. Drug-free insomniacs showed low relative theta power in frontal, parietal, and occipital regions than controls.

Conclusions: Benzodiazepine users with chronic insomnia did not show no decline of memory function but showed impairment of executive function compared to drug-free insomniacs and controls. The EEG of chronic insomniacs showed hyperarousal manifestation regardless of benzodiazepine exposure compared to controls. However, benzodiazepine was effective in decreasing the severity of insomnia symptom. Thus, clinicians should take into consideration advantages and disadvantages of using benzodiazepines for insomnia treatment.

TOWARDS AN INTEGRATIVE DESIGN-ORIENTED THEORY OF SLEEP-ONSET AND INSOMNOLENCE FROM WHICH A NEW COGNITIVE TREATMENT FOR INSOMNOLENCE (SERIAL DIVERSE KINESTHETIC IMAGINING, A FORM OF COGNITIVE SHUFFLING) IS PROPOSED FOR EXPERIMENTALLY TESTING THIS AGAINST ALTERNATIVES

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We present progress towards an integrative design-oriented (IDO) theory of sleep onset and insomnolence: the somnolent information-processing theory (SIPt; Beaudoin, 2013, 2014). We define "insomnolence" as difficulty falling (back) asleep — a key feature of insomnia (DSM-V).

We argue that theories of human sleep onset and propensity require an IDO approach. By "design-oriented" we mean adopting the design stance (Dennett, 1982; Poggio, 2012; McCarthy, 2008) which is universally known in theoretical Artificial Intelligence and cognitive science but unused in theories of sleep onset and insomnolence, SIPt aside. Like other cognitive science, IDO involves interdisciplinary information-processing theories; but it is also integrative, aiming to specify how requirements of autonomous agency (competence) are realized by the interaction of diverse component processes (subsuming motivational, cognitive, executive and ancillary functions). The IDO approach requires that any appeal to key psychological constructs ("consciousness", "arousal", "emotion", "attention", "goals", "intention", etc.) be grounded in specific IDO theories. This approach is meant to contribute to a paradigm shift in research in insomnia, "emotion" and psychology more generally, in response to what Beaudoin, Hyniewska & Hudlicka (2017) and Muthukrishna & Henrich (2019) identified as the root of psychology´s replication crisis: lack of rigorous, ambitious, progressive, evolutionarily grounded theoretical integration. We claim control of human somnolence posed a significant evolutionary challenge particularly due to their abundant cortex.

Leading theories of insomnia tend to explain insomnolence in terms of cognitive and/or physiological activity (Perlis, 2011) or "arousal" (Harvey, 2005). Cognitive theories of insomnia assume that attention, intention and effort to sleep are insomnolent (e.g., inhibiting "de-arousal", Espie, 2006). Rejecting these assumptions, we argue that arousal is a problematically polymorphic concept unsuitable for IDO explanations of somnolence.

In contrast, SIPt grounds its major concepts in specific IDO theories. In accordance with Moors´ (2017) skepticism, SIPt replaces "emotion" with computational architectures of motivation. More precisely, we leverage the H-CogAff (Sloman, 2003) and LIDA (Franklin et al, 2013) architectures. We replace the concept of "emotion" and "arousal" with IDO concepts of perturbance and alarms. Perturbance is an emergent state in which an insistent motivator tends to control executive functions (Beaudoin, 1994; Wright, Sloman & Beaudoin, 1996). Perturbance is theoretical grounding for repetitive thought (Watkins, 2008). Alarms (Oatley, 1992; Sloman, 2003; Baars & Franklin, 2009) are urgent global control signals which, we claim, also underlie the alarm reaction (Selye 1936).

SIPt postulates that (1) chronobiological processes (Borbély, 2016) are the principal contributors to somnolence; (2) sleep-onset-like information-processing is pro-somnolent (increases sleep propensity); (3) perturbance is insomnolent; (4) alarms are insomnolent; (5) some perceptual states affect sleep propensity: sensing supineness, rocking (Bayer et al, 2011) or skin temperature, Romeijn et al (2011).

We describe an effortful form of cognitive shuffling, serial diverse kinesthetic imagining (SDKI). It is suitable for an experiment pitting SIPt against other theories (eg, Espie, 2006

and Havey, 2005) since only according to SIPt should SDKI be both counter-insomnolent (per postulates 3 and 4) and pro-somnolent (per postulates 2 and 5).
Yet more theoretical work is required towards an IDO theory of somnolence.

PRE-SLEEP COGNITIVE ACTIVITY IN ADULTS: A SYSTEMATIC REVIEW

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Introduction: Cognitive activity during the pre-sleep period has long been hypothesized to be a critical determinant for insomnia. Unfortunately, there is no comprehensive review of the literature on this topic. The present study aims to fill this gap in the literature. More precisely, this systematic review focuses on three themes: 1) the nature of pre-sleep cognitive activity in good sleepers and individuals with insomnia, 2) the links between measures of pre-sleep cognitive activity and sleep onset latency (SOL) or insomnia, and 3) the effect of manipulating pre-sleep cognitive activity on SOL or insomnia.

Materials and Methods: For each theme, a systematic search was conducted in PsycInfo. In total, 1730 articles were sorted. The sorting processed comprised four steps. In step-1, two authors independently sorted the documents based on the titles and abstracts. In step-2, all disagreements resulting from step-1 were resolved by mean of consensus between the two authors and the main author. In step-3, the two authors independently sorted the remaining documents after reading them in full. In step-4, all disagreements resulting from step-3 were, again, resolved by mean of consensus.

Results: Regarding the first theme, mentation reports have been collected in a sleep laboratory, with an ambulatory monitoring device, or using a voice-activated tape-recorder. Normal transition to sleep is characterized by sensorial imagery, inhibition of higher cognitive processes, hallucinations, and changes in agency. Moreover, pre-sleep thoughts in individuals with insomnia frequently relate to planning or problem-solving, and are more unpleasant than in good sleepers. Regarding the second theme, ten questionnaires and three interviews were identified. Insomnia is associated with more thoughts interfering with sleep, counterfactual processing, worries, maladaptive thought control strategies, covert monitoring, and cognitive arousal. Regarding the third theme, several strategies have been tested: mental imagery, hypnosis, paradoxical intention, articulatory suppression, ordinary suppression, and distraction. Their effect on sleep onset is either beneficial, negligible, or detrimental.

Conclusions: In conclusion, our understanding of the links between pre-sleep cognitive activity and insomnia might be improved based on new psychological theories explaining normal sleep onset. Such theories would help in interpreting available data, in developing new measures of pre-sleep cognitive activity, and in creating novel treatment strategies.

Acknowledgements: None.

DAILY TASK PERFORMANCE IN INSOMNIA DISORDER: THE NEGATIVE AFFECT OF SLEEP AND INCLUSION OF EFFORT AS A COMPENSATORY MECHANISM

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Introduction: Insomnia diagnoses are contingent upon reports of deficits in daytime functioning, but the present literature is very limited in its exploration of the consequences of symptoms - like the poor sleep - on 'everyday' activities. Furthermore, although it is assumed that poor sleep is followed by poor daytime functioning; only a minority of measures allow insomnia sufferers to report that relationship. The scope of this current investigation was to examine how specific activity types are affected by poor sleep reports in insomnia disorder, and what degree of compensation - in this case, additional effort - can be deployed to participate in everyday tasks.

Materials and methods: This pilot study included forty-one individuals (22 insomnia patients, 15= female, age M= 49.91, SD= 17.59 years; 19 good sleepers, 14= female, age M= 31, SD= 8.9 years). From 12-options, including tasks like work, self-care, and leisure, participants indicated: (a) what they completed that day, (b) how much their sleep negatively affected their ability to participate in each task, and (c) how much effort it took to participate in each task, via a daily-diary for two-weeks. Both (b) and (c) included ratings from 0-4 with greater numbers indicating a larger affects/effort.

Results: Overall, mean task participation was equal between groups with the exception of 'attending school/studying' (item 6), on which good sleepers reported spending a greater proportion of their time over 14-days (insomnia = 11%, good sleeper = 43%, t= (37) -3.006, p=.005, d=.96). The relationship between the tasks and the negative affect of sleep was generally aligned to effort for both groups. The insomnia group reported their sleep negatively affected their participation in tasks more so than the good sleeper group (p = .000-.016, d =0.40-2.23). But, failed to report more effort than good sleepers for several tasks including 'exercising' (item 1); 'completing health tasks' (item 3); and 'eating meals as usual'. On effort, paired sample t-tests demonstrated that for both groups, some tasks required much less effort than others. For example, 'Completed health tasks' (item 3), was amongst those that required the least effort to participate in (insomnia M= 0.75, SD= 0.56; good sleeper M= 0.52, SD= 0.91). Whilst the 'working/volunteering' (item 5) was amongst those that required the most (insomnia M= 2.21, SD=0.79; good sleeper M=1.46, SD=1.15).

Conclusions: Based on this data, we can begin to understand parts of the insomnia sufferers' day that they are finding more challenging than other - even more so than individuals who have good sleep. Amongst our sample, these features are subject to a great deal of variation, so it may be possible to determine specific features of insomnia 'types' in future studies with larger data pools. Additionally - once standardised - these performance indicators may be useful for providing benchmarks to be used in conjunction with cognitive and behavioural therapies for insomnia.

Insomnia
Board #129 : Poster session 3
EVALUATION OF A NOVEL TASK PARTICIPATION DIARY AS A METRIC FOR DAYTIME FUNCTIONING IN THE INSOMNIA POPULATION

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Introduction: Insomnia diagnoses are contingent upon reports of deficits in daytime functioning, but the present literature is very limited in its exploration of the consequences of symptoms - like the poor sleep reports - on 'everyday' activities. Furthermore, although it is assumed that poor sleep is followed by poor daytime functioning; only a minority of measures allow insomnia sufferers to indicate that relationship. Whilst no tools to the authors' knowledge also allow individuals to report any compensatory mechanisms they might use to overcome these negative impacts of poor sleep. To address this, the current investigation measured sleep impact, and effort to complete general tasks.

Materials and methods: This pilot study included forty-one individuals (22 insomnia patients, 15= female, age M= 49.91, SD= 17.59 years; 19 good sleepers, 14= female, age M= 31, SD= 8.9 years). From 12-options, including tasks like work, self-care, and leisure, participants indicated: (a) what they completed that day, (b) how much their sleep negatively affected their ability to participate in each task, and (c) how much effort it took to participate in each task, via a daily-diary for two-weeks.

Results: Overall, results demonstrated that insomnia patients performed fewer activities on average $t=$ (39) -2.111, p=.041, d=.65) than good sleepers (M= 7.49, SD=1.35, vs. M=8.40, SD=1.43). Of the individual tasks, there was only one item that differed significantly between groups (item 6 'attended school/studied': $t=$ (37) -3.006, p=.005, d=.96) reflecting that more of the younger group were university students. To address this 'occupational' difference, secondary analyses excluded item 6 of the diary and subsequently showed the insomnia (M=7.43, SD=1.36) and good sleeper (M=7.97, SD=1.40) groups performed a comparable number of tasks $t=$ (39) -1.232, p=.226, d=.39). Additionally, the perceived negative impact of sleep remained significantly greater $t=$ (26.99) 6.308, p= .000, d=1.91) in the insomnia group (M=1.54, SD=.93) than the good sleeper group (M=.21, SD=.33). As did the reports of effort in carrying out these tasks in the insomnia group $t=$ (39) 3.659, p=.001, d=1.14) (insomnia M=1.56, SD=.63, good sleeper M=.77, SD=.75).

Conclusions: These results indicate that individuals with insomnia attempt the same number of activities across the day (after compensating for occupational differences), but they report more negative impact on those activities and more effort required perhaps in trying to overcome those negative impacts. For now, future investigations using more comparable populations are required to ensure the validity of this tool. Following validation of this diary, it could be used to inform both researchers and clinicians of individual patient needs and concerns, and also provide specific benchmarks on which to base treatment efficacy.

THE ICSD-3/DSM-5 DIAGNOSTIC CRITERIA FOR INSOMNIA REINFORCE THE ASSOCIATION BETWEEN INSOMNIA, ANXIETY AND DEPRESSION

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Introduction: The diagnostic criteria for insomnia were changed in ICSD-3 (International Classification of Sleep Disorders, third edition) and DSM-5 (Diagnostic Statistical Manual of Mental Disorders classification version 5). One main change was that patients exclusively presenting with non-restorative sleep no longer qualified for the diagnosis. In the present study we wanted to examine what effect this change in the diagnostic criteria had on the association between insomnia, anxiety and depression.

Materials and methods: The study is based on a large and comprehensive sleep survey available on the website of the Norwegian Competence Center for Sleep Disorders (www.sovno.no). The survey opened in 2012, and our data was collected in June 2016. Validated questionnaires, Bergen Insomnia Scale and Hospital Anxiety and Depression Scale (HADS), were used to set the diagnoses insomnia, anxiety and depression.

Results: A total of 48,932 participants fulfilled the criteria for insomnia based on ICSD-2/DSM-IV. Of these, 87.6% met the criteria for insomnia based on ICSD-3/DSM-5; the remaining 12.4% did not meet the new criteria (these participants reported non-restorative sleep). The prevalence of possible anxiety (HADS-A ≥ 8) among participants who met the newer criteria was 62.9%, while the prevalence of possible depression (HADS-D ≥ 8) was 38.1%. Among participants who did not meet the newer criteria, the prevalence of possible anxiety (48.1%) and possible depression (30.4%) was significantly lower ($p < 0.001$ for both).

Conclusions: The present study showed that the newer ICSD-3/DSM-5 diagnostic criteria for insomnia reinforced the association between insomnia, anxiety and depression. This implies that a larger proportion of patients with insomnia will have comorbid anxiety and depression with the ICSD-3/DSM-5 diagnostic criteria as compared with the older diagnostic criteria.

CONQUERING INSOMNIA: COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I) -WORKSHOP FOR COMMUNITY MENTAL HEALTH CARE PROVIDERS

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Insomnia affects 15-33% of the population with even higher prevalence rates in the elderly and clinical populations. CBT-I (Cognitive Behavioral Therapy for Insomnia) is considered the first-line treatment for chronic insomnia due to its superior long-term efficacy, lack of side effects, and patient preference compared to sedative-hypnotics, which are associated with significant side effects and risks. CBT-I also doubles the improvement rates of depression compared to antidepressant medication alone in depressed patients with insomnia. It improves other co-morbidities including pain and fibromyalgia, substance abuse, and PTSD. There is a shortage of clinicians trained to deliver this highly effective treatment.

A half-day workshop (didactic presentation, case-examples and video demonstration) was designed for CMH providers to provide education about CBT-I.

The workshop was evaluated through a satisfaction evaluation questionnaire and a pre-/post-workshop knowledge questionnaire.

87.5% of participants were satisfied with the workshop and 96.4 % of respondents agreed that the workshop was relevant to their work. After the workshop, learners showed increased self-perceived confidence in CBT-I related knowledge including the components and assessment of sleep hygiene. Additionally, their self-perceived confidence in ability to implement CBT-I in their practice improved.

Conclusion/ Limitations: A brief interactional workshop can increase providers' self-perceived knowledge and comfort with using CBT-I strategies in patient care.

Longitudinal instruction with higher-level evaluation is needed for more meaningful impact on practice changes and clinical outcomes.

SLEEP DISTURBANCES IN YOUNG ADULTS WITH A HISTORY OF CHILDHOOD TRAUMATIC BRAIN INJURY: RELATIONSHIP WITH FATIGUE, DEPRESSION, AND QUALITY OF LIFE

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Introduction: Sleep disturbances are highly prevalent in survivors of childhood traumatic brain injury (TBI), with evidence of persistent sleep problems presented until adolescence; while outcomes in adulthood remain unexplored. This study aimed to evaluate sleep, fatigue, depression, and quality of life (QoL) outcomes in young adults who sustained TBI in childhood and assess the relationships among these outcome variables.

Materials and Methods: We recruited 54 young adults with mild ($n = 14$), moderate ($n = 27$), and severe ($n = 13$) TBI, and 13 typically developing control (TDC) participants as part of a 20-year follow-up of a longitudinal prospective study. Sleep was assessed subjectively with the Pittsburgh Sleep Quality Index, and objectively using actigraphy sleep efficiency.

Results: At 20 years postinjury, differences in subjective sleep quality between the TBI and TDC group ($p = .0500$, $r = -.24$), and among the TBI severity groups ($p = .058$) approached statistical significance. Participants with mild ($p = .054$, $r = -.37$) and moderate ($p = .025$, $r = -.35$) TBI reported poorer subjective sleep quality compared to those with severe TBI; both with medium-to-high effect sizes. Despite being relatively prevalent in TBI, objective sleep disturbance, fatigue, depression, and QoL outcomes were not significantly different between TBI and TDC groups. Poorer subjective sleep quality significantly increased symptoms of fatigue and depression, and reduced general health, while objective sleep was not significantly associated with these variables.

Conclusions: These findings indicate that some young adults with TBI presented with sleep disturbances, fatigue, depression, and poor general health; with subjective sleep quality significantly impacting on these latter outcomes. More studies are needed to provide evidence-base for the potential use of sleep interventions in this TBI population.

Acknowledgements: We thank our collaborators from the Sleep Research Laboratory, Melbourne School of Psychological Sciences, University of Melbourne. We also thank all families and participants for their dedication to this study and generous participation in this follow-up.

Insomnia
Board #106 : Poster session 1

HAND SELF-SHIATSU TO PROMOTE SLEEP FOLLOWING SPORT-RELATED CONCUSSION IN YOUNG ATHLETES

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Introduction: Sport-related concussion (SRC) is prevalent and has numerous serious physical and emotional consequences. Although literature demonstrates sleep deficiency is a frequent negative consequence of SRC, minimal research has been conducted exploring non-pharmacological interventions to improve sleep post-SRC. A 2014 study of chronic pain patients who learned to apply the complementary and alternative medicine (CAM) intervention hand self-Shiatsu (HSS) had promising, sleep-promoting results [1] and we hypothesized that HSS warrants further investigation with young athletes reporting sleep problems post-concussion. Specifically, a proof of concept study was conducted to explore the feasibility of HSS as an intervention to promote sleep onset and continuity for young adults with SRC.

Materials and methods: Using a prospective case-series design participants acted as their own controls. Young athletes with self-reported sleep problems post-concussion were recruited through University and community sports organizations. Baseline and follow-up data (at 4 and 8 weeks) included standardized self-reported assessment tools and sleep actigraphy.

Results: There were seven participants, involved in diverse sports, ranging in age from 18 to 25 years. The study was underpowered to draw definitive conclusion and statistically significant improvement in actigraphy sleep scores between baseline and follow-up was not achieved. However, metrics for sleep quality and daytime fatigue showed significant improvement and participants rated the acceptability and feasibility of HSS positively.

Conclusions: These findings suggest that HSS may have the potential to improve sleep and reduce daytime fatigue in young post-concussion athletes. This pilot study allows for refinement of the research protocols upon which to build further, large-sample, controlled studies [2].

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GONE TO THE DOGS: PET DOGS IN THE SLEEP ENVIRONMENT OF PATIENTS WITH CHRONIC PAIN

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Introduction: The prevalence of chronic pain is high in many industrialized nations. Pain takes a significant toll on personal physical and mental well-being, as well as exerting very high costs to families, employers and society in general. Encouragingly, research shows that pain and sleep have a reciprocal nature, thus suggesting that interventions to improve sleep may decrease pain symptoms. To-date, we know little about how owning a pet dog may influence the pain/sleep relationship. Typical advice to remove pets from the bedroom negates the possible positive benefit of human-animal co-sleeping and a more nuanced examination is warranted. **Aim:** To investigate pain patients' perception about the impact of their pet dog on sleep.

Materials and methods: A content analysis of interview data was conducted to explore patients' perception about the impact of the pet dog on sleep. The qualitative dataset was extracted from a subgroup of participants in a larger study focused on the pain patient/pet dog relationship [1]. The subgroup was asked, "Does your dog have a positive or negative impact on your sleep?" Using an iterative approach, the data were thematically coded.

Results: Theme codes included: companionship; physical presence/'cuddles'; routine/schedule; distraction from anxiety/worry at night; reassuring/protective presence; active intervention to keep participant safe; daytime activity to promote sleeping at night; and reciprocal concern for the sleep of the pet dog.

Conclusions: Pet dogs may play important roles in helping some chronic pain patients achieve better quality sleep. Routine advice to remove the dog to improved sleep could be counter-productive and more nuanced and contextualized recommendations should be developed [2].

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Insomnia
Board #131 : Poster session 3

TRAUMA AS AN INSOMNIA PRECIPITATING EVENT AMONG WOMEN VETERANS

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Introduction: Women Veterans experience high rates of trauma and stressful life events, which are predictive of insomnia. Little is known about how the type of event (i.e., traumatic or other stressful event) impacts sleep disturbance. The aims of the current analyses were to:
1) describe the traumatic and nontraumatic events that women Veterans link with insomnia symptom onset,
2) examine differences in sleep characteristics among women Veterans who identified traumatic, nontraumatic, or no insomnia precipitating events, and
3) examine differences in posttraumatic stress disorder (PTSD) and depression symptoms among women Veterans who identified traumatic, nontraumatic, and no insomnia precipitating events.

Materials and methods: Baseline data were collected from 347 women Veterans, who were enrolled in a behavioral sleep intervention trial (mean age = 47, SD=13). Participants completed the Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Disturbing Dream and Nightmare Severity Index (DDNSI), Patient Health Questionnaire-9 (PHQ-9; measure of depression), and PTSD Checklist-5 (PCL-5). Sleep efficiency (SE) was assessed subjectively by sleep diary and objectively by wrist actigraphy over one week. Participants responded to 2 open-ended questions assessing stressful life events and health changes that coincided with insomnia symptom onset. Responses were coded as traumatic (i.e., PTSD criterion A events), nontraumatic, and no events. Analyses of covariance were performed to examine the effect of insomnia precipitating event type on sleep and psychological distress variables, after controlling for sociodemographic factors.

Results: Mean duration of insomnia symptoms was 16 (SD=12) years. Overall, 66% of participants endorsed only nontraumatic events, 26% endorsed traumatic events, and 8% endorsed no events. The most commonly reported nontraumatic events were interpersonal events, military-related events, and health-related events. The most commonly reported traumatic events were life threatening injury/illness and sexual assault. Participants who endorsed traumatic events reported more severe insomnia (p=0.003), PTSD (p=0.001), and depression symptoms (p=0.012), and poorer quality of sleep (p=0.042) than participants who endorsed no events. Participants who endorsed traumatic events reported more severe PTSD symptoms (p=0.004), a longer duration of sleep problems (p=0.001), and poorer quality of sleep (p=0.039) than participants who endorsed nontraumatic events. Participants who endorsed nontraumatic events reported more serve insomnia (p=0.029) and PTSD symptoms (p=0.049) than participants who endorsed no events. No other significant group differences were observed.

Conclusions: Most women Veterans identified events that coincided with insomnia symptom onset, and one quarter described a traumatic event. Those who endorsed traumatic events experienced greater sleep disturbance and psychological distress across measures. Trauma as a precipitant for insomnia may be related to higher symptom severity. Implications for treatment engagement and effectiveness remain unstudied.

Insomnia
Board #107 : Poster session 1
GLOBUS PALLIDUS A NOVEL DBS TARGET TO TREAT INSOMNIA IN A HUMAN SUBJECT

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Introduction: Therapy for Sleep disorders in patients with Parkinson´s disease (PD) remains challenging. While CBT and the use of hypnotic drugs remain the pillars of insomnia therapy, the latter is plagued by short and long term problems including dependency, gait problems, and cognitive side effects in the elderly.
We describe the first case of a human subject with chronic severe insomnia (SI), partially responsive to hypnotics. The patient was slated to receive standard DBS of GPi for Parkinson´s disease, with additional DBS of GPe for the relief of SI.
Materials and methods: The formal assessment included validated measures including Parkinson´s disease sleep scale (PDSS) and Insomnia severity index (ISI). The postoperative assessments were done every month. Sleep architecture was compared by Polysomnography conducted pre and post DBS implantation at 2 and 4 months follow up.
Results: Favorable response at 4 weeks after DBS implantation was noted, with the patient relapsing rapidly after device was blindly turned off. The postoperative ISI & PDSS scores and polysomnography (PSG) parameters, improved at 1 month. PSG documented Sleep efficiency post-DBS-implantation was of 72.3% compared to pre-DBS-implantation of 29.7%.There were no hardware-related complications over follow-up period. The patient did not required hypnotics anymore.
Conclusions: This is the first documented case of a neuromodulatory device (DBS) for the relief of insomnia in a human subject. DBS appeared to have stimulated sleep mechanisms resulting in effective control of severe insomnia in a patient with Parkinson´s disease. This report supports further investigation of the utility of DBS for treating insomnia in PD, where other options are not successful.
Acknowledgements: Chris Potter CRT, RPSGT, RST, Mayo Clinic Florida Sleep Center

EVALUATION OF THE EFFICACY OF EMAIL-DELIVERED VS FACE-TO-FACE GROUP COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN YOUTHS: A RANDOMIZED WAIT-LIST CONTROLLED TRIAL

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Introduction: Insomnia is one of the most prevalent sleep disorders and often preceds development of mental health problems. It may also lead to significant personal distress, impaired daytime functioning and increased societal burden. While cognitive behavioral therapy for insomnia (CBT-I) is recognized as a first-line treatment for adult insomnia, there has been limited research on CBT-I in youths. The current study aimed to compare the efficacy of face-to-face group (FG) and email-delivered self-help (ESH) CBT-I to wait-list control (WL) in youths.

Materials and Methods: This study was a randomized, assessor blind, parallel controlled trial. Youths (aged 12-24 yrs) who met DSM-5 criteria for insomnia were randomized to one of three groups (FG, ESH, and WL). Both treatment programs consisted of 8 sessions delivered either in a group or via emails. Participants were assessed at baseline and one week after the intervention/at week 9. The two treatment groups were additionally assessed at one month follow-up. Treatment effects were examined and compared using linear mixed models.

Results: A total of 135 youths (mean age: 20.0±2.5 years, male: 34.5%) were randomly assigned to FG (N=45), ESH (N=45) and WL (N=45) condition. Overall drop-out rate was 23%, with a higher rate in the email group (ESH vs FG vs WL: 37.8%, 12.2%, 20%, p = 0.01). At post-treatment, both active treatment groups showed a significant improvement of insomnia symptoms as assessed by Insomnia Severity Index (ISI) (FG: β = -0.9, p < 0.05; ESH: : β = -0.7, p < 0.05), better sleep quality as assessed by Pittsburgh Sleep Quality Index (FG: : β = -1.09, p < 0.001; ESH : β = -1.0, p < 0.05), less pre-sleep-arousal (FG: : β = -1.10, p < 0.001; ESH: : β = -0.98, p < 0.001) and less fatigue (FG: : β = -0.90, p < 0.05; ET: : β = -1.23, p < 0.001). Clinician-rated depression score (HAM-D) was also significantly reduced in the treatment groups (FG: : β = -0.97, p < 0.001; ESH: : β = -0.56, p < 0.05), while the improvement of self-reported depressive symptoms was only observed in the email group (ESH: : β = - 0.59, p < 0.05), but not FG (β = -0.23, p > 0.05), compared to WL. Comparison between the two treatment groups showed that FG outperformed ESH in improving maladaptive sleep-related beliefs (as assessed by dysfunctional beliefs and attitudes about sleep, DBAS) at post-1-week follow up (β =0.78, p < 0.05).

Conclusions: Our findings suggest that both group-based and self-help CBT-I resulted in improved insomnia symptoms, sleep quality and other functional outcomes in youth. The relatively comparable effects between the treatment groups suggested that self-help CBT-I is an acceptable and feasible alternative treatment option for young people, particularly when face-to-face treatment is not available. However, the higher dropout rate of the self-help email group underscored the need of additional support to enhance treatment engagement and adherence in order to maximize the effect of this alternative treatment approach.

CAN WE PREVENT INSOMNIA?A BRIEF COGNITIVE BEHAVIORAL THERAPY IN AT-RISK ADOLESCENTS

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Introduction: Adolescence is a transitional period characterized by substantial changes in physiological, cognitive and neuropsychological functioning, making adolescents liable to sleep and mental problems. Insomnia, which often precedes the development of psychiatric illnesses such as depression and anxiety is a prevalent chronic sleep problem amongst adolescents. There is robust evidence to support familial and genetic influence as an important risk factor predisposing adolescents to the development of insomnia. This study aimed to examine whether a brief cognitive behavioral therapy for insomnia (CBT-I) could prevent the future development of insomnia in at-risk adolescents.

Materials and methods: Adolescents (aged 12-18 years) with a family history of insomnia and currently experiencing sub-threshold insomnia symptoms (< 3 times/week but at least once per month) were randomly allocated to an intervention group who received four weekly, group-based CBT-I prevention or a non-active control group. Assessments were conducted at baseline, 2-week, 6-month and 12-month after the intervention. The primary outcomes were the incidence rate of insomnia ascertained by clinical interview and the severity of insomnia symptoms as measured by Insomnia Severity Index. The trial was registered with the Chinese Clinical Trial Registry (ChiCTR-IPC-15005966).

Results: A total of 242 adolescents (mean age: 14.9±1.76 years, male: 43.4%) were randomly assigned to intervention (n =121) or control group (n = 121), and 94% (n=114) of the former completed at least 3 out of 4 sessions. 218 (90.1%), 219 (90.5%) and 206 (85.1%) adolescents attended the 2-week, 6- month and 12-month post-intervention assessment. We found lower incidence of insomnia (including both acute and chronic) in the intervention group over 12-month follow up compared with the control group (6.3% vs 21.2%; Breslow generalized Wilcoxon $\chi2 = 10.16$, df = 1, p = 0.001). Linear mixed model revealed a significant improvement observed in the intervention group as compared to control group on insomnia symptoms (F= 3.20; p = 0.024) at 2 weeks post intervention and the improvements were maintained at 6- and 12-month follow up. There were also improvement in vulnerability to stress-related insomnia (F = 3.77; p = 0.012), dysfunctional beliefs towards sleep (F = 2.68, p =0.048), and daytime sleepiness (F = 2.77, P = 0.043) at post intervention when compared to the control group.

Conclusions: To our knowledge, this study provides novel evidence that a brief CBT-I programme is effective in preventing the future onset of insomnia and can improve the associated vulnerability factors and functional outcomes in at-risk adolescents. The findings suggest that a brief CBT-I programme may have the potential to reduce the burden associated with insomnia in young people and provide the empirical base for such a programme as a promising prevention initiative at school-level.

EVALUATION OF BEHAVIORAL INSOMNIA TREATMENT IN SHARED MEDICAL VISIT SETTING FOR MIGRAINEURS WITH COMORBID INSOMNIA: APPLICATION OF THE RE-AIM FRAMEWORK

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Introduction: Migraine is a common and disabling condition with worldwide societal burden ranking fifth to eighth in causing disability. Insomnia is prevalent in migraineurs. The relationship between sleep and pain is bidirectional and targeting sleep treatment can potentially improve pain and sleep outcomes. The best practice first line treatment for chronic insomnia is cognitive behavior therapy for insomnia (CBT-I). However, CBT-I requires time and expertise. Providers at a university-based headache specialty clinic piloted sleep shared medical visits (SMV) to address comorbid insomnia in migraineurs. The program was designed to improve access and quality of care through enhancing more face time for education and group learning. The objective of this pilot project was to apply the RE-AIM framework (reach, effectiveness, adoption, implementation, and maintenance) to evaluate this abbreviated CBT-I program coined Behavioral Insomnia Treatment in SMV setting (BT-SMV). To the knowledge of this author, this was the first program using behavioral insomnia techniques in a SMV setting in real-world clinical environment to address comorbid insomnia in migraineurs in a headache specialty clinic.
Materials and methods: The BT-SMV program was evaluated using quantitative and qualitative data through application of the RE-AIM framework. The BT-SMV program consisted of three 2-hour biweekly sessions (BT-SMV0 or baseline visit, BT-SMV1 or treatment one visit, and BT-SMV2 or treatment two visit) with optional individual follow up visits at two weeks and six weeks after BT-SMV2.
Results: The reach was low to moderate in terms of access (9.4%) and recruitment (61%); participants (N=21) tended to be more highly educated and had higher percentage of males than the target population. The BT-SMV program demonstrated improvements in both sleep and migraine outcomes at six weeks post CBT-I: 7.8 points reduction for Insomnia Severity Index, 4% increase in sleep efficiency, T-scores reduction from 60 to 48, and 57 to 49 for the PROMIS Sleep Related Impairment and Sleep Disturbance respectively; 4-day reduction in headache frequency, 21 points reduction in MIDAS scores, 1.2 reduction in worst headache intensity, and no change in average headache intensity. Within-subject comparison of the 6-week post sample also showed trends towards improvement in both sleep and migraine outcomes except for headache pain intensity.
Conclusion: Findings support integration of two SMV treatment sessions of abbreviated CBT-I in the real-world clinical setting of a headache specialty clinic. However, generalizability of findings is limited by the small sample size, low post treatment survey response rate (29%), and participants' sociodemographic characteristics. Future recommendation is to continue data collection to determine any statistically significant improvements in sleep and migraine outcomes. The BT-SMV program can potentially serve as a model of practice for treating comorbid insomnia in migraineurs in the clinical setting while more complicated cases can be referred to behavior sleep medicine specialists.

SUBJECTIVE SYMPTOMS, NOT OBJECTIVE CIRCADIAN MEASUREMENTS, ARE PREDICTIVE OF DEPRESSION IN INSOMNIA DISORDER

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Introduction: Insomnia affects up to 10% of adults and is associated with 24-hour cognitive, physical, social, emotional and work performance impairments. There is a strong bidirectional relationship between insomnia and depression. Similarly, evening chronotype has been linked with depression. We aimed to investigate the influence of subjective (anxiety, chronotype, sleep quality) and objective (polysomnography sleep and melatonin) predictors on depression in people with insomnia disorder.

Materials and methods: Adult participants with diagnosed DSM-5 insomnia disorder completed a 7-day sleep diary followed by overnight polysomnography and dim light melatonin onset (DLMO) testing the next night. Participants completed the Pittsburgh Sleep Quality Index (PSQI), Dysfunctional Beliefs about Sleep (DBAS), Horne Ostberg Morningness-Eveningness (MEQ), and the General Anxiety Disorders (GAD-7) questionnaires. Current depressive symptoms were defined as Patient Health Questionnaire (PHQ-9)≥10. Pearson's correlations were performed for associations between subjective and objective variables. Linear multiple regression was used to determine the ability of subjective and objective variables to predict depression in insomnia.

Results: 115 participants were included in the study who were on average 47.1 years (SD14.8), slightly overweight (BMI 25.6kg/m^2 (SD5.3)), predominantly female (70%) with an average Insomnia Severity Index score of 19.9 (SD4.2). N=52 (44%) had no or mild depression, with the remainder reporting moderate n=35 (30.4%); moderately severe n=18 (15.7%); or severe n=10 (8.7%) depression. Individually, subjective sleep quality (r=0.30, p< 0.001), chronotype (r=0.30, p< 0.001), dysfunctional beliefs about sleep (r=0.33, p< 0.001), and anxiety (r=0.61, p< 0.001) were associated with depression in insomnia, but objective sleep and chronotype measures were not, including total sleep time, sleep onset latency, wake after sleep onset, DLMO onset and phase delay.Age and sex-adjusted multiple regression showed that subjective sleep quality, chronotype, dysfunctional beliefs about sleep, and anxiety were predictive of insomnia (r^2 =0.42, p=0.004), a model which is improved when previous depression is added (r^2=0.44, p=0.006) and further improved with the addition of polysomnographically-measured total sleep time and sleep onset latency (r^2 =0.51, p< 0.001). DLMO and phase delay did not improve the ability of the model to predict depression.

Conclusions: This is the first study evaluating subjective and objective measures of sleep, chronotype and circadian phase as predictors for depressive symptoms (PHQ-9) in insomnia. Individually, neither subjective nor objective measures of chronotype were predictive of depression in insomnia. Anxiety scores were highly predictive of depression in insomnia. The combination of anxiety, dysfunctional beliefs about sleep, poor subjective sleep quality and chronotype was predictive of depression. The addition of circadian phase (DLMO) did not improve this prediction, but the addition of polysomnographic measurements of total sleep time and sleep onset latency did.

This study did not assess very delayed chronotypes, so results cannot be extrapolated to those populations.

Circadian phase was not required to predict depression in insomnia, but rather attitudes and beliefs about sleep seem to be more important for depression in this population.

INSOMNIA RISK IS ASSOCIATED WITH INCREASED BETA POWER DURING NREM SLEEP

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Introduction: Pathophysiological models of insomnia identify hyperarousal as a core feature. Despite discrepant results, emerging studies have consistently shown that individuals with insomnia exhibit increased high-frequency electroencephalographic (EEG) activity during non-rapid eye movement (NREM) sleep. Recent data also suggest that heightened premorbid sleep reactivity, based on the Ford Insomnia Response to Stress Test (FIRST), is associated with cognitive and physiological indices of hyperarousal, conferring increased risk for insomnia. However, the association between sleep reactivity and NREM high-frequency EEG activity remains unknown. The present study aimed to compare the EEG spectral power density profiles during NREM sleep between individuals with insomnia and good sleepers with high or low sleep reactivity.

Materials and methods: Participants were 24 adults (26.0 ± 5.4 years; 70.8% female) with insomnia (INS; n = 8) and without insomnia. Based on a median score of 20 on the FIRST, good sleepers were further sub-divided into those with high (HV; n = 8) and low sleep reactivity (LV; n = 8). Participants underwent 1 night of polysomnography assessment. Five-sec epochs containing artifact were manually rejected. Power spectral analysis using Fast Fourier Transform was performed in 5-sec epochs within NREM sleep at frontal, central, and occipital EEG derivations (F3, F4, C3, C4, O1, O2). Absolute and relative spectral power were calculated for six frequency bands (delta: 0.8-4.6 Hz, theta: 4.6-8 Hz, alpha: 8-12 Hz, sigma: 12-15 Hz, beta1: 15-20 Hz, beta2: 20-35 Hz, and gamma: 35-40 Hz) for each individual channel and averaged across channels. One-way ANOVAs were computed to compare group differences on logarithmically normalized spectral power.

Results: During NREM sleep, both the INS and the HV groups showed significantly greater global absolute beta2 power (power averaged across all channels) than the LV group ($ps <$ .01). When examined topographically, the HV participants showed greater absolute beta2 power in frontal, central and occipital derivations relative to the LV participants, with the difference between groups peaking at C3 ($p = .025$). No significant differences on these measures were observed between the HV and INS groups. Relative NREM alpha power over the left frontal derivation (F3) in the INS group was higher relative to the LV group ($ps <$ .05). None of the remaining relative power differed by group.

Conclusions: Results suggested that heightened trait-like sleep reactivity was associated with globally elevated high frequency beta2 power during NREM sleep. An altered EEG profile in high-frequency bands may constitute premorbid markers for insomnia vulnerability. More research is warranted to validate and expand these preliminary findings.

ACUPUNCTURE FOR TREATMENT OF INSOMNIA: A SYSTEMATIC REVIEWS

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Introduction: To evaluate the reliability of the methodological quality and efficacy assessment of systematic review (SR) of acupuncture for insomnia
Materials and methods: A systematic search was performed following Preferred Reporting Items for Systematic Reviews and randomized controlled trials of researches acupuncture in the treatment of insomnia in recent years and carries out a comprehensive analysis.
Results: finding out that most modern clinical treatment of insomnia start from the heart, brain, and mind in the clinical use of body acupuncture and auricular needle, needle acupuncture treatment for insomnia, which achieves good clinical curative effect. Most of the reviews included suggested that the acupuncture group was more effective than the control group in the treatment of insomnia.
Conclusions: we also find that clinical research literature quality of acupuncture treatment insomnia is not high in the current clinical treatment, ordinary clinical studies of evidence-based medicine thinking is not perfect enough, and it is short of researches of acupuncture treatment and acupuncture interval factors. There are also few researches on acupuncture stimulation, acupuncture and clinical efficacy. Moxibustion is an important therapeutic method for acupuncture, and treatment of insomnia is generally low in the use of moxibustion. To some extent, it provides a research direction for the treatment of insomnia in the clinical optimization

PREDICTORS OF DROPOUT FROM SELF-HELP COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Insomnia disorder is one of the most common sleep disorders, affecting approximately 10% of the general population. Cognitive behavioral therapy for insomnia (CBT-I), a multimodal psychological intervention, is considered as the first line treatment for adults with insomnia. Because of its lower cost and higher accessibility, self-help CBT-I has become one of the preferable delivery modalities. However, high dropout rate to self-help CBT-I is common which may potentially compromise the therapeutic effect. Whilst young people may be well-suited to self-help digital treatment programme, very little is known about the predictors of dropout in CBT-I among them. This study aimed to explore the predictors of dropout in youths with insomnia receiving CBT-I delivered via emails.
Methods and materials: We analyzed the data from a randomized controlled trial of an eight-week program of group CBT-I and self-help CBT-I delivered by emails. The current analysis focuses on 46 participants who were randomized to self-help CBT-I from Hong Kong. Demographics, clinical characteristics, sleep variables of participants were recorded at baseline. Nonparametric tests and chi-square tests were used to identify potential factors for predicting treatment dropout, and the influence of these potential predictors on the risk of dropout was analyzed using a binary logistic regression.
Results: Seventeen participants (36.96%) did not complete treatment. The distributions of age, gender, wake after sleep onset (WASO), sleep onset latency (SOL), total sleep time (TST), and scores in Hospital Anxiety and Depression Scale (HADS), Depression Anxiety Stress Scales (DASS), Depressive Symptom Inventory-Suicidality Subscale (DSI-SS), Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Pre-Sleep Arousal Scale(PSAS), Cognitive Failures Questionnaire (CFQ), Pediatric Daytime Sleepiness Scale (PDSS) were similar between the dropouts and completers. Ford Insomnia Response to Stress Test (FIRST) score and sleep efficiency (SE) at baseline were higher in the dropouts than the completers (all $p < .05$). According to regression analysis, FIRST score and SE at baseline were both significantly associated with increased risks of treatment dropout (FIRST: OR, 1.41, 95%CI, 1.11-1.78, $p < .01$; SE: OR, 1.32, 95%CI, 1.10-1.58, $p < .01$).
Conclusion: The results revealed that higher SE and FIRST score could predict treatment dropout. It is possible that participants with higher SE might have perceived lesser sleep impairments, leaving little room for improvements, hence their motivation to continue treatment was lower. The exact reason for enhanced vulnerability for insomnia (as reflected by a higher FIRST score) for the higher droput rate is unclear as these dropout subjects with higher FIRST score had similar severity of insomnia (ISI score) and mood features (HADS score) to that of the completers. These findings are important for understanding how to best maximize self-help program for young insomnia patients. The study was limited by small sample size and further study will be needed to fully understand the causes for dropout and to enhance adherence of self-help CBT-I.

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY TO EVALUATE THE IMPROVEMENT OF SLEEP QUALITY OF PATIENTS WITH INSOMNIA BY A NEWLY DEVELOPED SLEEP DEVICE: A PRELIMINARY STUDY

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Introduction: Insomnia is a common sleep disturbance that affects patients' health and quality of life and accounts for considerable utilization of medical resources. The most common treatment for insomnia is pharmacological therapy with hypnotics. However, it can result in adverse effects, drug tolerance and dependence. Cognitive behavior therapy for insomnia (CBT-i) has demonstrated its efficacy, but poor compliance and short supply of CBT-i have always been important issues. More interventions are thus needed to increase the treatment effects of patients with insomnia. Therefore, a sleep device with SRF (Sleep Restore Frequency) was developed to integrate the bio-energy generated Schumann resonances into these treatments. The purpose of this study is to evaluate the sleep improvement of patients with insomnia by using this sleep device (Enerkey Kingdom).
Materials and methods: This is a randomized and placebo-controlled study. We enrolled 20 patients with insomnia and separated them into 2 groups: the sleep device group and the placebo device group. All patients use their devices for 4 weeks. Objective sleep-related factors were measured by PSG before and after intervention. Subjective sleep-related factors were measured by Pittsburgh Sleep Quality Index (PSQI), 36-Item Short-Form Health Survey (SF-36), Epworth Sleepiness Scale (ESS), Beck Depression Inventory II (BDI-II), Beck Anxiety Inventory (BAI), and Self-Efficacy Scale (SES) administered every two weeks.
Results: Ten patients were randomized to the sleep device group (60% female; 50.6 ± 14.5 year) and 10 patients in the placebo device group (80% female; 45.1 ± 13.9 year). In PSQI, subjective sleep quality ($p = 0.021$), sleep latency ($p = 0.030$), and daytime dysfunction ($p = 0.022$) score were improved significantly in the sleep device group after intervention. The change from baseline in subjective sleep quality score was significantly greater in the sleep device group than the placebo device group ($p = 0.035$). In SF-36, mental health ($p = 0.011$) and bodily pain ($p = 0.012$) score were improved significantly in the sleep device group after intervention. The change from baseline in bodily pain score was greater in the sleep device group than the placebo device group ($p = 0.089$). Also in PSG, sleep latency score was improved significantly in the sleep device group after intervention ($p = 0.028$). The change from baseline in sleep latency score was greater in sleep device group than placebo device group ($p = 0.011$).
Conclusions: The findings of this preliminary study suggest that the sleep device improved insomnia patients' sleep latency, daytime function, sleep quality, and mental health. Interestingly, it also could improve patients' bodily pain.

ENTRAINMENT OF BINAURAL AUDITORY BEATS ON SUBJECTS WITH INSOMNIA SYMPTOMS

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Introduction: It has been reported that binaural beat(BB) stimulation, which has two different frequencies on both ears, is effective in relieving anxiety, stress, and insomnia. This study aims to clarify the brain wave entrainment effect of BB and to identify the mechanism of action of the BB for improving insomnia.

Materials and methods: Subjects with subclinical insomnia symptoms were recruited from the community. An audio apparatus without the distortion of a sound source is set with theta (6 Hz) BB. Participants used the apparatus for 30 minutes before going to bed for two weeks. Quantitative EEG was measured two times before and after the two-weeks of BB intervention period.

Results: A total of 43 subjects (32 females, mean age = 34.3 ± 10.4) participated in the trial. Before treatment, when participants (N=43) listened to music without BB in the laboratory, the relative power of delta (temporal, P=0.004; parietal, P=0.005; occipital, P=0.006) and theta frequency (temporal, P=0.004; central, P=0.001; parietal, P=0.001; occipital, P=0.003) increased and the relative power of alpha decreased (frontal, P=0.008; temporal, P=0.012; central, P=0.008; parietal, P=0,004; occipital, P=0.005). When participants listened to music with BB, the relative power of theta frequency increased (occipital, P=0.009). After two weeks of intervention with music without BB, theta power increased after listening to music with BB in the laboratory (parietal, P=0.009). After listening to music with BB for two weeks, the decrease of beta power from the baseline was more prominent than after listening to music without BB, when participants listened to music without BB in the laboratory (occipital, P=0.008).

Conclusions: When participants listened to music with theta BB, the entrainment of theta wave was observed. And the music was presumed to have a nonspecific relaxation effect. After exposure to music with BB for 2 weeks, beta power decreased more compared to exposure to music without BB, which suggests that exposure to music with BB for two weeks is likely to reduce hyper-arousal state and contribute to relieving insomnia.

EFFECT OF A NATURAL PRODUCT ON SLEEP IN ANIMAL MODELS

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Introduction: Bugu is a natural product composed of edible plant extracts. The aim of the present study is to investigate the efficacy of Bugu on sleep in animal models of hypnosis and circadian disruption.

Materials and Methods: To analyze the sleeping behavior, we used pentobarbital-induced sleeping model and circadian disruption model after oral administration of Bugu in mice. Sleep latency and total sleeping time were recorded by electroencephalography (EEG). The locomotor activity was examined by open field test. Novel object recognition test was performed in circadian disruption model to evaluated memory. In addition, the expression of sleep-related protein was assessed in mouse brain tissues by immunohistochemistry (IHC).

Results: We found that Bugu reduced sleep latency and increased total sleep time in pentobarbital-induced sleeping mice. Bugu-treated mice exhibited decreased activity during the open field test. Additionally, Bugu decreased wake and rapid eye movement (REM) time and increased total sleep and non-rapid eye movement (NREM) sleep. In circadium disruption model, Bugu reduced the locomotor activity and increased preference for the novel object in the novel object recognition test. Furthermore, Bugu decreased tyrosine hydroxylase expression in mouse brains.

Conclusions: These results suggest that Bugu exerts sleep-promoting effects in mice, which could be beneficial for the treatment of insomnia.

COLLEGE STUDENT SLEEP DISTURBANCES AND PSYCHOSOCIAL FUNCTIONAL IMPAIRMENT

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Introduction: Approximately 60% of college students report chronic sleep disturbances. Chronic sleep disturbances, such as insomnia, negatively influence physical energy, cognitive resources, and affective states which will inhibit psychosocial functioning (i.e., the ability to adapt to major life domain problems). Students must avoid psychosocial dysfunction to effectively balance life domains (e.g., academic, work, and social responsibilities). However, two avenues potentially place insomniacs at risk for exacerbated psychosocial dysfunction: sleep debt and state sleepiness. Sleep debt occurs when circadian rhythms conflict with society-determined scheduling norms (e.g., early courses conflict with biological sleep onset). Both state sleepiness - the subjective feeling of needing sleep - and sleep debt negatively predict self-regulation and affective states. Thus, we expected insomnia to predict psychosocial dysfunction, with a stronger relationship observed at higher sleep debt and sleepiness.

Materials and methods: Undergraduate participants (n = 472; M_{age} = 19.06, SD_{age} = 1.17; 52% white, 23% black, 4% Asian, .2% Pacific Islander/Alaskan Native; 28% male) completed a cross-sectional survey assessing insomnia, sleepiness, sleep debt, and psychosocial dysfunction.

Results: Hierarchical linear regressions tested whether sleepiness or sleep debt moderated a relationship between insomnia and psychosocial dysfunction. Mean-centered insomnia and the focal moderator (i.e., sleepiness or sleep debt) entered the model at Step 1, and their interaction term at Step 2 to predict functional impairment. Results failed to identify an insomnia by sleepiness interaction on functional impairment ($\Delta F[1, 468]$ = .158, p = .875); however, both insomnia (b = .42, p < .001) and sleepiness (b = .74, p < .001) were unique predictors. Similarly, sleep debt was not a significant moderator ($\Delta F[1, 468]$ = .022, p = .982), but results confirmed the unique positive effects of insomnia (b = .40, p < .001) and sleep debt (b = -.16, p = .004). After only observing strong direct relationships of insomnia and sleepiness on functional impairment, we considered that sleepiness might mediate the relationship. Results of an exploratory mediation analysis showed that insomnia significantly predicted sleepiness (b = .06, $t[470]$ = 2.59, p = .010, CI95%[.02, .11]) and sleepiness (b = *.75, t[469]* < .001, CI95%[.48, 1.01]) significantly predicted psychosocial dysfunction. Although the direct effect remained significant (b = .42, $t[469]$ = 5.95, p < .001, CI95%[.28, 56]) the indirect effect via state sleepiness was reliable (b = .05, CI95%[.01, .10], suggesting possible partial mediation. Importantly, the reverse model (impairment-->sleepiness-->insomnia) was not significant as sleepiness did not predict insomnia (p = .32). Although this cross-sectional data cannot determine causality, these results do *suggest* that sleepiness might partially explain the insomnia to impairment relationship; warranting further research.

Conclusions: Although our interaction hypotheses were not supported, the findings advance the academic literature by demonstrating the direct influence of insomnia, sleepiness, and sleep debt on psychosocial dysfunction. Moreover, exploratory analyses suggested that sleepiness might explain the insomnia and psychosocial dysfunction association; future longitudinal or experimental research should confirm. College students' daily functioning depends highly on good sleep. Based on the present findings, campuses should promote sleep hygiene to improve students' psychosocial functioning.

Insomnia
Board #134 : Poster session 3

DO ADHD SYMPTOMS AND INSOMNIA INTERACT TO PREDICT IMPAIRED EXECUTIVE FUNCTIONING?

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Introduction: About 8% of college students suffer clinical chronic insomnia with nearly 60% experiencing some sleep disruption that hinders self-regulation and learning. Attention-deficit/hyperactivity disorder (ADHD) also disrupts executive functioning via inattention, hyperactivity, and/or impulsivity. Given that both insomnia and ADHD disrupt executive functioning uniquely, we expected an insomnia and ADHD symptomology interaction to predict executive dysfunction in a college student sample.

Materials and Methods: Undergraduate participants (n = 472; M_{age} = 19.06, SD_{age} = 1.17; 52% white, 23% black, 4% Asian, .2% Pacific Islander/Alaskan Native; 28% male) completed a cross-sectional survey assessing ADHD symptomology (inattention, hyperactivity, impulsivity), insomnia, and executive dysfunction (overall, self-restraint, self-organization, self-motivation, emotional regulation, and time management dysfunction).

Results: We used hierarchical linear regressions with mean-centered ADHD symptoms (inattention, hyperactivity, impulsivity) entered at Step 1, mean-centered insomnia at Step 2, and their interaction terms at Steps 3, 4, and 5 to predict each executive dysfunction dimension. As expected, an insomnia by impulsivity interaction predicted overall executive dysfunction ($\Delta F[1, 464]$ = 1.97, p = .049, ΔR^2 = .003). Simple slopes analysis showed that at average (b = 5.26, $t[464]$ = 3.96, p < .001, $CI95\%[2.65, 7.87]$) and high (+1 SD) impulsivity levels (b = 8.13, $t[464]$ = 4.09, p < .001, $CI95\%[4.23, 12.04]$) the insomnia and executive dysfunction relationship strengthened compared to low (-1 SD) impulsivity levels (b = 2.38, t[464] = 1.96, p = .05, $CI95\%[-1.47, 6.23]$). However, insomnia and impulsivity only interacted to predict self-restraint ($\Delta F[1, 464]$ = 1.98, p = .049, ΔR^2 = .004) and self-motivation ($\Delta F[1, 464]$ = 2.76, p = .006, ΔR^2 = .009), but not time-management, self-organization, or emotional regulation (all interaction ps > .068). Concerning self-restraint, simple slopes analysis showed a stronger insomnia and executive dysfunction relationship when moving from average (b = .73, $t[464]$ = 2.17, p = .03, $CI95\%[0.07, 1.39]$) to high (b = 1.45, $t[464]$ = 2.90, p = .004, $CI95\%[0.47, 2.44]$) impulsivity; low impulsivity attenuated that association (b = .001, $t[464]$ = 0.003, p = .998, $CI95\%[-.97, .97]$). For self-motivation, high impulsivity strengthened (b = .73, $t[464]$ = 1.96, p = .05, $CI95\%[.00, 1.45]$) and low impulsivity weakened (b = -.78, $t[464]$ = 2.53, p = .034, $CI95\%[-1.49, -0.06]$ the insomnia to executive dysfunction relationship; average impulsivity attenuated that relationship (b = -.03, $t[464]$ = -0.10, p = .919, $CI95\%[-.51, .46]$) .

Conclusions: These results partially support expectations that insomnia and ADHD symptomology interact on college students' executive dysfunction; however, impulsivity was the only significant moderator. At high impulsivity, insomnia's negative influence on students' overall executive functioning, self-restraint, and self-motivation was exacerbated, whereas low impulsivity reduced or attenuated those associations. In sum, chronic insomniacs are particularly at risk for executive dysfunction if they also are highly impulsive. These results further the academic literature, but they may also provide insight for counselors, academic advisors, or others working with college student populations. Interventions that foster either insomnia or impulsivity reductions should improve college students' executive functioning.

RESULTS OF AN 8-MONTH PAN-CANADIAN RANDOMIZED CONTROLLED TRIAL OF AN INTERNET-BASED BEHAVIORAL INTERVENTION FOR PEDIATRIC INSOMNIA, THE BETTER NIGHTS, BETTER DAYS PROGRAM

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Introduction: Pediatric insomnia is highly prevalent and has significant negative impacts on children's and families' psychosocial health. Despite robust evidence supporting the safety and efficacy of behavioural treatments for children, fewer than 15% of children with insomnia receive these interventions due to a myriad of access barriers. eHealth interventions can overcome treatment barriers and have been found to be effective for the treatment of insomnia in adults. eHealth programs to support parents to manage their children's insomnia are lacking. The *Better Nights, Better Days* (BNBD) program was developed by a team of Canadian pediatric sleep researchers to address this gap in treatment delivery for pediatric insomnia. This fully-automated, self-guided, and bilingual (French and English) eHealth program was developed based on behavioural interventions evaluated previously by the investigators as well as on published evidence.
Materials and methods: BNBD was evaluated using a 2-arm randomized controlled trial (RCT) stratified by age group (toddler, pre-school, school-age) to determine the effectiveness of treating insomnia in 1-to 10-year old children. Participants were assigned using a 1-to 1 allocation to receive access to the BNBD intervention or a control group that was able to access other treatment resources. The effects were assessed at 4 and 8 months post-randomization. The primary objective was to assess the impact of the intervention on children's sleep efficiency using actigraphy and parent-report sleep diary data. The secondary objectives were to evaluate the impact of the intervention on children's and families' psychosocial health.
Results: The RCT was launched in September 2016 and data collection was completed in October 2018. A total of 533 participants (primary caregivers of children with insomnia residing in Canada) were enrolled in the trial from across Canada (Atlantic: 108; Central:180; Prairies & Northern: 101; West: 144) with relatively equal distribution across the age groups (Toddlers: 183; Pre-Schoolers: 186; School-Aged: 164). Of these families, 86% were English speaking and 14% were French speaking. A total of 377 participants were randomized (intervention: n=190; control: n =187). Of these, 291 completed 4-month (intervention n=129; control n=162), and 269 completed 8-month assessments (intervention n=118; control n=151). All data has been collected, actigraph data has all be scored and questionnaire data cleaned. Analyses are in progress and will be available by the time of this presentation.
Conclusions: Positive results in the final analyses would demonstrate the potential to have a direct effect to significantly improve children's sleep, as well as child and family well-being and quality of life. Given the eHealth service delivery model, this program can be easily scaled up to reach families across Canada and abroad. Ultimately, our goal is to increase access to evidence-based care for parents of children with insomnia to improve psychosocial outcomes for these families.

BOTH GOOD AND POOR SLEEPERS OVERESTIMATE WAKEFULNESS AFTER WAKING FROM A NAP: IMPACT OF SLEEP INERTIA

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Introduction: Accurate time perception is an important element of evaluating time awake in the middle of the night. Sleep inertia (SI), the state of confusion after waking from sleep, can negatively affect cognitive functions potentially including time perception. Inaccurate time perception in individuals with insomnia might have negative impacts on their emotional arousal at night. For instance, it can cause anxiety, because they believe they have been awake for much longer than they actually have been (overestimation of wakefulness). It is speculated that this overestimation of wakefulness is a function of the hyperarousal seen in insomnia disorder. However, we speculate this overestimation of time is partially due to sleep inertia. The aim of this study was to test the impact of sleep inertia on time perception after waking from a nap (experimental condition) and after a wake period (control condition) in both good and poor sleepers.

Materials and methods: Six participants with insomnia symptoms (Insomnia Severity Index: 16.7) and 12 good sleepers (Pittsburgh Sleep Quality Index: 3.7) were required to complete both a nap and wake condition, followed by a 15-minute time estimation task. Participants were between 19-22 years old, mostly male (61%) and predominantly of white background (94%). The order of completion of both conditions was randomised. We calculated the difference between the 15 minute target and the participants' time estimation; negative values indicated an overestimation and positive values indicated an underestimation of time. Polysomnography was used to determine sleep onset and also to score sleep stages (light vs. deep sleep).

Results: After the nap there was a greater overestimation of time compared to the wake condition (-3.7 min (SD 4.8) vs. -.0.9 min (SD 5.2)). This difference approached significance, $t(17)=-2.089$, $p=0.052$, $d=0.7$. The difference in those individuals who reached stage 3 sleep in the nap condition (n=10), when waking with sleep inertia is more likely, was significant (-5.0 min vs. 0.1min, $t(9)=-3.22$, $p< 0.05$, $d=1.1$). A mixed design ANOVA revealed there was no main effect of sleep status (poor sleeper vs. good sleeper) on this difference, both for the overall group ($p=0.746$) and those participants who reached stage 3 sleep in the nap condition ($p=0.362$).

Conclusions: The overestimation of time awake was more pronounced after waking from a nap condition compared to after a wake period. The difference in overestimation was significant once only those who woke up from stage 3 sleep were considered. Interestingly, this difference in time estimation between conditions was present in both poor and good sleepers. Perhaps the phenomenon of overestimating wakefulness in patients with insomnia is not just a function of the cognitive hyperarousal associated with the condition, but also a function of waking from sleep and sleep inertia influencing time perception. Further research in a larger sample and in patients with diagnosed insomnia disorder is needed to confirm this speculation.

DARIDOREXANT (ACT-541468), A NEW DUAL OREXIN RECEPTOR ANTAGONIST, FOR THE TREATMENT OF INSOMNIA DISORDER: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, ACTIVE-REFERENCE PHASE 2 STUDY

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Introduction: There is a need for an effective and well-tolerated agent to treat insomnia disorder, without negatively impacting next-day functioning. Daridorexant (ACT-541468), a new dual orexin antagonist, has demonstrated a favorable safety profile without relevant accumulation in healthy subjects. The primary objective of this Phase 2 study was to investigate the dose-response relationship of daridorexant, on sleep variables in subjects with insomnia disorder.

Materials and methods: Eligible adults (≤64 years) with insomnia disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th Edition criteria) were randomized (1:1:1:1:1:1) to receive, 5, 10, 25, or 50 mg daridorexant, placebo or 10 mg zolpidem for 4 weeks. Main efficacy endpoints were the change from baseline (placebo run-in) to Days1&2 for wake after sleep onset (WASO; primary) and latency to persistent sleep (LPS; secondary). Other efficacy endpoints were total sleep time (TST) and subjective sleep variables (subjective WASO [sWASO], subjective latency to sleep onset [sLSO], and subjective TST [sTST]). The dose-response of daridorexant was evaluated using MCP-Mod methodology. Safety, including next-morning sleepiness (Karolinska Sleepiness Scale, KSS), was also assessed.

Results: Of 1005 subjects screened, 360 (median age 47 [range, 36-53]; 64% female) were randomized. A significant dose-response of daridorexant was demonstrated for the change from baseline to Days1&2 in WASO ($p \leq 0.0001$). Observed mean reductions from baseline to Days1&2 for WASO were −28.99, −33.75, −39.64, and −45.49 min for ascending daridorexant doses (placebo, −20.98 min; zolpidem, −31.23 min) and were sustained at Days28&29 (-37.76, -43.74, -39.84, -46.97 min for ascending daridorexant doses [placebo, -33.80 min; zolpidem, -37.08 min]). A significant dose-response for the change from baseline to Days 1&2 in LPS at daridorexant doses 10 mg and above was detected ($p< 0.05$). Observed changes from baseline in mean LPS to Days1&2 were −26.88, −29.31, −36.14, and −36.41 min for ascending daridorexant doses (placebo, −22.02 min; zolpidem, −45.12 min). Reductions in LPS were sustained at Days28&29. TST was dose-dependently increased from baseline to Days1&2 and to Days28&29. Dose-response relationships were observed for sWASO, sLSO and sTST, and were significant at Week 4 for sWASO and sTST. Daridorexant treatment was well-tolerated at all doses, with no evidence of dose-dependent adverse effects. Treatment-emergent adverse events (TEAEs) were reported in 35%, 38%, 38%, and 34% of subjects treated with 5, 10, 25, and 50 mg daridorexant, respectively (30% for placebo; 40% for zolpidem). The main TEAEs across all groups were headache, somnolence, and nasopharyngitis. No signs of rebound insomnia were observed. Mean KSS scores for all treatment groups were lower (i.e. improved) than baseline at all timepoints.

Conclusion: Daridorexant demonstrated a significant dose-response for WASO, LPS and TST. Subjective sleep parameters were consistent with objective PSG data. Daridorexant was well tolerated without dose-dependent safety concerns and the increased efficacy at higher doses did not translate into residual next-morning effects. Phase 3 evaluation of daridorexant (10-50 mg) in adults with insomnia is ongoing (ClinicalTrials.gov:

NCT03575104, NCT03545191, NCT03679884).

"SUMMER SLEEP CAMP" FOR TEACHERS: A PILOT STUDY

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Introduction: Cognitive behavioural therapy for insomnia (CBT-I) is the leading evidence-based treatment for chronic insomnia. We observed that school teachers were frequently referred for insomnia treatment but they were rarely available to attend the clinic during the school year. The current study provides a summary of a pilot study of a new program, offered in the summer, for teachers with insomnia.
Methods: A five-session group-based CBT-I protocol was developed which included sleep education, sleep hygiene, stimulus control therapy, sleep restriction, cognitive therapy and relaxation training. The program was offered twice: in July 2018 and July 2019. In addition to conventional CBT-I, time was scheduled to foster discussion on the unique barriers to sleep that teachers might experience. Recruitment was conducted through a university press release, interviews with local news organizations, and emails sent through the regional school boards. Nine teachers registered for the program and completed pre-treatment questionnaires confirming their chronic insomnia. Eight (elementary and high school teachers) completed the intervention; one (retired teacher) dropped out after the 2nd session because keeping a sleep diary increased her anxiety. Outcomes included sleep diary data, the Insomnia Severity Index (ISI), and client satisfaction.
Results: The eight completers showed an improvement in sleep diary measures of sleep onset latency in minutes: M_{pre} = 29.0 (SD_{pre} = 21.4) vs M_{post} = 18.9 (10.3); wake after sleep onset in minutes: M_{pre} = 45.8 (30.1) vs M_{post} = 13.4 (9.9); early morning awakening in minutes: M_{pre} = 41.1 (41.6) vs M_{post} = 21.9 (11.8); number of awakenings: M_{pre} = 2.1 (1.2) vs M_{post} = 1.1 (0.6) and sleep efficiency: M_{pre} = 72.8% (11.0%) vs M_{post} = 86.4% (6.4%). The mean ISI score fell from 16.8 (moderate insomnia range, SD = 3.8) to 9.5 (subthreshold insomnia range, SD = 3.7). Effect sizes were medium to large for all measures except for total sleep time (small). On a scale of 1 ("very poor") to 5 ("excellent"), participants rated the quality of the treatment program at M= 4.8 (SD = .5). Teachers reported experiencing improved sleep and a greater sense of control over their sleep behaviours. With regards to program design, they spoke of enjoying the opportunity to talk with fellow teachers about pressures of the school year, health and wellness.
Conclusions: A multi-component CBT-I group program tailored to teachers is feasible, and preliminary results are promising. The program was associated with improvements in sleep and was well received by participants.

COGNITIVE-BEHAVIOURAL INTERVENTIONS FOR INSOMNIA IN PRIMARY CARE: A SYSTEMATIC REVIEW

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Introduction: The primary care provider is the professional most likely to be consulted by the person with insomnia. Practice guidelines recommend that chronic insomnia be treated first with cognitive behavioural therapy for insomnia (CBT-I) and that hypnotic medication be considered only when CBT-I is unsuccessful. Despite evidence of CBT-I's efficacy, systematic reviews of its effects in primary care settings are lacking. The aim of this study was to review the effects on sleep outcomes of CBT-I delivered in primary care.

Methods: Medline, PsycInfo, EMBASE and CINAHL were searched for articles published from 1987 to August 2018 that reported sleep results on the use of CBT-I in general primary care settings. Article inclusion criteria: original research on the effects of CBT-I, quantitative measures of sleep outcomes, based in general primary care, a minimum of 10 adult ($\geq$ 18 yrs) patients. Two researchers independently assessed and then reached agreement on the included studies and the extracted data. Cohen's *d* was used to measure effects on sleep diary outcomes and the Insomnia Severity Index.

Results: Out of a total of 192 identified articles, 13 were selected for final inclusion. Medium to large positive effects on self-reported sleep were found for CBT-I that was provided in 4-6 sessions. Improvements were generally well maintained 3 to 12 months post-treatment. Studies of interventions in which the format or content veered substantially from conventional CBT-I were less conclusive. In only three studies was CBT-I delivered by the GP; it was usually provided by nurses, psychologists, nurse practitioners, social workers or counsellors. Six studies included advice on withdrawal from hypnotics.

Conclusions: The findings support the effectiveness of full multicomponent CBT-I in general primary care. The data were non-conclusive about briefer variations of CBT-I, e.g., interventions done in fewer than 4 sessions and that do not include stimulus control and sleep restriction. We observed variability not only in the intervention components but in the level of sleep disorders screening, and in the health discipline and CBT-I training of the providers--all potential moderator variables deserving further research. Future studies should use standard sleep measures, examine daytime symptoms, and investigate the impact of hypnotic tapering interventions delivered in conjunction with CBT-I.

VIDEO-CONFERENCE DELIVERY OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA: EFFECTS ON EMPLOYEES ON LONG-TERM DISABILITY LEAVE

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Introduction: A growing body of research demonstrates that insomnia is associated with an increased risk of work disability and a delayed return to work. The efficacy of cognitive behavioral therapy for insomnia (CBT-I) in reducing insomnia symptoms is well-established, although its effectiveness for employees on disability leave has not been investigated. We examined the effects of a novel CBT-I program (HALEO), designed to be readily accessible from home, on long-term disability leave employees with insomnia. The program comprises five weekly 30-min video-conference-enabled sessions with a therapist, supported by a digital platform. We also examined effects on comorbid depression and anxiety symptoms.

Materials and methods: Twenty-nine participants diagnosed with insomnia and on long-term disability leave completed the HALEO CBT-I program. Participants were employees of a large Canadian insurance company and screened for other untreated sleep disorders. The effectiveness of CBT-I was measured by change in Insomnia Severity Index (ISI) scores. The Hospital Anxiety and Depression Scale (HADS) was used to measure changes in depression (HADS-D) and anxiety (HADS-A) symptoms. The ISI and HADS were completed at the beginning of therapy (baseline) and just before the final session (post-therapy). Data were analyzed with one-tailed Student paired t-tests.

Results: ISI scores were significantly lower post-therapy (M = 12.65, SD = 5.15) compared to baseline (M = 19.79 SD = 4.02; t(28) = 8.32) $p < .001$, Cohen's d = 1.54). HADS-D scores were also significantly lower post-therapy (M = 9.17, SD = 5.02) versus baseline (M = 10.93, SD = 4.44; t(28) = 3.58) $p < .001$, d = 0.67). HADS-A scores did not significantly differ between post-therapy (M = 9.76, SD = 4.13) and baseline (M = 10.57, SD = 3.31; t(28) = 1.56) $p = .065$, d = 0.29).

Conclusions: The results indicate that the HALEO CBT-I program is effective at reducing symptoms of insomnia in a population of employees on long-term disability leave, yielding a large effect comparable to studies examining traditional face-to-face CBT-I. Furthermore, consistent with studies demonstrating significant antidepressant effects of face-to-face and internet-delivered CBT-I, the HALEO CBT-I program significantly reduced depression symptoms. Together, these findings suggest that effective therapist-led CBT-I can be made accessible to employees on long-term disability leave via a video-conferencing digital platform. The next step is to examine whether improving insomnia symptoms shortens the duration of disability leave and promotes a return to work.

Insomnia
Board #117 : Poster session 1
MIGRATON AND SLEEP

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Introduction: Last year, about 1 million refugees came to Germany. Many of the refugees are accommodated in makeshift accommodation. Many doctors and nurses are involved in support activities and the health care of these immigrants. The participating sleep physicians, psychologists and nurses have a good insight into the life situation. In addition to the general medical conditions, the sleep medical conditions are also rather bad and necessarily improvable. Especially, we sleep-medically trained experts know what health consequences may have worse, non-restful sleep on mental and physical health.
Narrow spatial conditions, poor acoustic and light-related conditions, poor bedding conditions and possible posttraumatic stress disturbances increase sleep disturbances and sleep disorders and can trigger them.
So sleep disorders should be very common in migrants, adult and child refugees. Disturbed sleep in migrants and refugees usually could appear as comorbid disorder to different somatic, psychiatric diagnosis and psychological disturbances as metabolic syndrom, posttraumatic stress disorder, depression and anxiety disorders. There could be many different predictors for sleep disturbances in these vulnerable groups: pre-migration stress in the home country, acculturation, trauma before, while and after migration, integration and life style in the host country.
Because learning is important for the integration of migrants, the basics of learning must also promoted. According to the findings of sleep medicine, this also includes undisturbed and restful sleep. Therefore, accommodation of migrants housing conditions should be established, which take care for a relaxing and undisturbed sleep.
1. Relationship between Migration and Sleep Disorders
2. Influence of PTSD, Depression and Anxiety on Sleep
3. Chronobiology and Sleep Disorders in Refugees and Peoples with Migration background
4. Pathophysiology in Sleep of Refugees and Peoples with Migration background
5. Treatment possibilities in Refugees and Peoples with Migration background
Methods: In our actual study, we could include 33 participants from different countries: 17 was women (51.52 %) and 16 was men (48.49 %).
The participants were examined by psychiatric anamnesis and sleep anamnesis; they even were tested with different sleep questionnaires.
Findings: In our population, we found 32 patients with Insomnia (96.96 %), 25 with Nightmares
(75.75 %), 6 with Sleep Apnea Syndrome (18.18 %), 2 with Restless Legs Syndrome (0.06 %) and one of them have had Pavor nocturnus, Somnambulism, Hypnotic Hallucinations and / or Sleep Wake Rhythm Disorder (0.03 %).
Summary: We can conclude that migration is an important factor, which influenced the good sleep in refugees and resulted in many different sleep disorders.
Sleep disturbances in Migrants are predicted by war experience on the past. In working migrants, the integration and adaptation to the host society bears higher risk for snoring, metabolic diseases and insomnia. Sleep difficulties in adult and child refugees are strongly correlated to trauma.
Keywords: Sleep, Sleep disturbances, Sleep disorders, Insomnia, Migrants, Refugees, Asylum seeker, Trauma

IMPACT OF LEMBOREXANT TREATMENT ON THE PATIENT GLOBAL IMPRESSION - INSOMNIA SCALE

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Introduction: For a treatment regimen for insomnia to be considered successful, it is important to show change from baseline from the patient's perspective. Thus, clinical trials for insomnia generally include outpatient data using daily sleep diaries to determine the magnitude of change in sleep onset and, in some cases, sleep maintenance variables. The Insomnia Severity Index is also frequently used to assess change in severity of insomnia symptoms. The Patient Global Impression - Insomnia version (PGI-I) is a self-report assessment of subjects' perception of study medication effects on their sleep relative to before entering the study. The outcome is not change from baseline, but rather the global impression of the study medication's effects at end of treatment. The PGI-I includes 3 items related to study medication effects (helped/worsened sleep; decreased/increased time to fall asleep; and increased/decreased total sleep) answered on a 3-point scale (1=positive, 2=neutral, 3=negative), and 1 item related to perceived appropriateness of study medication strength answered on a different 3-point scale (1=too strong, 2=just right, 3=too weak). Results are presented for the PGI-I at the end of 6 months of treatment with lemborexant (LEM), a dual orexin receptor antagonist under development for the treatment of insomnia, versus placebo (PBO).

Materials and Methods: SUNRISE-2 (NCT02952820) was a Phase 3, 12-month, double-blind, global study in 949 (full analysis set) female and male adults with insomnia disorder that included a 6-month PBO-controlled treatment period (after a PBO run-in) followed by a 6-month active-only treatment period. Subjects received PBO (n=318), LEM 5mg (LEM5; n=316) or LEM 10mg (LEM10; n=315) for the 1st 6 months. The PGI-I was administered at Months 1, 3, 6, 9, and 12; results from the end of PBO-controlled treatment are reported.

Results: Previously reported results based on daily sleep diaries demonstrated that LEM5 and LEM10 were associated with larger and statistically significant changes from baseline in sleep onset (shorter time to fall asleep) and sleep maintenance (higher sleep efficiency and less wake after sleep onset) versus PBO. PGI-I analyses at Month 6 indicated that significantly more subjects who received LEM5 or LEM10, versus subjects who received PBO, reported that their study medication "helped" sleep (67.3% and 68.8% vs 45.0%, respectively; both P< 0.0001) and reduced time to fall asleep (72.8% and 73.1% vs 46.1%, respectively; both P< 0.0001). Approximately 20% more subjects treated with LEM reported an increase in total sleep time (PBO=39.9%; LEM5=58.0%; LEM10=62.0%), both percentages significantly greater than PBO (both P< 0.0001). In the LEM5 and LEM10 groups, 55.6% and 53.4% of subjects selected that the treatment strength was "just right", versus 36.0% of subjects in the PBO treatment group (LEM5, P=0.1256; LEM10, P=0.0073). LEM was well tolerated. Most adverse events were mild or moderate.

Conclusions: Results from this patient-reported outcome measure offer a perspective on improved sleep and supplement the sleep diary data demonstrating improvement on conventional sleep parameters. The scale, with its simple format, may be a useful adjunct in determining the overall effectiveness of a new treatment.

Insomnia
Board #119 : Poster session 1
THE EFFECT OF CHINESE MEDICAL PSYCHOLOGICAL SLEEP REGULATION TECHNOLOGY: A RANDOMIZED CONTROLLED TRIAL FOR INSOMNIA

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Introduction: Cognitive behavioral therapy for insomnia(CBTi) is the first choice treatment for insomnia. We confront some difficulties in clinic for cultural factor, patients cognition to CBTi and medicine. Some of them, especially older and low level of education, worry about possible side effects of western medicine and prefer to tangible and visible treatments such as Chinese medicine, acupuncture. Even we recommend CBTi and they try 1 or 2 times, they usually don't want to continue this therapy because of no rapid effect. CBTi is not well implemented because of poor patient compliance. So we create a native psychological therapy,Chinese medical psychological sleep regulation technology, which combines Chinese culture and cognitive behavioral contents. The aim of the current study is to assess the efficacy of this therapy.

Materials and methods: 106 participants met the diagnostic criteria for insomnia (code F51.1) in the third edition of the Chinese Classification of Mental Disorders and Diagnostic Criteria (CCMD-3). They were randomly assigned either to therapy group or control group. Therapy group patients were treated by Chinese medical psychological sleep regulation technology. 2 treatments per week,40 minutes each time. Estazolam was prescribed in control group. 1~2mg per night. Participants completed 4-week sleep diaries and PSQI at baseline and post-treatment.

Results: 105 patients completed 4 weeks therapy. 1 patient gave up drug for possible side effects in control group after randomization. So there were 105 cases dates in full data analysis set. PSQI scores significantly decreased in both therapy group and control group compared to baseline(W0) at the end of treatment(W4)($p<0.05$). 44 out of 53 patients were improvement on PSQI in therapy group. 23 out of 52 patients were improvement on PSQI in control group. Therapy group was significantly effective than control group ($p=0.0005$). We also compared the seven component scores of PSQI of two groups. Patients of therapy group showed significant decrease in sleep latency(SL) and use of sleeping medication($p<0.05$), increase in sleep duration and sleep efficiency(SE)($p<0.05$). Two groups had no significant difference in sleep disturbances and daytime dysfunction($p>0.05$).

Conclusions: Both Chinese medical psychological sleep regulation technology and Estazolam are efficient in insomnia. Chinese medical psychological sleep regulation technology may has a better effect on treatment, especially in sleep latency(SL), use of sleeping medication, sleep duration and sleep efficiency.

USE OF BLINDED HYPNOTIC TAPERING FOR HYPNOTIC DISCONTINUATION

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Introduction: Hypnotic users commonly make unsuccessful attempts to discontinue their hypnotics. Previous research suggests that the difficulties patients have in achieving hypnotic discontinuation may be largely due to anxiety that arises when they knowingly reduce their hypnotic medication dose or withhold their medication entirely. This study tested a blinded tapering approach to reduce patients' anxiety and help them discontinue their hypnotics.
Materials and methods: This study enrolled 78 (M age = 55.2 ± 12.8 yrs.; 65.4% women) users of benzodiazepine and benzodiazepine receptor agonists. Enrollees completed baseline measures including the Insomnia Severity Index (ISI) and they provided information about the types and dosages of the hypnotics they used. They then completed 4 sessions of cognitive behavioral insomnia therapy (CBTI). Subsequently they were randomized to one of three 20-week, double-blinded tapering protocols wherein their medication dosage either remained unchanged (CTRL) or was reduced by 25% or 10% every two weeks, or. During tapering, all enrollees were seen biweekly by the study physician who provide support and guidance while monitoring medication withdrawal effects. At the end of the 20-week period the study blind was eliminated and those who completed one of the two blinded tapering protocols entered a 3-month follow-up period, whereas CTRL participants are offered an open label taper before completing the follow-up.
Results: ISI scores (ISI=18.07±0.58) showed that the total sample entered the trial with moderately severe insomnia complaints despite almost nightly hypnotic use. These scores declined into the mild range after CBTI (10.19±0.53) and tapering (9.62±.63) and approached the normative range by follow-up (7.59±1.05). Thirty nine (86.7%) of the 45 who completed one of the blinded tapering protocols to date totally discontinued their medication use by the end of the 20-week tapering phase, whereas 12 (75%) of 16 in the CTRL group discontinued hypnotic use by the end of their open label tapering. At follow-up 22 (73.3%) of 30 who completed blinded tapering remained medication free whereas only 5 (35.7%) of 14 in the CTRL group who underwent open-label tapering remained medication free. Comparisons at follow-up showed those who received the open-label taper continued to use hypnotics on average 2-3 nights/week compared to about 1 time every other week for the blinded taper group (p < .05). Furthermore, at follow-up, the average weekly diazepam equivalent dose of medication used by the open label tapering group was about 5 times higher than the average weekly dose used by the blind tapering group (p < .025).
Conclusions: CBTI combined with blinded hypnotic tapering seems a promising new treatment approach to help hypnotic users overcome their medication dependence and improve insomnia symptoms.

PREVALENCE AND MAGNITUDE OF PARADOXICAL INSOMNIA: IS IT A DISTINCT SUBTYPE AMONG PATIENTS WITH INSOMNIA DISORDER?

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Introduction: Paradoxical insomnia (PI) is a clinical condition that remains poorly understood. Patients with PI subjectively report significant sleep disturbances even though these complaints are not confirmed by the objective polysomnographic measurement of their sleep. Despite various studies reporting subtle sleep microstructural and cortical arousal differences between good sleepers and PI patients, this subtype of insomnia is not recognized in the current diagnostic criteria of insomnia disorder. Current classification lumped insomnia subtypes into one category due to limited data regarding PI. Further, estimated rates of PI come from small sample size studies and fluctuate from 0 to 63%, which created controversy if PI should be considered as an insomnia subtype. Also, no previous studies assessed gender related differences among patients with PI. Hence, the importance of conducting further studies to better understand the subtle differences that might exist between patients with insomnia disorder. Thus, our aim is to determine whether there are gender differences among these patients and to identify the magnitude of PI within a large clinical sample, which will help advance the field towards precision medicine.

Materials and methods: This retrospective study was conducted on 694 patients consulting at the Center for Advanced Research in Sleep Medicine (Montreal, Canada). All patients were subject to polysomnography (PSG) and diagnosed by a sleep specialist. We identified PI subjects as having a sleep duration misperception of at least 90 minutes compared to their PSG, despite having normal sleep (ie. sleep-onset latency (SOL) less than 30 minutes, sleep efficiency of 85% and a total sleep time of 6.5 hours or more). To study the discrepancy between the objectively reported SOL and the subjective one, we used a construct called "Sleep Onset Latency Difference Ratio (SOLDR)". SOLDR is defined as the ratio of the subjectively reported SOL in the morning questionnaire over the objective SOL recorded in the PSG. The discrepancy between the subjective and the objective total sleep time (TST) was measured using the Misperception Index, which was computed as follows: (objectiveTST - subjectiveTST)/objectiveTST. The severity of anxiety, depression and insomnia were assessed using Beck anxiety inventory, Beck depression inventory and insomnia severity index.

Results: The average age of the patients was 49 years; 60% of the cohort were females. Sex analysis revealed that 70% of those who underestimate sleep by 90 minutes despite normal sleep are women. Further, there was significant sex differences in sleep architecture (all p-values < 0.05) except for sleep efficiency. When TST measures and the definition of normal sleep were used, the prevalence of PI was 40 % and 24 % respectively. The average fold change of the cohort was 4.62 ± 10.00. The mean misperception index of the sample was 0.16 ± 0.29.

Conclusions: Our SOLDR model demonstrated that a subset of insomnia patients perceived that they took almost 5 times more time to fall asleep than they objectively did. This result supports the existence of a distinct subtype of insomnia; which in turn emphasizes the need for a personalized treatment approach for insomnia disorder subtypes.

THE OFF-LABEL USE OF ANTIPSYCHOTICS FOR INSOMNIA DISORDER: A MAJOR PUBLIC HEALTH CONCERN

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Introduction: Insomnia disorder (ID) is the second most prevalent sleep disorder affecting 10% of the general population. The AASM, ESRS and ACP clinical practices guidelines strongly recommend that cognitive behavioral therapy for insomnia (CBTi) should be the first line treatment for ID. However, discrepancies exist between clinical practices and guidelines recommendations since pharmacotherapy remains widely used. In the last decade, the number of sleep medication prescriptions increased by 293% in the US. Further, medication prescriptions for ID are often administered via a trial and error approach ranging from benzodiazepines to over the counter products. Moreover, off-label hypnotics are being prescribed for ID while there is little scientific evidence to support their effectiveness; hence, current clinical guidelines do not recommend them for non-comorbid ID unless response to other available treatments have failed. In addition, patients administer these medications for longer periods than recommended (< 4 weeks) despite major side effects such as dependence, tolerance, ID rebound, residual sedation and cognitive effect. Thus, the objective of our study is to address this public health concern by reporting the frequency of off-label treatments prescribed for ID prior CBTi referral, in a tertiary reference center.
Materials and methods: Retrospective analysis was conducted to review clinical files of patients consulting at the Center for Advanced Research in Sleep Medicine (Montreal, Canada). Overall, 760 adults (>18 years) were included in the study. All patients were diagnosed by a sleep specialist and recommended CBTi treatment. Patients were assigned to one of two groups: "Insomnia-only" or "Insomnia+PsychiatricComorbidity" according to the ICSD-3 and DSM-5 diagnostic criteria. Total sleep time of polysomnography records was used to identify patients with short (< 6 hours) and normal sleep durations (≥6hours). The severity of depression, anxiety and insomnia was assessed with Beck depression inventory (BDI), Beck anxiety inventory (BAI) and insomnia severity index (ISI). Finally, the twenty-first edition of the Anatomical Therapeutic Chemical (ATC) classification system (international standard for drug utilization studies and monitoring) was used to classify patients' medications prescribed before referral to our clinic.
Results: In total, the average group age was 54 years, 65% of the cohort were females and 68% were diagnosed with Insomnia-only. There are no group differences between Insomnia-only and Insomnia+PsychiatricComorbidity in age, sex, BAI, and ISI scores (all p-values > 0.05). However, the Insomnia+PsychiatricComorbidity had significantly greater BDI scores (p-value = 0.02) and had more short sleepers compared to those with Insomnia-only (52% vs 77%). Further, there were group differences in the frequency of the top four medication classes between insomnia-only and Insomnia+PsychiatricComorbidity groups. Among the top drug categories of the Insomnia-only group, "Antipsychotics" (13%) were frequently used and Seroquel was the most commonly prescribed drug (85%).
Conclusions: In accordance with previous reports, our results demonstrate that antipsychotics are widely used to treat ID despite the limited scientific evidence to support its effectiveness. Hence, our findings highlight the importance of conducting public health awareness to promote standard treatments for ID.

HOW OUR FAMILY DOCTORS MANAGE CHRONIC INSOMNIA? ANALYSING BIG DATA TO IMPROVE THEIR CLINICAL PRACTICE

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Introduction: Insomnia is the most prevalent medical pathology in adulthood and is currently considered a public health problem, being necessary to study precisely its diagnostic-therapeutic approach.
Materials and methods: Retrospective observational study about insomnia patients diagnosed and treated by primary care in our area (Department of Health of Sagunt, Valencia, Spain), between 2008 and 2018 (more than 100000 patients, collected random and anonymously from our two largest regional healthcare network databases), in order to analyse big data about epidemiology, and comorbidity, as well as which are the primary care strategies for chronic insomnia diagnosis, management and treatment.
Results: Comparative between our data and another similar samples published show higher prevalence and incidence, increased comorbidity and number of consultations and much more psychoactive drugs overprescription. Besides, there is too much variability in diagnostic, asessement and treatment criteria and procedures and a significant lack of resources and effectiveness in primary care chronic insomnia management in our environment.
Conclusions: According to our results, in our sample, chronic insomnia is one of the most important public health problems and there are too many failures. pitfalls and obstacles in his primary care management so it is urgent to have more resources to find out the causes and solve the problem as soon as possible
Acknowledgements: To all the people who have participated and made it possible

CIRCADIAN PREFERENCE AS A MODERATOR OF THE EFFECTS OF DIGITAL CBT FOR CHRONIC INSOMNIA

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Introduction: Digital cognitive behavioral therapy for insomnia (dCBT-I) has been shown to improve sleep and health for insomnia sufferers. More knowledge about predictors and moderators for dCBT-I treatment outcome is called for. The primary aim of this study was to test if circadian preference moderates' effects of dCBT-I on the insomnia severity index while controlling for age and sex. A secondary aim is to test if circadian preference moderates' effects of dCBT-I on symptoms of fatigue and psychological distress.

Materials and methods: This study performs on 1721 Norwegian adults with self-reported insomnia, who were either randomized to dCBI-I (i.e., SHUTi) or an online patient education (PE) intervention with simple advice to improve sleep. The participants were divided into five groups based on their circadian preferences as measured with The Horne-Östberg Morningess Eveningness Questionnaire, reduced version (rMEQ): Definitely evening-type, moderately evening-type, neither-type, moderately morning-type and definitely morning-type.

Mixed-model interactions were used to examine whether MEQ-grouping influenced the effects of dCBT-I compared to PE on the Insomnia Severity Index (ISI), Hospital Anxiety and Depression Scale (HADS), and Chalder Fatigue Questionnaire (CFQ). Individuals were included as random effect, and time, group and rMEQ and their two-way and three-way interactions (time x group x MEQ-grouping) were included as categorical covariates, while adjusting for age and sex.

Results: The mixed-model interactions (group x time x MEQ-grouping) showed significant effects of dCBT-I compared to PE on the ISI, for moderately morning types (estimated difference [ED] = -5.51, 95% CI -6.85 to -4.17, $p < .001$), neither types (ED = -4.95, 95% CI -5.77 to -4.11, $p < .001$), and moderately evening types (ED = -4.10, 95% CI -5.39 to -2.82, $p < .001$). For definitely morning types and definitely evening types, dCBT-I was not associated with reduced ISI scores compared to PE. Similarly, the group x time x MEQ-grouping interactions showed significant effects of dCBT-I compared to PE on the CFQ, for moderately morning types (ED = -2.20, 95% CI -3.81 to -0.59, $p =.007$), neither types (ED = -2.30, 95% CI -3.36 to -1.24, $p < .001$), and moderately evening types (ED = -2.82, 95% CI -4.51 to -1.13, $p < .001$). For definitely morning types and definitely evening types, dCBT-I was not associated with reduced CFQ scores compared to PE. Finally, a slightly different pattern was demonstrated in the mixed-model interactions with HADS as outcome, with significant effects of dCBT-I compared to PE for moderately morning types (ED = -1.40, 95% CI -2.70 to -0.10, $p =.035$) and neither types (ED = -1.25, 95% CI -2.09 to -0.40, $p =.004$). However, for definitely morning types, moderately evening types and definitely evening types, dCBT-I was not associated with reduced HADS scores compared to PE.

Conclusion: Insomnia sufferers with circadian preferences in the extremes do not seem to achieve significant improvements in sleep and daytime functioning with dCBT-I, compared to a PE intervention. These results may have implications for the allocation of insomnia sufferers to dCBT-I.

INSOMNIA IMPACTS THE PATIENT AND THE HOUSEHOLD: PERCEPTIONS OF THE BURDEN OF INSOMNIA ON NEXT-DAY FUNCTIONING

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Introduction: The impact of insomnia on patients' next-day functioning is well recognized. Less is known about how insomnia impacts household cohabitants. This survey examined perceptions of both insomnia patients and household cohabitants on the impact of insomnia/sleep difficulties on next-day functioning.

Materials and methods: The Harris Poll conducted the survey in the U.S from February 14 - March 8, 2019. Respondents were sampled from online consumer panels. Qualified individuals completed an online self-administered questionnaire. "Patients" were adults (≥18y) who had been diagnosed with insomnia (11% of respondents), or had experienced sleeping difficulties (falling asleep or staying asleep for ≥3 nights/week for ≥3 months; 89% of respondents). "Cohabitants" were adults (≥18y) who were not diagnosed with insomnia and did not experience sleeping difficulties, but who resided with an adult relative diagnosed with insomnia (9% of respondents), or with sleeping difficulties (91% of respondents). Raw survey data were weighted by relevant factors to be representative of the total U.S. adult population who, or whose adult relatives, have insomnia/sleeping difficulties.

Results: 525 patients (mean age 46y; 55% female) and 505 cohabitants (mean age 52y; 49% female) completed the survey. Approximately 2/3 of patients rated "waking up refreshed and ready to start the day" and "functioning normally throughout the day" as "very important" in managing their insomnia/sleeping difficulties. However, 93% of patients who experienced sleepiness or grogginess reported having these difficulties at least 2-3x/week and 95% rated them as "very" or "somewhat bothersome." Following a bad night's sleep, 67% of patients reported feeling tired/fatigued, and < 10% reported feeling "ready to start their day." Also, 90% of patients "strongly" or "somewhat" agreed that having a good night's sleep means "having a good day."

Survey results also demonstrated the negative impact of patients' insomnia/sleeping difficulties on cohabitants. Over half of cohabitants (53%) whose relatives experienced morning sleepiness or grogginess rated these difficulties as "very" or "somewhat bothersome" for the cohabitant. Following a bad night's sleep for the patient, 26% of cohabitants reported feeling tired/fatigued themselves. Also, 85% of cohabitants "strongly" or "somewhat" agreed that they are themselves more likely to have a good day when the patient has a good night's sleep.

Waking up well was one of the main goals of insomnia treatment. The majority of patients (70%) and cohabitants (81%) agreed that it wasn't enough for an insomnia medication to help the patient sleep; it should also help them function the next day. Patients and cohabitants reported similar top treatment goals: "waking up rested and refreshed the next morning" (patients, 59%; cohabitants, 55%); "functioning better throughout the day" (patients, 44%; cohabitants, 38%); and "waking up ready to enjoy life each day" (patients, 48%; cohabitants, 33%).

Conclusions: Results of this online survey suggest that the burden of insomnia/sleep difficulties on next-day functioning is not only an issue for patients but also for household cohabitants. Achieving insomnia treatment goals that reduce the negative impact of insomnia on next-day functioning in patients may also extend benefits to other household members.

Insomnia
Board #125 : Poster session 2

LONGER DAY LENGTH ENHANCES SLEEP AND MENTAL HEALTH OUTCOMES DURING A BEHAVIOURAL INTERVENTION FOR INSOMNIA

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Introduction: Approximately 30% of adults worldwide experience insomnia symptoms, which are linked to psychiatric comorbidities and lower quality of life. Behavioural interventions for insomnia often involve clients staying up later and/or waking up earlier than usual, which can affect exposure to light. This is important because daylight exposure affects sleep quality and wellbeing. However, it is unknown whether time of year affects outcomes in behavioural insomnia interventions. We provide preliminary data on the impact of day length and sunrise and sunset times on sleep and mental health outcomes post behavioural intervention for insomnia, as part of a large RCT.

Materials and methods: Eighty-eight treatment-seeking individuals (18-82 years) enrolled in a RCT over a 29-month period. Clients completed a seven session behavioural intervention for insomnia (completed over 7-10 weeks). Individuals completed questionnaires assessing sleep (Insomnia Severity; ISI), depression (Patient Health Questionnaire-9), and anxiety (Beck Anxiety Inventory, BAI), as well as sleep diaries (Sleep Efficiency; SE, and Sleep Latency; SL). Correlations assessed whether changes in day length, sunrise, or sunset during treatment were associated with change in sleep and mental health measures.

Results: Increasing day length across the intervention period was associated with greater improvement in sleep dairy SE ($r = .27$, $p = .015$). Later sunrise (i.e., shorter days across the intervention period) was associated with reduced improvement in sleep diary SE ($r = -.24$, $p = .027$), whilst a later sunset (i.e., a longer day) was associated with increased improvement in sleep diary SE ($r = .23$, $p = .037$). Individuals starting or finishing treatment during longer days showed greater improvement in subjective sleep (ISI: $r = -.34$, $p = .001$; $r = -.26$, $p = .016$ pre to post treatment, respectively) and mental health (PHQ: $r = -.22$, $p = .039$; $r = -.24$, $p = .024$; BAI: $r = -.29$, $p = .007$; $r = -.33$, $p = .002$ pre to post treatment, respectively).

Conclusions: Results show, for the first time, behavioural insomnia treatment is associated with greater improvement in subjective sleep and mental health symptoms during periods of longer day length. Therefore, individuals seeking treatment for insomnia in the spring or summer months might have improved treatment response and mental health outcomes. Results have significant clinical implications, highlighting the need to consider the time of year when undertaking behavioural insomnia treatment.

VALIDITY AND POTENTIAL CLINICAL UTILITY OF A CONSUMER AND RESEARCH-GRADE ACTIVITY TRACKER IN INSOMNIA DISORDER: OUTSIDE THE LABORATORY

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Introduction: Accurate assessment of sleep can be fundamental for monitoring, managing, and evaluating treatment outcomes within a magnitude of diseases. Proliferation of consumer activity trackers gives easy access to measuring of objective sleep. We evaluated the performance of a readily available commercial device (Fitbit Alta HR, FBA) relative to a validated research-grade actigraph (Actiwatch Spectrum Pro, AWS) in measuring sleep before and after a cognitive behavioural intervention in Insomnia Disorder.
Methods: Twenty five individuals with DSM-5 insomnia disorder (M=50.6 ±15.9 years) wore both a FBA and AWS and completed a sleep diary during an in-lab polysomnogram assessment and for one week preceding and following 7 weekly sessions of cognitive-behavioural intervention for insomnia. Device performance was compared for sleep outcomes (total sleep time, sleep latency, sleep efficiency, and wake after sleep onset). Analyses assessed: 1) agreement between devices across days and pre- to post-treatment; 2) whether pre- to post-treatment changes in sleep assessed by devices correlated with clinical measures of change.
Results: Devices generally did not significantly differ from each other on sleep variable estimates, either night-to-night, in response to sleep manipulation (pre-post treatment), or in response to changes in environment (in-lab vs. at-home). Change in sleep measures across time from each device showed some correlation with common clinical measures of change in insomnia, but not insomnia diagnosis as a categorical variable.
Conclusions: Overall, this consumer device (FBA) provides similar estimates of sleep outside the laboratory as a research grade actigraph. Despite the similarity between FBA and AWS performance, the use of consumer technology is still in its infancy and caution should be taken in interpretation.

Insomnia
Board #141 : Poster session 3
EXAMINING THE EFFECTS OF DIGITAL CBT FOR INSOMNIA ON DEPRESSIVE SYMPTOMS IN INDIVIDUALS WITH INSOMNIA SCORING ABOVE CLINICAL CUT-OFF FOR DEPRESSION: A RETROSPECTIVE ANALYSIS OF 3,352 PARTICIPANTS FROM TWO LARGE-EFFECTIVENESS RCTS (OASIS & DIALS)

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Introduction: Insomnia and depression commonly co-occur, however these conditions can be challenging to treat concurrently using depression-specific therapies. Evidence suggests that in-person cognitive behavioural therapy (CBT) for insomnia may be an appropriate treatment to improve both insomnia and depressive symptoms. However, research has yet to examine the effects of fully-automated digital CBT for insomnia in people with insomnia who also exhibit clinically severe depression symptoms. This study examined the effects of automated digital CBT for insomnia (SleepioTM) on symptoms of both depression and insomnia, and assess if improvements in sleep mediate improvements in depression symptoms in those meeting clinical cut-off for depression (PHQ-9 ≥10) at baseline.
Materials and methods: This study presents a secondary analysis of RCT data from two effectiveness studies examining the effects of digital CBT for insomnia (study 1: Freeman et al. 2017; The Lancet Psychiatry; study 2: Espie et al. 2018; JAMA Psychiatry). Participants in study 1 were randomised to receive treatment-as-usual (TAU) and either digital CBT or a waitlist control and TAU, and in study 2 were randomized to TAU and either digital CBT or sleep hygiene education and TAU. Individuals allocated to treatment in both trials were provided access to Sleepio, which is delivered across six sessions, each lasting approximately 20 minutes. Data were included from 3,352 individuals, aged 18-89 with complaints of insomnia indicated by Sleep Condition Indicator who met clinical cut-off for depression at baseline (≥10 PHQ-9). The primary outcome was depressive symptoms (PHQ-9) at post-treatment (study 1: 10 weeks; study 2: 8 weeks) and follow-up (study 1: 22 weeks; study 2: 24 weeks).
Results: Overall, there was a significant reduction in depression symptoms compared with control (post-treatment difference (SE): -3.03 (0.27), $p < 0.001$, d =0.2; follow-up (SE): -2.75 (0.31), $p < 0.001$, d=0.18), with a significant odds ratio of achieving remission at post-treatment (OR=1.84, $p < 0.001$) and follow up (OR=1.80, $p < 0.001$). Digital CBT also led to improvements in insomnia symptoms (post-treatment (SE): 5.19 (0.29), $p < 0.001$, d =0.64; follow-up (SE): 5.15 (0.35), $p < 0.001$, d=0.64). Improvements in insomnia symptoms associated with digital CBT was shown to mediate improvements in depressive symptoms.
Conclusions: This secondary analysis of combined RCT data showed that digital CBT for insomnia improves not only insomnia symptoms but also symptoms of depression. In addition, improvement in insomnia symptoms explained the improvement in depressive symptoms. These findings suggest that digital CBT for insomnia may be an appropriate intervention for some individuals with comorbid insomnia disorder and clinically severe depressive symptoms.

THE INFLUENCE OF THE LENGTH OF AWAKENINGS ON SLEEP ONSET MISPERCEPTION

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Introduction: Insomnia patients often overestimate their sleep onset latency (SOL) compared to objective recordings. An underlying mechanism of sleep onset misperception might be sleep fragmentation. Recently, we modelled the influence of the length of uninterrupted sleep fragments on sleep onset misperception, hypothesizing that sleep fragments that are too short might be neglected. Sleep onset was defined as the first epoch of the first sleep fragment exceeding L_s minutes. We varied L_s from 0.5 to 40 minutes and assessed the resulting difference between modelled SOL and SOL perceived by the subject, using the Root Mean Square Error (RMSE). Results showed that insomnia subjects required uninterrupted sleep fragments of at least 30 minutes to adequately perceive sleep onset. These results imply that sleep fragmentation at the beginning of the night indeed influences the perception of the sleep onset. However, the model is a simplification of reality, because it considers the length of sleep fragments, but not the length of the awakenings disturbing sleep. Here we describe an extended model that allows to also study the influence of the length of wake fragments on sleep onset misperception.

Materials and methods: We analyzed overnight polysomnographic data of 139 subjects with insomnia to model the combined influence of sleep and wake bout lengths on sleep onset misperception. A wake length parameter L_w was added to the model, and varied from 0.5 to 5 minutes. We assumed that awakenings shorter than L_w minutes are neglected by the subjects. Therefore, in case of a wake fragment shorter than L_w minutes, its neighboring sleep fragments were merged into one sleep fragment. Thus, the wake length parameter was used to adapt the input sleep lengths, after which the model was run for different sleep length parameters. Model performance was assessed by comparing RMSEs across models with different parameters.

Results: Applying the initial model, not taking into account the length of the wake fragments, resulted in an optimum RMSE for L_s=38 minutes (RMSE = 142.4). Thus, insomnia patients required 38 minutes of uninterrupted sleep to adequately perceive sleep onset. Applying the extended model, including the length of wake fragments, the lowest RMSE was found for L_s=45 minutes and L_w=1 minute, but the RMSE was only slightly reduced to 139.8. Additionally, we observed a limited occurrence of long wake fragments in the polysomnographic data. For instance, on group level, 67% of the wake fragments had a length of one minute or shorter.

Conclusions: Adding the length of wake fragments to the input parameter space of our sleep onset misperception model only marginally improved model outcome compared to assessing the influence of sleep lengths alone. Thus, little additional value for the prediction of perceived sleep onset is gained by adding wake length as a parameter. This is in line with the observation that only few long awakenings were present in our dataset. Our results show that the length of the wake fragments is of less importance to the perception of sleep onset compared to the length of the sleep fragments.

THE EFFECTS OF SEX AND AGE ON CLINICAL MANIFESTATIONS OF CHRONIC INSOMNIA DISORDER

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Introduction: Chronic insomnia disorder (CID) is characterized by frequent and persistent difficulty initiating or maintaining sleep that results in general sleep dissatisfaction. This study aimed to investigate difference in clinical and laboratory features of chronic insomnia disorder according to sex and age.

Materials and methods: Those who were diagnosed as CID based on the 3rd edition of International Classification of Sleep Disorders (ICSD-3) and aged from 40 to 79 years were recruited. The exclusion criteria were serious medical or neurological conditions and a history of treatment for insomnia in recent one year. We compared the subjective and objective sleep parameters between middle-aged group (ages 40-64 years) and elderly group (ages 65-79 years), and between men and women. Outcome measures were: Pittsburgh sleep quality index (PSQI), Epworth sleepiness scale (ESS), Insomnia severity index (ISI), habitual bedtime and wake-up time, subjective sleep latency (sSL), subjective total sleep time (sTST), subjective sleep efficiency(sSE), and polysomnography (PSG)-derived sleep parameters.

Results: Among 127 participants, 46 were elderly, and 42 were male. There was no significant difference in demographic data and sleep scales (i.e., PSQI, ESS, and ISI) between men and women, or between middle-aged and elderly patients.The elderly patients with CID tended to go to bed and rise both earlier than middle-aged patients and reported less sTST and lower sSE; on the other hand, objective sleep parameters were not significantly different between the two age groups except for apnea-hypopnea index (AHI, $p < 0.001$) and periodic limb movement index (PLMI, $p=0.001$), both higher in the elderly group. After we adjusted sex, AHI, PLMI, BDI, and BAI as covariates, reduced stage N2 sleep in elderly group became significant.

By sex, there was no significant difference in subjective sleep parameters, while objective sleep was much different. As manifested by PSG, men with CID showed more wake after sleep onset (WASO, $p=0.017$), greater number of awakening ($p=0.005$), less TST ($p=0.010$), lower SE ($p=0.012$), and higher AHI ($p < 0.001$) than women. Significant sex difference was also observed in the sleep structure with prominently reduced stage N3 and increased stage N1 sleep in men compared with women (N1: $p=0.002$; N3: $p < 0.001$). The significance all remained even in the adjustment model.

However, we could not find any significant interactive effect of age and sex on any sleep variables.

Conclusions: As elderly patients subjectively complain poorer sleep than middle-aged patients, they are more likely to seek medical help including hypnotic medication. Less disturbed objective sleep in women than men with CID may be related with more subjective sleep dissatisfaction in women with CID compared to their male counterparts.

Acknowledgements: none

Insomnia
Board #122 : Poster session 1
PHYSIOLOGICAL AND PSYCHOBEHAVIORAL FACTORS ASSOCIATED WITH INSOMNIA AMONG PATIENTS UNDER HEMODIALYSIS

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Introduction: Patients under dialysis usually comorbid with sleep-related disorder, such as restless leg syndrome (RLS), obstructive sleep apnea (OSA), periodic limb movement disorder (PLMD)..etc. Besides, patients often suffer from fatigue after dialysis and have less energy expenditure. Moreover, many patients take naps during dialysis that is contributing inadequate sleep habits. The aim of this study is to explore the potential mechanisms of insomnia among dialysis patients.

Materials and methods: We recruited 89 patients who receive hemodialysis at Taipei Medical University Hospital, including 36 females and 53 males. They were asked to complete a set of questionnaires, including Dysfunctional Beliefs and Attitudes about Sleep - 16 (DBAS-16), Sleep Hygiene Practice Scale (SHPS), Insomnia Severity Index (ISI), Patient Health Questionnaire-9 (PHQ-9), General Anxiety Disorder-7 (GAD-7), Sleep-50 Questionnaire (SLEEP-50).

Results: We collected 67 valid questionnaires, including 38 males and 29 females. 17 patients were classified as insomniacs based on ISI score over 15. The regression analysis showed PHQ-9 scores(β=454, p=.014), patient's age(β =231, p=.021), sleep environment of SHPS(β =-287, p=.047), and worry of DBAS-16 (β =405, p=.042)have predictive power to ISI scores.

Conclusions: Our study found that patients under hemodialysis have higher rate of insomnia. Patient's depressive severity (PHQ-9), age, sleep-associated worry, and over-concerned sleep environment could predict the severity of insomnia (ISI) which is concordant with previous studies of primary insomnia. On the contrary, RLS and poor sleep hygiene did not show prediction toward insomnia. Therefore, we speculate that the adaptation to disease and emotional hyperarousal before sleep are the underlying mechanisms of insomnia among hemodialytic patients. As a result, we suggest cognitive-behavioral treatment should be taken into consideration while treating insomnia of this group. Furthermore, we suggest to make some prevention strategies for the high-risk group.

ASSOCIATION BETWEEN WORK PRODUCTIVITY, SLEEP PROBLEMS, AND CHRONOTYPE: CROSS-SECTIONAL STUDY

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Introduction: Short sleep duration and poor sleep quality are problems worldwide. Sleep problems are known to reduce productivity for work. Measurement of presenteeism, which is a decrease in work productivity due to mental and physical dysfunction, is widely conducted and is an important indicator that accounts for more than half to three quarters or more of the total health cost related to corporate management. Sleep problems have become the fourth leading cause of presenteeism; thus, dealing with this is an important management issue. There is no epidemiological study that evaluates the relationships between each sleep components(sleep duration and sleep quality), chronotype and productivity comprehensively. For instance, considering each component constituting sleep, individual chronotypes, and different sleep schedules depending on workdays or free days, a study about the relationship between sleep and presenteeism has never been conducted in the world. Chronotype and different sleep shcedules should be considered in order to improve sleep. As far as we know, this study is the world´s first epidemiological study to identify social and biological effects of sleep and each sleep component affecting worker productivity.
Materials and methods: Design: Cross sectional analysis of a questionnaire survey. Setting: The study was conducted in 17 offices in Tokyo, Japan.
Participants: The study included 2897 people who were 1835 men and 1062 women, and 18 to 76 years of age. People who answered all the sections for the study and agreed to the academic use of their data were included in the analysis.
Main outcome measures: Productivity loss was measured using Short Form of the Work Limitations Questionnaire (WLQ-SF) after adjusting characteristics of participants.
Results: The decline in productivity due to presenteeism of people with short sleep duration, between 5 and 6 hours ($\beta = 0.068$, $p = 0.004$) and less than 5 hours ($\beta = 0.105$, $p < 0.001$), on work days was significantly greater. Subjective sleep quality ($\beta = 0.124$, $p < 0.001$), sleep latency ($\beta = 0.073$, $p < 0.001$), sleep disturbance ($\beta = 0.123$, $p < 0.001$), use of sleep medication ($\beta = 0.044$, $p = 0.007$), and daytime dysfunction ($\beta = 0.359$, $p = 0.001$) were significant factors affecting presenteeism. When adjusting for confounding factors, sleep duration in work days, sleep duration in free days, and chronotype were not significant for presenteeism in the multiple regression analysis.
Conclusions: Optimal sleep pattern varies per person depending on the chronotype and age. Thus, a comprehensive improvement of sleep is needed to improve work productivity. It may be important for workers to have satisfying sleep duration and quality.

A COMPARISON OF THE EFFECTS OF CBT-I BETWEEN PRIMARY INSOMNIA AND COMORBID INSOMNIA

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Introduction: Cognitive-behavioral therapy for insomnia (CBT-I) is effective not only for primary insomnia but also for comorbid insomnia, which is associated with physical, psychiatric and other sleep disorders. However, it is not yet clear whether the effects of CBT-I on comorbid insomnia and that on primary insomnia are equal. The aim of this study was to compare the effects of CBT-I for comorbid insomnia with that for primary insomnia.

Materials and methods: The eligible subjects were 27 patients who had been diagnosed with chronic insomnia disorder by ICSD-3, with chronic hypnotics use as outpatients, wishing to receive individual CBT-I at our hospital. The subjects completed 5-session CBT-I and were divided into 2 groups: primary insomnia (P) group and comorbid insomnia (C) group. P group was 16 participants (50% male), with a mean age of 62.8 years. The mean duration of insomnia was 45 months and mean nightly dosage of hypnotics before CBT-I (at baseline) was 1.05 mg (1 being equivalent to 1 mg of flunitrazepam). C group was 11 participants (63.6% male), with a mean age of 64.4 years. Comorbid disease of C group included psychiatric (n = 5, major depression and anxiety disorder), physical (n = 2, chronic pain) and other sleep disorders (n = 4, obstructive sleep apnea and restless legs syndrome). The mean duration of insomnia was 158 months and mean nightly dosage of hypnotics at baseline was 1.55 mg.

The short-term outcome (4 weeks after CBT-I) was measured by using Insomnia Severity Index Japanese version (ISI-J), Self-rating Depression Scale (SDS), 36-Item Short-Form Health Survey (SF-36) and 7-days sleep diaries (total sleep time (TST), sleep efficacy (SE), sleep onset latency (SOL), wake after sleep onset (WASO)). We analyzed changes in baseline and post-treatment in each group and compared the changes between two groups. The long-term outcome about the changes in the dosage of hypnotics (GABA receptor agonist) was evaluated by checking medical records at 6 months after CBT-I.

Results: ISI-J scores improved after treatment in both groups (P group: baseline 15.1, post-treatment 9, C group: baseline 15.1, post-treatment 13), but the improvement was significant in only P group. SE, WASO and some subcategories of SF-36 also improved significantly in only P group. In both groups, the dosage of hypnotics significantly decreased, and the effects were maintained at 6 months after CBT-I (P group: baseline 1.07mg, post-treatment 0.76mg, 6 months after treatment 0.59mg, C group: baseline 1.57mg, post-treatment 1.25mg, 6 months after treatment 1.1mg).

Conclusions: The effectiveness of CBT-I on comorbid insomnia was not equal to that on primary insomnia in our study. Previous studies have also pointed out that CBT-I´s effects might not be consistent due to the diversity of comorbid insomnia. Hence, it will be necessary to investigate in detail the factors related to the difference and the influence of CBT-I for comorbid insomnia, in order to perform more effective CBT-I.

RELAPSE AND TREATMENT-RESISTANCE AFTER CBT-I: THE ROLE OF RESIDUAL SLEEP AND ANXIETY SYMPTOMS

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Introduction: Remission rates of insomnia after cognitive-behavioral therapy (CBT-I) usually range between 40% and 60%, which leaves a substantial proportion of treated patients with insomnia. Moreover, some of those who achieve remission initially after treatment may relapse later. There is little information to identify those individuals. This study aimed to investigate clinical variables at post-treatment associated with future relapse or treatment resistance at 12-month follow-up.

Methods: This is a secondary analysis of a comparative trial of behavior therapy (BT), cognitive therapy (CT) and cognitive-behavioral therapy (CBT) for chronic insomnia (Harvey et al., 2014). The Insomnia Severity Index (ISI) was used to determine participants' insomnia status (ISI< 8: remission). Measures taken at post-treatment included several sleep parameters derived from sleep diary and Polysomnography (PSG), Dysfunctional Beliefs and Attitudes about Sleep (DBAS), the State-Trait Anxiety inventory (STAI). Individuals who achieved remission at post-treatment (ISI< 8) and those who remained in remission at follow-up were compared to those who remitted at post-treatment but relapsed at follow-up (ISI ≥ 8). Among those who did not remit at post-treatment (ISI ≥ 8), comparison was made between treatment-resistance and delayed remission at follow-up. Binary logistic regressions were used to examine predictors of relapse or treatment resistance, while controlling for age, gender and treatment groups condition. Two-way ANOVAs were further performed to compare trajectory of significant predictors by calculating interaction effects of remission groups* time.

Results: Among the 188 participants who took part in the original study, 151 were included in this analysis (63.6% females, average age of 47.36 years-old ± 12.55). Overall, 75 participants (50%) remitted at post-treatment, and 22 of them (29%) had relapsed at follow-up (mean ISI = 10.32 ± 2.36). Among the 76 non-remitters at post-treatment (n=76), 19 remitted at follow-up (25%). Results of binary logistic regressions showed that higher scores on state anxiety (B= 0.08, p=0.04) and CT&BT (vs. CBT) were associated with relapse. Moreover, longer sleep onset latency (B=0.07, p=0.04), longer wake time (TWT; B=0.03, p=0.02) and lower sleep efficiency (SE; B=-0.13, p=0.04) from sleep diary was also associated with relapse that were independent of effects of state anxiety. As for the treatment resistance higher trait anxiety (B=0.08, p=0.02) and DBAS scores (B=1.20, p=0.002) emerged as significant predictors of treatment resistance. Yet, treatment groups did not predict treatment resistance. Sleep parameters from sleep diary and PSG were not significant after controlling for traits anxiety. Results from ANOVAs suggested that trends of TWT and SE significantly contrasted between group of relapse and non-relapse; the trends of DBAS scores significantly differed between group of treatment-resistance and delayed remission.

Conclusion: After CBT-I, several sleep parameters as well as state anxiety symptoms predicted relapse. Treatment resistance was significantly associated with traits anxiety and cognitive symptoms at post-treatment. To optimize the outcome of CBT-I, more attention should be focused on anxiety symptoms. Moreover, regarding treatment-resistant insomnia, booster sessions might be needed to address dysfunctional beliefs. Understanding of

different trajectories of TWT and DBAS might be useful in identifying risk groups at earlier stage of treatments.

COMPLEMENTARY AND ALTERNATIVE TREATMENTS FOR INSOMNIA/SLEEP DEPRESSION-ANXIETY SYMPTOM CLUSTER: META-ANALYSIS OF ENGLISH AND CHINESE LITERATURE

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Introduction: Complementary and alternative medicine (CAM) are widely used by individuals with insomnia or emotional disturbances. Yet, evidence regarding the efficacy of CAM therapies are conflicting. Given that depressive and anxiety symptoms frequently cooccur with insomnia or poor sleep quality, this study aims to estimate the efficacy of CAM therapies for insomnia/sleep disturbance-depression-anxiety symptom.
Methods: A systematic review of the literature was performed to identify randomized controlled trials (RCT), published in English or Chinese, investigating the effect of CAM therapies on significant insomnia/poor sleep quality and coexisting depression and/or anxiety symptoms. Meta-analyses were completed by calculating within-group effect size (ES) of each CAM treatment on sleep, depression and anxiety measures (posttreatment scores compared to pretreatment scores). Random-effect models were adopted for estimation of weighted ESs and confidence intervals. Further moderating analyses of study quality, language, treatment duration and presence of physical diseases were conducted on ESs. Between-group ES of CAM (vs. waitlist and minimal treatment controls) were also computed in high-quality studies.
Results: Among 5047 articles, a total of 62 studies were included for the systematic review and meta-analysis (30 from Chinese databases; 32 from English databases). CAMs were categorized into six groups: a) Acupuncture or/and Acupressure: AA; b) Mind-body/body-mind therapies with meditative/mindful components: MB; c) compound Chinese herb medicine: CHM; d) Music and relaxation: MUR; e) Massage; f) Aroma therapy. All CAM modalities yielded significant, moderate to large effect sizes on sleep, depression and anxiety symptoms. However, ESs heterogeneity was large except for the ES of MB on insomnia severity index ISI ($I2 = 0.02\%$; $ES = -0.80$; $k= 4$). Analyses on subgroup of high-quality studies (mainly investigating AA and MB treatments; total 22 treatment arms) showed that ESs were reduced but remained significant. Significant between-group differences were found between Acupuncture-Acupressure/Mindfulness-based and waitlist controls. Yet, no significant differences were found when these two CAMs were compared to non-specific /placebo controls. For moderating effects, in general, lower study quality, Chinese literature, longer duration of Mindfulness-based treatments and the absence of physical disease were associated with larger ESs, although the ESs varied according to specific outcome measures and analyses.
Conclusion: Certain CAM treatments (MB and AA) appeared promising in ameliorating sleep-emotional symptoms. However, there is a need to closely examine the presence and the nature of the active components in different CAM approaches. Cultural context of treatments as well as clinical characteristics of participants should be systematically reviewed in order to understand "what (does not) works for whom".

OBJECTIVE AND SUBJECTIVE SLEEP PROBLEMS AND QUALITY OF LIFE OF REHABILITATION IN-PATIENTS WITH MILD TO MODERATE STROKE

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Introduction: The principal objectives of this study were to investigate relationships between objective sleep parameters that is, sleep onset latency, wake after sleep onset, number of awakenings, sleep efficiency, and sleep duration, and the quality of life after mild to moderate stroke.
Materials and methods: The subjects were 112 first-time mild to moderate stroke patients admitted to a rehabilitation unit. At about 20 days after stroke, physical functions, depression, anxiety, quality of life, subjective insomnia, quality of sleep, and fatigue were assessed. Objective sleep parameters were also assessed using wrist worn actiwatch.
Results: Patients with insomnia had greater sleep onset latency (p=0.001), wake after sleep onset (p=0.005), awoke more frequently (p=0.013), and slept less efficiency (p< 0.001) than patients without insomnia, but total sleep durations were similar. In all participants, lower overall domain of quality of life was significantly associated with sleep onset latency (p=0.009), and total insomnia severity index (p< 0.001), total Epworth Sleepiness Scale (p< 0.001), the National Institute's Health Stroke Scale (p=0.004), Modified Barthel Index (p=0.034), and Screening Tests for Aphasia and Neurologic-Communication Disorders (p=0.044) scores.
Conclusions: Objective sleep parameters (sleep onset latency and sleep efficiency) were found to be associated with quality of life during the early stage of rehabilitation in mild to moderate stroke patients.
Acknowledgements: none

INVESTIGATION OF DIFFERENCES IN FUNCTIONAL CONNECTIVITY ACROSS SELF-REPORTED SLEEP-WAKE STATES IN PATIENTS WITH INSOMNIA AND GOOD SLEEPER CONTROLS: STUDY INTRODUCTION AND METHODS

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Introduction: We previously showed that adults with insomnia have fewer differences between NREM sleep and the resting-state in relative regional cerebral metabolic rate when compared to good sleeper controls. Brain regions showing the greatest group by state differences were the left heteromodal regions of the frontoparietal cortex, the posterior cingulate, and the lingual/fusiform gyri. This study aimed to replicate and extend these findings using resting-state fMRI. We hypothesize that patients with insomnia will have less sleep-wake differences in functional connectivity in regions of interest (ROIs). In this abstract, we describe the methods that have been conducted, the analyses we intend to run, and anticipated results.

Methods: The study sample ($M = 21$ years old, range 18-25) included 12 participants with insomnia and 16 good sleepers. Groups were well-matched for age and sex. Diagnoses of insomnia were verified using the Structured Clinical Interview for DSM-5. Each participant arrived at the designated MRI facility about 30 min prior to their reported habitual bedtime. Participants were fitted with an fMRI-compatible polysomnography cap that included scalp electroencephalograph, chin electromyograph, electrooculograph, and electrocardiograph leads. When participants felt sleepy, they were placed in the scanner. Participants were instructed to close their eyes and were given permission to sleep. At the start of the resting-state scan, the lights were turned off. Participants were given up to 2 hours to fall asleep. Following the resting-state fMRI scan, participants were asked to report how long it took them to fall asleep and how long they slept. We calculated functional connectivity for wakefulness during the five minutes prior to self-reported sleep onset and, for sleep, the 5 minutes following self-reported sleep onset. We will quantify functional connectivity for the 5 previously identified ROIs (i.e., left middle frontal gyrus, left parietal cortex, posterior cingulate cortex, right lingual gyrus, and left lingual gyrus) with the rest of the brain. We will conduct 5 separate group (insomnia vs. good sleepers) by condition (self-reported sleep vs. wake) repeated measures ANOVAs to determine functional connectivity.

Implications: Findings from this study may provide support for and extend beyond previous studies that suggest insomnia affects relative regional brain metabolism through the reduction of differences between wake and NREM sleep-states. If so, the differences discovered using resting-state fMRI may link to dysregulation in regions of the default mode network associated with awareness, such as the posterior cingulate cortex and precuneus, which are also implicated in the development of depression.

THE SLEEP BELIEF-PRACTICE INDEX (SBPI) FOR THE DISCREPANCIES BETWEEN BELIEFS AND PRACTICES ON "GOOD" SLEEP

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Introduction: To develop a sleep belief-practice index to measure discrepancies between beliefs and practices on "good" sleep and to examine its relationships with insomnia and mental health.

Materials and methods: Two online surveys were conducted in Japan to develop and validate the Sleep Belief-Practice Index (SBPI) scales, a pair of new scales designed to measure beliefs and practices on sleep and their discrepancies. In Study 1 (N = 400), survey data for 40-item pilot version of the scales were entered into exploratory factor analysis. In Study 2 (N = 2952), survey data were entered into factor analysis to confirm scale items and factors and then correlation analyses to confirm positive associations of SBPI (i.e., sleep belief-practice discrepancy) with insomnia and feelings. Fourteen items were extracted for respective SBPI-B and SBPI-P (SBPI-P items are described in parentheses): (1) For a good sleep, I should (usually do) prepare my sleep environments properly, (2) For a good sleep, I should (usually do) adjust the height of my pillow, (3) For a good sleep, I should (usually do) select a comfortable bed and linens, (4) For a good sleep, I should (usually do) have quiet environments, (5) My health should be affected if I cannot sleep well at night (I usually try to sleep well to keep myself in good health), (6) Mood when awakening affects activities during the day (I usually try to wake up in a good mood for better activities during the day), (7) Everything should be going bad if I cannot sleep well at night (I usually do keep a good night sleep for having everything going well), (8) For a good sleep, I should (usually do) sleep for the same period of time every day, (9) For a good sleep, I should (usually do) go to bed at a regular time every day, (10) For a good sleep, I should (usually do) sleep soon after lying on a bed, (11) For a good sleep, I should (usually do) sleep without any interruptions, (12) For a good sleep, I should (usually do) wake up early, (13) For a good sleep, I should (usually do) keep my bed environments warm enough, and (14) For a good sleep, I should (usually do) keep my body peripherals warm.

Results: We selected common 13-item scales on sleep beliefs (SBPI-B) and practices (SBPI-P) with four factors, namely, environments, regularity, well-being, and thermal conditions, and confirmed each scale with acceptable Cronbach's alphas (alphas = 0.857 and 0.865 for SBPI-B and SBPI-P, respectively). The discrepancy of sleep beliefs and practices (SBPI-D) was found to be positively correlated with insomnia and negative feelings.

Conclusions: We developed and validated SBPI based on scale development work and two questionnaire surveys. Sleep beliefs-practices gap was associated with insomnia. Mitigating the beliefs toward a moderate level, enhancing the practices toward a satisfactory level, or a combination of these could help fill the gap between sleep beliefs and practices, and thus should be effective for relieving insomnia.

Insomnia
Board #124 : Poster session 1

ONLINE PRENATAL TRIAL IN MINDFULNESS SLEEP MANAGEMENT (OPTIMISM): A PILOT RANDOMIZED CONTROLLED TRIAL FOR INSOMNIA IN PREGNANCY

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Introduction: Sleep deficiency affects a majority of pregnant women with significant impact on daily function, mood, and pregnancy and birth outcomes. Depression symptoms affect approximately 16% of pregnant women and are strongly correlated with sleep deficiency. Mindfulness meditation is a promising treatment approach because it targets emotional and cognitive reactivity, common pathways for developing depression and insomnia symptoms. There are insufficient prenatal resources to provide individualized therapy or group in-person classes to improve pregnant women's sleep and mood. The purpose of this study is to test the feasibility and estimate the efficacy of a novel six-week online mindfulness meditation intervention to help pregnant women with a history of depression self-manage insomnia. The intervention will incorporate elements of mindfulness, stimulus control, and sleep restriction in the context of pregnancy.

Materials and methods: The OPTIMISM study is a two-arm, parallel group RCT using block randomization in a 1:1 allocation. Broad community based recruitment will occur through prenatal care providers, maternity services (First Steps, WIC, Nurse Family Partnership), perinatal mental health providers, and social media. Data will be collected at baseline (T1) and post-intervention (T2). Primary eligibility criteria are: 12-28 weeks gestation with viable pregnancy, prior diagnosis of depression currently in remission (score < 3 on the PHQ-2 depression screening questionnaire), and subjective report of insomnia (score > 7 on the Insomnia Severity Index). Participants will complete online baseline measures and 8 days of actigraphy sleep monitoring and diaries before being randomized to the mindfulness treatment or education-only (sleep hygiene) control. Participants will complete six weekly online modules (Articulate Storyline), continue daily sleep diaries, and participate in a treatment-specific online discussion forum. Immediately after intervention completion participants will repeat online assessments, an intervention acceptability survey, and eight days of actigraphy and sleep diaries. A brief online survey will provide additional acceptability data 4 weeks postpartum. The primary outcome measure is sleep quality measured with the Pittsburgh Sleep Quality Index. Secondary outcome measures include: sleep measured with actigraphy and diaries (sleep efficiency, total sleep time, total wake time), PROMIS measures (fatigue, sleep related impairment, sleep disturbance); intervention adherence and acceptability; mood (depression, anxiety, positive affect, quality of life); and self-management and behavior change (self-efficacy, self-regulation, sleep problem acceptance, and trait mindfulness).

Results: Recruitment has commenced for a target of 25 participants in each group. Statistical analysis of outcomes will use between-group differences from baseline (T1) to post-intervention (T2) on psychological and sleep measures, using an intention-to-treat approach and correcting for any significant differences in covariates measured at baseline. The trial is registered with ClinicalTrials.gov (NCT04016428).

Conclusions: This research is innovative in addressing sleep in pregnancy using a self-management research design and methods that can be accessible and cost-effective for large numbers of pregnant women. The results from this study will inform future refinement and efficacy testing of the intervention in a larger randomized controlled trial.

DYSFUNCTIONAL BELIEFS ABOUT SLEEP CAN MEDIATE THE EFFECT OF FEAR OF PROGRESSION ON INSOMNIA OF CANCER PATIENTS

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Introduction: The role of dysfunctional belief about sleep is important for the development of insomnia among cancer patients. This study aimed to investigate whether dysfunctional belief about sleep mediates the relationship between fear of progression and insomnia in cancer patients.

Materials and methods: A total of 337 cancer patients participated in our study. Dysfunctional belief about sleep, severity of insomnia, depression, and anxiety, fear of progression were measured with the following questionnaires: C-DBS (Cancer-related Dysfunctional Beliefs about Sleep), ISI (Insomnia Severity Index), PHQ-9 (Patient Health Questionnaire-9), FoP (Fear of Progression), and state subcategory of STAI (State and Trait Anxiety Inventory). Demographic information included age, sex, type of cancer, stage, type of treatment, history of operation, and psychiatric diagnosis. Path analysis was used to clarify the relationships among variables. Since the C-DBS consists of two items (Q1-Immune & Q2-Recurrence), we implemented an additional path analysis including these variables in our second analysis.

Results: Our path analysis model indicated that C-DBS mediated the effect of FoP (β=0.36, p< 0.001) and sex (β=0.13, p=0.009) on ISI. PHQ-9 (β=0.32, p< 0.001) and STAI (β= -0.09, p=0.071) had direct influence on ISI scores. In our second path analysis, Q1-immune item mediated the effect of FoP (β=0.29, p< 0.001) on ISI, and Q2-recurrence item mediated the effect of FoP (β=0.17, p< 0.001) and sex (β=0.09, p=0.019) on ISI. Age did not have any correlations with either CDBS or ISI.

Conclusions: The path analysis model in the present study indicated that C-DBS mediate the effect of FoP and sex on ISI. From our second path analysis, the results implied that there might be an internal process of Q1-immune and Q2-recurrence. Since dysfunctional belief about sleep in cancer patients mediated the effect of fear of progression on insomnia, efforts to reduce those beliefs should be considered as well as management of fear of progression for better sleep of cancer patients.

Insomnia
Board #147 : Poster session 3
WILL TREATMENT OF INSOMNIA ALSO REDUCE WORK-RELATED IMPAIRMENT?

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Introduction: Insomnia has been shown to be associated with work-related impairment, but less is known about whether successful treatment of insomnia leads to reduced work-related impairment. The aim of this study was to examine the effect of cognitive behavior therapy for insomnia (CBT-I) on sickness absenteeism (SA), sickness presenteeism (SP), overall work impairment (OWI), and activity impairment (AI).

Materials and methods: The sample included 77 (59 females) working participants diagnosed with insomnia referred to a public sleep clinic. All patients were randomized to receive either digital CBT-I (dCBT-I) or face-to-face CBT-I (FtF CBT-I). For the purposes of the current study, the two treatment conditions were combined into one group. The Work Productivity and Activity Impairment questionnaire for General Health (WPAI:GH) was used to measure SA (work time missed due to ill health), SP (productivity loss while at work due to ill health), OWI (aggregated score of SA and SP), AI (impairment in daily activities outside of work due to ill health). Insomnia symptoms were evaluated using the Insomnia Severity Index (ISI). Treatment responders were defined as having a reduction in total ISI score of at least 8 points from baseline to six months follow-up, whereas remitters were defined by an ISI score of 7 or less at six-months follow-up.

Results: Overall, patients significantly improved on SP ($p = .002$; Cohen´s $d = .45$), OWI ($p = .001$; $d = .54$), and AI ($p < .001$; $d = .61$) but not SA ($p = .20$; $d = .21$) at six months follow-up compared with baseline. Furthermore, patients who were treatment responders at six months follow-up improved significantly more on AI ($p = .026$) but not on SA ($p = .38$), SP ($p = .066$) or OWI ($p = .059$) compared with non-responders. For remitters compared with non-remitters we found significant improvement on SA ($p = .034$), SP ($p = .003$), OWI ($p = .003$), and AI ($p = .007$).

Conclusions: Remitters at six months follow-up had significant improvement on all outcomes, whereas responders only had improvement on AI. Given the link between insomnia and work-related impairment, the current study implies benefits of receiving CBT-I and particularly achieving remission from insomnia on both an individual and a societal level.

A MOBILE PHONE APP ADMINISTRATION OF INTENSIVE SLEEP RE-TRAINING TREATMENT OF CHRONIC INSOMNIA IN THE HOME ENVIRONMENT

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Introduction: Insomnia is associated with personal impairments, health risks, and economic burden. An estimated prevalence of 5-10% suffer from chronic insomnia most of whom are untreated or under treated. The large majority of insomnia cases are medically treated with pharmaco-therapy despite offering only symptomatic relief during administration. Cognitive/behavior therapy for insomnia (CBTi) offers more effective long term treatment without side effects. However, CBTi administered by sleep psychologists and is limited by small numbers of these specialists. Intensive Sleep Re-training (ISR) has shown great promise as a new behavior therapy, particularly for sleep onset insomnia. It condenses behavioral therapies normally taking 3-4 weeks, into a period of only 12-24 hours. It was administered in a sleep laboratory and required PSG monitoring of sleep/wake state to detect sleep onsets and awaken the patient 2-3 minutes later. This method allowed many rapid sleep onset opportunities in one laboratory session of 12-24 hours. However, the laboratory-based protocol for ISR is expensive and of limited availability. A less expensive method of administering ISR in the home environment recently became available in the form of a mobile phone application (app). It uses a behavioral response to auditory stimuli as a measure of wakefulness. The aim of this pilot study was to assess the effectiveness of this mobile phone app administration of ISR for the treatment of insomnia.
Materials and methods: Twelve participants meeting the ICSD-3 criteria for chronic insomnia were recruited for a quasi-experimental before and after treatment design study. On the treatment night for each sleep onset attempt the app elicited just audible brief tone stimuli to which the patient responded with a hand movement of the phone. When the patient failed to respond, the phone awoke the patient with a high intensity vibration for the next trial of falling asleep. Trials were carried out for 10 hours with patients averaging a total of 30 trials most of which had sleep onset latencies < 10 min. Sleep diaries were obtained for a baseline week pre-treatment, the week immediately after training, and follow-up after four weeks.
Results: There were significant improvements in all sleep diary measures for the week immediately after treatment. Sleep latency reduced 44 min, WASO by 33 min, and total sleep time and sleep efficiency increased by 58 min and 14% respectively. These benefits tended to diminish by the 4 week follow-up but with sleep onset latency and sleep efficiency still significantly improved from baseline. Insomnia Severity index showed a significant (p< .001) 6-point decrease from baseline that was maintained through the follow up period. Several measures of daytime functioning and mood showed significant and sustained improvements over the follow-up period.
Conclusions: The mobile phone app administration of Intensive Sleep Re-training in the home environment looks very promising but needs to be confirmed with a placebo controlled randomized control trial. If confirmed, it offers a readily available treatment of insomnia in the home without drugs.
Acknowledgements: Michael Schwartz, the developer of Sleeponq mobile phone application for the administration of Intensive Sleep Re-training.

CORRELATION OF HYPERTENSION WITH CORTISOL LEVEL AND INSOMNIA SEVERITY INDEX-INA SCORE IN ACUTE ISCHEMIC SMALL VESSEL STROKE PATIENTS

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Introduction: Patients with acute ischemic stroke often complain of sleep difficulty, one of which is insomnia. Insomnia is influenced by several factors, which is cortisol and hypertension, and hypertension is a risk factor for stroke. A high increase in cortisol levels causes hypertension and decrease in serotonin and melatonin which causes insomnia via axis HPA. This study is conducted to find correlation of hypertension with cortisol level and insomnia severity index-INA score in acute ischemic small vessel stroke patients.

Material and method: This was a cross sectional analitic study held in RSUP Dr. Hasan Sadikin, RSAU dr. M Salamun Bandung and RS. Dustira, Cimahi from January - April 2019. The eligible subjects had their blood taken for cortisol levels measured using ECLIA method. Hypertension has known with anamnesa, physical examination and Insomnia Severity Index was used for measure insomnia. Scores (ISI-INA) are used for the initial screening of insomnia with high sensitivity and specificity. Spearman test used in this study.

Result: A total of 81 subject have been diagnosed acute ischemic strokes onset 1-3days. Mean of age 60 (±10,07) and range 32-81 years. Stroke onset mean 2.25 days. Range of cortisol level 5,88-19,04 mcg/dL and mean of cortisol 10.98 mcg/dl. Risk factors of hypertension 74 (91.36%) and range of ISI-INA score 2-24 with mean of ISI-INA 9.28. Correlation analysis of cortisol with hypertension was not statistically significant with ($r = 0,038$, $p = 0,739$) and correlation between hypertension with ISI-INA score was statistically significant ($r = 0,211$, $p = 0,058$).

Conclusions: There is no correlation between cortisol level with hypertension in acute ischemic stroke and no correlation between hypertension with ISI-INA score.

Keywords: acute ischemic small vessel stroke, cortisol level, ISI-INA score, hypertension

Insomnia
Board #148 : Poster session 3

CORRELATION BETWEEN SMOKING AND INSOMNIA SEVERITY INDEX-INA SCORE IN ACUTE ISCHEMIC SMALL VESSEL STROKE PATIENTS

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Background: Patients with acute ischemic stroke often complain of sleep difficulty, one of which is insomnia. Insomnia is influenced by several factors, one of which is smoking, and smoking is a risk factor for stroke. Smoking causes a decrease in serotonin and melatonin via axis HPA which causes insomnia. This study is conducted to find correlation between smoking and Insomnia Severity Index-INA score in acute ischemic small vessel stroke patients.
Method: This was a cross sectional analytic study held in RSUP Dr. Hasan Sadikin, RSAU dr. M Salamun Bandung and RS. Dustira, Cimahi from January - April 2019. Smoking has known with anamnesa and Insomnia Severity Index was used for measure insomnia. Scores (ISI-INA) are used for the initial screening of insomnia with high sensitivity and specificity. Spearman test used in this study.
Result: A total of 81 subject have been diagnosed acute ischemic strokes onset 1-3 days. Mean of age 60.68 (±9.40) and range 37-78 years. Stroke onset mean 2.25 days. Smoker 28 (34,56%). ISI-INA score 2-23 with mean of ISI-INA 10.57 (±5.24) . Correlation analysis of smoking with ISI-INA score was statistically significant with (r=0,258; p = 0,021).
Conclusion: There is a positive correlation between smoking and ISI-INA score in acute ischemic stroke
Keywords: acute ischemic small vessel stroke, ISI-INA score, smoking

ADHERENCE TO THE QUARTER-HOUR RULE FOR INSOMNIA: IS TIME PERCEPTION AFFECTED BY SLEEP INERTIA?

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Introduction: Cognitive behavioral therapy for insomnia (CBT-I) is the first line treatment for insomnia. One component of CBT-I is the "quarter-hour rule" (QHR), which instructs patients to get out of bed when they have not been able to fall back asleep within approximately 15 minutes. Since people with insomnia tend to overestimate wakefulness, these individuals may have difficulty estimating when 15 minutes have passed. Getting out of bed too early (overestimating time) means they are not giving themselves a chance to fall back asleep. Getting out of bed too late (underestimating time) means they reinforce the association between bed and wakefulness for longer than permitted. We hypothesise that sleepiness/sleep inertia after waking from sleep (vs. wake) might contribute to the impairment in time perception, in addition to any distortion that are unique to insomnia. The objective of the present study was to assess differences in time estimation following a wake and sleep condition in good sleepers.

Materials and Methods: Nine good sleepers, aged 22-54 years (mean=33.2), were recruited from the Laval University community. Participants' sleep quality was evaluated using the Pittsburgh Sleep Quality Index, where a score of 5 (6 for students) or lower was needed to be eligible. Participants were required to perform a time estimation task (TET) where they were asked to determine when they believed 15 minutes had passed. Before the TET, sleepiness was evaluated using the Stanford Sleepiness Scale. The sleep condition required participants to spend a night in laboratory conditions. They were woken up after two hours (in order to increase the chances of waking from slow wave sleep, and with sleep inertia) and asked to perform the TET. In the wake condition, individuals were required to perform the TET during the day in a Laval University room. The sleep and wake conditions were separated by 4 days and the order was randomised (wake first; N = 4; sleep first; N = 6). Digital sleep diaries were kept and actigraphy devices were worn during the overnight in the lab to capture more details about their sleep. A paired-samples t-test was conducted to assess whether the wake or sleep condition affected time estimation, while a repeated-measures ANOVA was conducted to verify whether sleepiness differed significantly between the wake and sleep condition (manipulation check).

Results: Participants underestimated time in both the sleep and wake condition. In both conditions participants thought 15 minutes had passed after more time had actually passed, thus underestimating time (sleep: mean=16.56 min. passed, SD=4.40 min.; wake: mean=17.22 min. passed, SD=4.41 min.). A paired-samples t-test revealed that the time estimation did not differ significantly between conditions $t(8) = -.360$, $p > .05$. The repeated-measures ANOVA showed that sleepiness was higher in the sleep condition, $F(2, 16) = 10.295$, $p < .05$.

Conclusions: Contrary to our predictions, participants underestimated the 15 minutes target in both the wake and sleep conditions despite sleepiness being higher after waking from sleep. More participants are being recruited for further analyses.

Insomnia
Board #133 : Poster session 2
SLEEP EFFORT AS A PREDICTOR OF TREATMENT OUTCOME AND RELAPSE IN COGNITIVE BEHAVIOURAL INSOMNIA THERAPY

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Introduction: Sleep effort refers to the extent that an individual actively attempts to control their sleep. From a cognitive behavioural framework, sleep effort is one factor relevant to the maintenance of insomnia by increasing pre-sleep arousal, thus impeding the natural processes that control sleep. Therefore, sleep effort may be one construct relevant in psychological treatment of insomnia. The present study looks at sleep effort as a predictor of treatment outcome and relapse in cognitive behavioural insomnia therapy.

Materials and Methods: This study examined 312 patients (*M age* = 44.39, ranging from 18 to 77) with current insomnia treated with four sessions of CBT for insomnia over an eight-week period as part of a larger clinical trial. The Glasgow Sleep Effort Scale (GSES) and Insomnia Severity Index (ISI) were administered at baseline and post-treatment to index sleep effort and subjective insomnia, whereby higher scores indicate greater active efforts to control sleep and poorer subjective quality of sleep, respectively. Furthermore, the ISI was administered monthly for a year post-treatment to assess for relapse (ISI $\geq$ 14) in patients who were considered to no longer have insomnia. In this study, relapse was defined as a score of $\geq$ 14 on the ISI at any of the 12 follow-up time points.

Results: A paired samples t-test determined that CBT for insomnia significantly reduced GSES scores, $t(180)$ = 17.42, $p < .001$, 95% CI [3.70, 4.65], indicating that patients were less likely to actively control their sleep after treatment. Linear regressions were conducted to evaluate whether baseline or changes in GSES scores predicted reductions in ISI scores. While baseline levels of GSES did not predict changes in insomnia severity, reductions in GSES scores were significantly related to decreases in ISI scores, $t(175)$ = 9.12, $p < .001$, B = .96, with an R^2 of .32. Finally, to evaluate whether GSES scores post-treatment predicted relapse during the one-year follow up, a binary logistic regression was performed to ascertain the effects of sleep effort on the likelihood that participants will relapse. The logistic regression model was statistically significant, $\chi^2(1)$ = 14.44, $p < .001$. The model explained 14.9% (Nagelkerke R^2) of the variance in relapse rates and correctly classified 74.2% of cases. Specifically, a one unit increase in GSES scores led to 1.32 times increase in the likelihood of insomnia relapse.

Conclusions: The present collection of results suggests that sleep effort is an important variable in predicting patients' outcome immediately post-treatment and risk of relapse in a one-year follow-up. CBT for insomnia appears to be efficacious in reducing control of sleep and fostering greater trust in one's own natural sleep processes. Further research is needed to look at sleep effort as a potential mediator in treatment of insomnia.

INSOMNIA SEVERITY OR ITS CONSEQUENCES? ASSOCIATIONS BETWEEN A MIXED PORTRAIT INSOMNIA AND LIFE SATISFACTION

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Introduction: The Insomnia Severity Index (ISI; Bastien, Vallieres, & Morin, 2001) is widely used in Insomnia research and clinical assessment of Insomnia. ISI items can be regrouped into two factors; Insomnia Severity and Daytime Dysfunction. Perception (and misperception) being of such importance in insomnia, albeit perception of sleep difficulties, of sleep consequences, or else, the objectives of this paper are to investigate whether perception of insomnia severity or perception of its consequences were mostly associated with life satisfaction.

Materials and methods: Participants were part of a larger study where they had to complete weekly ISI. Duration of completion ranged from one week to a year. To ensure the validity of our two-factor structural model, confirmatory factory analysis (CFA) was performed using Mplus 6.12. Two-factor structure consisted of a Severity factor (items pertaining to difficulties falling or staying asleep and waking up too early in the morning) and a Daytime Dysfunction factor (items pertaining to satisfaction, worry, interference and noticeability of sleeping problems). Means were used as a cut point to dichotomize scores on both factors. A 'high' factor score represents higher Severity or Dysfunction. Overall, 382 individuals were included in this study. Mean age was 54.52 years old (SD 11.46). Participants were mostly women (70.8 %, n=269), married or in a relationship (65.3 %, n=248), born in the USA (53.2%, n=202) and working full time jobs (54.7 %, n=208). ANOVAs and khi-square analyses were performed.

Results: CFA confirmed excellent fit for a two-factor factorial structure ($\chi 2$ (10) = 15.67 p=0.11, RMSEA = 0.04, (0.00-0.07), CFI = 0.99, TLI = 0.99). The majority of the sample (67.5%, n=258) had consistent scores - be it high or low scores on both factors. 27.7% of these (n=106) presented high scores on both Severity and Dysfunction factors. A third of the sample (32.5%, n=124) had a mixed portrait. Among those who presented a difference between scores, more than half (59%, n=73) presented a higher Severity score and a low Daytime dysfunction score (HSLD), and 41% (n=51) showed the contrary pattern, i.e. lower Severity and higher Daytime dysfunction (LSHD).High Severity and Low Dysfunction (HSLD) participants were older (57.8 ± 10.4) than Low Severity and High Dysfunction (LSHD) participants (51.4 ± 11.9, F(1,122)=10.22, p=.002). HSLD participants reported more satisfaction in life (F(1,122)=17.10, p=.000, d=.756), about their finances (F(1,122)=14.77, p=.000, d=.698), health (F(1,122)=14.30, p=.000, d=.689), relationships (F(1,122)=11.29, p=.001, d=.612), and their sleep (F(1,122)=10.87, p=.001, d=1.211). Groups were not different according to gender, ethnicity, education level or employment (all *p* > .05).

Conclusions: In this study, participants reporting a less severe insomnia but felt it had a great impact on their daily life reported a lesser satisfaction with life, finances, health, relationships and sleep. This exploration of how insomnia affects life satisfaction demonstrates that people's perceptions of consequences may have a greater impact than severity of symptoms alone. Further work on mixed-portrait insomnia should take a look at objective and subjective sleep data, as well as sleep need and coping skills and mechanisms associated with different insomnia portraits.

INSOMNIA AND BED PARTNER ACCOMMODATION: PRELIMINARY EXPLORATION

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Introduction: Insomnia is the most prevalent sleep disorder across all ages and can cause many consequences such as fatigue, concentration and memory problems. Previous research from our group suggested that bed partners of individuals with insomnia (INS) engage in a range of behaviors geared towards accommodating insomnia. Some of these occur at high rates and are contrary to CBTI treatment recommendations (e.g., encouraging earlier bedtimes and later wake times). Despite what are likely good intentions, bed partners may contribute to the perpetuation of insomnia. The aim of this study is to understand how partner accommodation is affected by client-reported sleep and psychological portrait.

Materials and methods: Individuals seeking treatment for insomnia (INS) and their partners completed baseline questionnaires as part of a larger ongoing RCT investigating partner-assisted interventions for insomnia. Partner accommodating behavior was identified using an adapted version of the Family Accommodation Scale. INS and their partners were asked to wear actigraphs for 7 days. To understand what affects partner accommodation of insomnia, subjective and objective sleep variables (insomnia severity (ISI), sleepiness (ESS), sleep-related impairments (PROMIS)) psychological variables (depression (PHQ), anxiety (BAI), posttraumatic stress (PCL-5)) and quality of life (QLES) scores were obtained. T-Test for dependant samples, ANOVAs and Pearson correlations were used. Significance level was set at .05.

Results: 100 couples were included in the study (8% were same sex couples). INS consisted of 66 females and 34 males, mean age was 47.9 years old (±15.4). Partner sample consisted of 38 females and 62 males, mean age was 48.3 (±15.2). Age was not significantly different between groups (t (99) = -.68, p = .50). INS reported on average moderate insomnia symptoms (mean ISI score = 16.1 ± 3.9) and partners reported no clinically significant insomnia symptoms (mean ISI score = 5.1 ± 4.7).

Greater partners' accommodation was associated with increased INS-reported sleep-related impairments (r=.37) and objective daily variations of client sleep efficiency (r=.25), objective and subjective INS-reported sleep latency (r=.25 and .26) and its daily variation (r=.26 and .20). Partners were also more accommodating when INS reported greater depressive symptoms (r=.30) and a lower quality of life enjoyment and satisfaction (r=-.25). Low associations were also found between partners' accommodation and INS' insomnia severity (r=.20), anxiety (r=.21) and posttraumatic stress (r=.22).

Partner accommodation was not significantly different between partners' gender (F(1,79)=2.98, p=.09). Interestingly, there were significant differences when investigating partner accommodation and INS' gender (F(1,79)=5.05, p=.03), partner accommodation being higher when INS was a woman.

Conclusions: Preliminary exploration of data shows that partners are more accommodating of their partner's sleep difficulties when INS report more severe sleep problems and psychopathological symptoms in addition to worse quality of life. Partners also tended to be more accommodating when their INS partner was a woman. Further analyses will examine partner accommodation subscales (Unhelpful behaviors, Perceived impact and Lifestyle modification). This paper focused mainly on exploring INS reported variables, however partner sleep and its impact on their accommodation behaviors should also be investigated.

EFFECTIVENESS OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA COMORBID TO PARKINSON'S DISEASE: A FOCUS ON PSYCHOLOGICAL AND DAYTIME FUNCTIONING

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Introduction: Psychotropic drugs are the first-line treatment for insomnia disorder (ID) in Parkinson's disease (PD) while their effectiveness could not be fully demonstrated in this context. Cognitive behavioral therapy for insomnia (CBT-i) is effective for treatment of comorbid insomnia. We aimed to test the efficacy of CBT-i for ID comorbid to PD and to evaluate the impact of this intervention on various indices of daytime and psychological functioning in PD.

Materials and methods: Fifteen patients with ID comorbid to PD were enrolled in a single-case design with multiple baselines (3, 5, 7 weeks). Total wake time, sleep efficiency and daytime sleepiness were recorded on a standardized sleep diary. Self-reported measures of insomnia severity, anxiety and depressive symptoms, health-related quality of life, and psychological variables perpetuating ID (pre-sleep arousal, dysfunctional beliefs about insomnia, safety behaviors and self-efficacy for sleep) were completed at baseline, at the post-treatment phase, as well as at the 1- and 3-month follow-up phases. For each phase, all patients also underwent a clinical interview for ID diagnosis.

Results: CBT-i was effective in two-thirds of patients, with clinical and significant changes in their insomnia symptomatology and ID criteria. Significant positive treatment-related effects of the CBT-i intervention were also noted for all indices of daytime and psychological functioning, and for variables associated with the maintenance of ID. All of these improvements were well maintained at the 3-month follow-up.

Conclusions: Our results suggest that using CBT-i in PD is feasible. Nighttime and daytime outcomes compare favorably with those obtained in persons with insomnia in the context of other chronic illnesses.

NEW DIAGNOSTIC FRAMEWORK OF CHRONIC INSOMNIA BY COMBINATION OF CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS USING T-MAPS OF MULTI-TASK FMRI

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Introduction: Insomnia is defined as a disorder that causes difficulty initiating sleep, difficulty maintaining sleep or waking up too early with daytime dysfunction Insomnia disorder is a clinically important disease because it is common and causes many disabilities in daily life. Previous reports on neurobiological mechanism of insomnia has shown inconsistent results, so further researches are necessary. Functional magnetic resonance imaging (fMRI) is a functional imaging modality, which is powerful to understand neural changes of brain related to insomnia. Motivated by the success of deep learning in image classification, this study proposes a new diagnostic framework of deep learning based on multi-task fMRI.

Materials and methods: T-maps brain images using 3T MRI were acquired from 37 subjects including 19 patients with chronic insomnia disorder according to the criteria of the international classification of sleep disorders third edition, 18 controls. 2D CNNs and RNNs adopted transfer learning using T-maps of multi-task fMRI which represents different domains. The three domains examined in this study are response to sleep-related pictures, sleep-related sound and stroop task. 2D CNNs after decomposition of the 3D T-maps are built to capture the features of image slices while the gated recurrent unit (GRU) of RNN is cascaded to learn and integrate the inter-slice features for image classification.

Results: Accuracy derived from each of the three domains is 0.5 for brain response to sleep-related pictures, 0.556 to sleep-related sound, 0.528 to the stroop task and 0.806 for concatenation with 2D CNNs + RNNs. Sensitivity/specificity are 0.737/0.235 for brain response to sleep-related picture, 0.842/0.235 to sleep-related sound, 0.528/0.176 to the stroop task and 0.895/0.706 for concatenation with 2D CNNs + RNNs.

Conclusions: Concatenated T-maps of multi-task fMRI using pre-trained 2D CNN and RNN (GRU) showed better performance than that of individual task for diagnosis of chronic insomnia. Proposed method may solve the small sample size issues in the deep learning method and may be a new diagnostic framework of insomnia disorder.

Insomnia
Board #126 : Poster session 1
STATUS OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN CHINA

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Introduction: Cognitive behavioral therapy for insomnia (CBT-I) is widely accepted as an effective intervention for improving core insomnia symptoms. CBT-I is an evidence-based first-line psychotherapy method and recommended in the 'Guide to the Prevention and Treatment of insomnia in China. This review aimed to summarize the current situation of cognitive behavioral therapy for insomnia (CBT-I) in China.
Materials and methods: The review focuses on the issues existing in the current CBT-I application in China, including the status of clinical application, academic research, training, and Current problems and future directions.
Results: The current problems including oversimplified understanding of CBT-I, many doctors and psychotherapists believe that CBT-I is just a few techniques, and even some doctors without a CBT background are doing cbt-I, or without a foundation in sleep medicine. Insufficient and inadequacy of psychologists working on cognitive behavioral therapy for insomnia. The market of psychotherapy is not well regulated. Insufficient combination with Chinese Culture.
Conclusions: We need to strengthen the training of psychiatrists, establish a complete CBT-I training system and improve the training of practitioners, to strengthen collaboration among psychiatrists and psychotherapists, actively promote the development of localization, and establish normalized certification system.

Insomnia
Board #135 : Poster session 2
RESTING RESPIRATORY SINUS ARRHYTHMIA MODERATES THE RELATIONSHIP BETWEEN DAILY STRESS EXPOSURE AND INSOMNIA

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Introduction: Respiratory sinus arrhythmia (RSA) is a marker of vagal-dependent parasympathetic output to the heart. Numerous empirical studies have linked greater RSA with better emotion regulation and sleep quality. Previous research with good sleepers suggests that the presence of increased daily stressors (e.g., long, difficult work days, arguments with friends) may lead to more sleep disturbances, particularly among individuals with lower RSA. The goal of the present study was to determine whether RSA may also be a moderator of the relationship between stress and insomnia severity among individuals with an insomnia disorder.

Materials and methods: Fifty-five participants with an insomnia disorder were recruited. Most of the participants were female (75.4%) and middle-aged (M_{age} = 50.87, s_{age} = 16.03). The participants reported the severity of their insomnia in the past two weeks using the insomnia severity index (ISI; M = 17.33, s = 4.18) and their overall sleep quality in the past two weeks using the Pittsburgh Sleep Quality Index (PSQI; M = 11.17, s = 3.03). Daily diaries were administered for fourteen consecutive days to determine daily stress exposure, using items assessing interpersonal conflict, feeling overwhelmed by life challenges, and having to work hard and fast during the day. Resting RSA data were collected in the morning using the electrocardiogram (ECG) signal of the polysomnography. The ECG data was recorded at a sampling rate of 287 Hz. During the period of resting wakefulness, participants were instructed to sit comfortably in a chair with their eyes open for five minutes. Moderation models were used with ISI and PSQI as the dependent variables, average daily stress as the independent variable, and resting RSA as the moderator. Age and sex were included as covariates in the statistical models.

Results: There were no significant main effects of daily stress and resting RSA on insomnia severity and sleep quality, as measured by the ISI and PSQI, respectively. However, there was a significant interaction effect between daily stress and RSA on ISI ($F(1, 51)$ = 9.03, p = 0.0041) and PSQI ($F(1,51)$ = 4.89, p = 0.0315). These results suggest that there is a positive effect of daily stress exposure on insomnia severity and sleep quality that is specific to individuals with low RSA. Thus, high RSA may be a protective factor against increased sleep disturbances and poorer sleep quality associated with elevated stress exposure.

Conclusions: These findings advocate that RSA is a moderating factor in the relationship between stress and insomnia severity among individuals with an insomnia disorder. Greater daily stress is associated with greater insomnia severity and poorer sleep quality only among individuals with low RSA. Individuals with low RSA may be more susceptible to the impact of environmental and psychological influences on their sleep.

Insomnia
Board #152 : Poster session 3
RELIABILITY AND VALIDITY OF THE CHINESE VERSION DYSFUNCTIONAL BELIEFS AND ATTITUDES ABOUT SLEEP SCALE

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Introduction: To evaluate the psychometric characteristics of the dysfunctional beliefs and attitudes about sleep scale.
Materials and methods: 218 participants who were diagnosed with primary insomnia and insomnia comorbided with psychiatric disorders according to DSM-IV and 34 good sleepers were recruited. All participants were measured by Dysfunctional Beliefs and Attitudes about Sleep Scale（DBAS）, DBSA-16 and Pittsburgh Sleep Quality Index(PSQI) .30 of them were measured by DBAS two weeks later.
Results: 24 items were reserved and five factors were extracted.The Cronbach's coefficients of DBAS-24 was 0.827.The Cronbach's coefficients of five subscales were 0.416-0.778.Split-half reliability coefficient of total score was 0.807, and split-half reliability coefficient of five snbseales were 0.353-0.713. The test-retest reliability coefficient was 0.942， and coefficient of each subscales ranged from 0.758 to 0.932($p < 0.01$). Total DBAS-24 score was significantly correlated with DBAS-16 (r=0.859,$p < 0.01$) and PSQI(r=-0.478, p< 0.01).DBAS-24 scale had a good discriminant validity as well($(p < 0.01)$.
Conclusions: The reliability and validity of the DBAS-24 are adequate.
Acknowledgements: Fund program: National Major R&D Program Matching (Z161100002616006)

LONG-TERM EFFECT OF LEMBOREXANT ON FATIGUE IN SUBJECTS WITH INSOMNIA DISORDER: PATIENT-REPORTED OUTCOME FROM THE 6-MONTH PLACEBO-CONTROLLED TREATMENT PERIOD OF THE PHASE 3 STUDY SUNRISE-2

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Introduction: Fatigue, which can impede daytime functioning and reduce quality of life, is a chief complaint among patients with insomnia disorder. SUNRISE-2 is a 12-month Phase 3 clinical study of once-daily lemborexant (LEM) in adults with insomnia disorder. Here we report the effects of LEM compared with placebo (PBO) on subject-reported fatigue from the first 6-month treatment period of SUNRISE-2.

Materials and methods: SUNRISE-2 (NCT02952820) was a randomized, double-blind, PBO-controlled (first 6-months) Phase 3 study. The first treatment period was immediately followed by a second 6-month blinded active treatment period. After an ~2-week PBO run-in, subjects were randomized to PBO, LEM 5mg (LEM5) or LEM 10mg (LEM10) for 6 months. Subjects (age ≥18y) met DSM-5 criteria for insomnia disorder but did not need to meet a fatigue severity criterion, as assessed by the Fatigue Severity Score (FSS), for randomization. The FSS total score (FSSts) is the sum of all FSS responses (item responses range from 1 to 7; maximum possible total score is 63); higher scores indicate greater fatigue. Data were analyzed with a mixed-effect repeated measurement model with factors for age group, region, treatment, visit (Month 1, Month 3, and Month 6), and treatment-by-visit interaction as fixed effects, and baseline FSS score as a covariate. Missing values were not imputed and assumed to be missing at random.

Results: A total of 949 subjects were included in the full analysis set (PBO, n=318; LEM5, n=316; LEM10, n=315). The median age was 55y (range 18-88y). The FSSts for PBO, LEM5, and LEM10 were 35.2, 37.4, and 36.0, respectively, at baseline and decreased (improved) at the end of Month 3, resulting in a mean change from baseline of -4.3, -7.7, and -7.9. These decreases were larger and significant for LEM5 (least squares mean [LSM] treatment difference -2.18; P=0.0206) and LEM10 (LSM treatment difference -3.04; P=0.0014) versus PBO. At Month 6, FSSts remained improved, resulting in mean changes from baseline of -6.3, -10.1, and -8.9. These decreases were larger and significant for LEM5 (LSM treatment difference -2.50; P=0.0134) and LEM10 (LSM treatment difference -2.56; P=0.0128) compared with PBO.

The subgroup of subjects with at least a modest degree of fatigue at Baseline, defined as FSSts ≥18, was also examined (mean FSSts at Baseline: PBO [n=279], 38.3; LEM5 [n=297], 39.1; LEM10 [n=279], 39.0). For these subjects, FSSts decreased from baseline by ≥30% at Month 6 in 33.9% of the PBO group, 45.0% of the LEM5 group, and 51.7% of the LEM10 group.

Lemborexant was well tolerated; most adverse events were mild to moderate in severity.

Conclusions: LEM treatment (5 mg and 10 mg) significantly reduced subject-reported fatigue compared with PBO over a 6-month treatment period. These results demonstrate that treatment with LEM was associated with a clinically significant reduction in fatigue in subjects with insomnia disorder.

COMPLAINTS OF INSOMNIA IN A UNIVERSITY-BASED HEADACHE CLINIC

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Introduction: Insomnia is characterized by difficulty with initiating or maintaining sleep and early waking, along with daytime symptoms such as fatigue, sleepiness, inattention, mood disturbance, or impaired performance. Migraine sufferers have been found to have an increased risk of insomnia than the general population, even after controlling for common comorbidities and demographics. The nature of this relationship is unclear but small studies have suggested that chronic insomnia worsens headache severity, while migraine is associated with insomnia and sleepiness, especially chronic migraine.
These associations may represent shared pathophysiology; chronic insomnia is associated with increased central nervous system activation and physiologic arousal, while migraine is associated with decreased habituation. Depression and anxiety appear to be mutually reinforcing with migraine. Other factors, such as stress, caffeine intake, obesity, and psychological health may increase the risk of both conditions.
The most common headaches seen in Headache Clinic Are episodic migraine (EM), < 15 headache days a month, and chronic migraine (CM), >=15 headache days a month.
This study sought to examine the relationship between insomnia and headache in a tertiary referral clinic.
Materials and methods: All new patients referred to our tertiary headache clinic complete a detailed patient intake questionnaire prior to their first visit, which included multiple questions regarding their sleep. The patient´s headache diagnoses were included in the analysis.
Results: Of the 4869 patients that answered the questions regarding sleep, 67% (n=3264) patients endorsed "any difficulty with sleep". When asked "do you have insomnia", 33% (n=1606) answered yes while 46.5% (n=2265) answered no but have other sleep complaints commonly seen in insomniacs in spite of not self-identifying with having insomnia. Within the latter group, 64% reported waking up not feeling refreshed, 62% trouble staying asleep, 58% trouble falling asleep, and 54% frequent awakening. Of the entire population of headache patients, 22.9% (n=1115) patients endorsed fatigue and impaired sleep. Only 22% of patients perceived they had insomnia despite over 43% of patients endorsing waking up not feeling refreshed, 41% trouble staying asleep, 38% trouble falling asleep, and 35% frequent awakening.
The headache diagnoses most commonly given in patients with sleep problems included: Chronic migraine (CM) in 73%, Medication overuse headache (MOH) in 52%, Episodic migraine (EM) in 19%, Post-traumatic (PTH) in 6.3% and Cervicogenic headache in 4.7%.
Conclusions: Sleep issues are much more common in our tertiary headache clinic that in the general population, especially waking up not feeling refreshed, trouble staying and falling asleep, and frequent awakenings. In particular, sleep complaints are more frequent in CM and MOH than in overall headache.
A single question of "having insomnia" would have missed 46% of the patient with sleep issues. We recommend the use of several screening questions including common sleep complaints in patients with patients with chronic headaches.
In view of the large number of headache patients affected with sleep complaints, a close relationship with Sleep Medicine specialist is recommended. In addition, given the limited availability of sleep specialists in some areas, development of internal resources within headache clinics should be considered.

Insomnia
Board #127 : Poster session 1

COGNITIVE BEHAVIOURAL THERAPY FOR INSOMNIA IN A MULTIDISCIPLINARY SLEEP CLINIC: PARTICIPATION RATES AND EFFECTIVENESS

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Introduction: Although cognitive behavioural therapy is a recognised effective non-pharmacological treatment for insomnia, there is limited information regarding its uptake in clinical practice. This case series describes the participation rates and effectiveness of cognitive behavioural therapy for insomnia in patients attending a multidisciplinary sleep clinic.

Materials and methods: Cognitive behavioural therapy was delivered by psychologists. Data were collected using self-report questionnaires and extraction of medical records through opt-out consent. A paired-samples t-test was conducted to compare pre- and post-treatment Insomnia Severity Index (ISI) scores.

Results: 205 adult patients met the DSM-5 criteria for insomnia. Mean age was 45.1 years (range 18.1 to 84.9 years). 41.5% were male. Following assessment by a sleep physician, 194 (94.6%) were advised to see a psychologist for cognitive behavioural therapy. Of these patients, 121 (62.4%) saw a psychologist at our clinic, 11 (5.7%) participated in a cognitive behavioural therapy research study, and 4 (2.1%) were referred to a psychologist elsewhere. 58 (29.9%) did not see a psychologist despite recommendation from their sleep physician. Compared with the patients who proceeded to see a psychologist, the group that did not participate in cognitive behavioural therapy reported similar baseline rates of hypnotic medication usage. Of those who saw a psychologist at our clinic, 45 (37.2%) completed cognitive behavioural therapy and were discharged. 68 patients (56.2%) did not complete the cognitive behavioural therapy program. 18 patients submitted ISI questionnaires pre and post completion of cognitive behavioural therapy. The mean reduction in ISI score was 10.2 (95% CI 7.4 to 12.9, p< 0.001). Most of these patients (88.9%) reported that the program had met most or almost all of their needs.

Conclusions: These real-world findings from our multidisciplinary sleep clinic demonstrated about 30% of patients with insomnia did not proceed with cognitive behavioural therapy despite recommendation from their sleep physician. In addition, over half the patients who started seeing a psychologist did not complete the program. The small number of patients who completed ISI questionnaires following treatment for insomnia had improved ISI scores and most found the program beneficial. Further work is required to identify factors predicting which patients will participate in and benefit from cognitive behavioural therapy for insomnia.

Insomnia
Board #156 : Poster session 3
ASSOCIATED FACTORS OF SUBJECTIVELY PERCEIVED SLEEP IN THE MORNING IN PATIENTS WITH INSOMNIA

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Introduction: Discrepancies between subjectively perceived and objectively measured sleep parameters are well known in patients with insomnia, but clinical meaning of subjectively perceived sleep difficulties remains to be established. This study investigated factors affecting subjective perception of sleep in the morning in patients with insomnia.
Materials and methods: In this retrospective cross-sectional study, we evaluated 400 adults who had nocturnal polysomnography (nPSG) in the center for sleep and chronobiology of Seoul National University Hospital. Participants completed self-report questionnaire including Beck depression inventory (BDI), Pittsburgh sleep quality index (PSQI), and Epworth sleepiness scale before nPSG. In the morning after the nPSG, participants evaluated their sleep with following self-report items: subjective sleep latency, subjective total sleep time, subjective number of awakening, and level of refreshed in the morning (4 point Likert scale). Patients with insomnia - with insomnia symptoms (> 3months), PSQI score > 5, Apnea hypopnea index < 15, and periodic limb movement index < 5 - were collected and analyzed. Finally, a total of 109 patients with insomnia (female n = 37, 33.9%; age 43.39 ± 15.32 years; body mass index 24.83 ± 3.29) were included for the analysis. Pearson and Spearman correlation analysis were used to determine the factors affecting subjective self-report of the previous sleep in the morning. (Significance level $p < 0.05$).
Results: After adjusting for age, sex and BDI score, subjective sleep latency on the self-report in the morning was positively correlated with sleep latency on nPSG ($r = 0.338$, $p < 0.001$). Subjective total sleep time was positively correlated with total sleep time on nPSG ($r = 0.365$, $p < 0.001$). Subjective total sleep time was negatively correlated with PSQI score ($r = -0.320$, $p = 0.001$). The association between subjective total sleep time and PSQI score was consistent after adjusting for total sleep time or wake after sleep onset on nPSG. Level of refreshed in the morning from sleep was associated with BDI ($r = -0.342$, $p < 0.001$) and PSQI scores ($r = -0.224$, $p = 0.019$), but not with any objective sleep parameters on nPSG.
Conclusions: Our results demonstrated that subjectively perceived sleep latency and sleep time in the morning was associated with objectively measured sleep latency and sleep time, respectively. Short perceived sleep time in the morning is also related with poor sleep quality on PSQI. Refreshed feeling after the sleep is not associated with objective sleep measures but with subjectively measured depressed mood symptoms and sleep quality. Patients with insomnia feel less refreshed after the sleep as they are more depressed and report poorer sleep quality. These results may help us evaluating symptoms of insomnia patients in clinical setting.

Insomnia
Board #128 : Poster session 1

EFFECT OF EMAIL-DELIVERED CBT-I ON INSOMNIA, ANXIETY, AND DEPRESSION FOR UNIVERSITY STUDENTS IN JAPAN: A RANDOMIZED CONTROLLED TRIAL

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Introduction: A previous study showed that a form of CBT-I delivered by email, called the REFRESH program, may be a cost-effective way for college students with poor sleep quality to improve their sleep and reduce depressive symptoms (Trockel et al: *J Clin Sleep Med* 2011;7:276-281). However, that study was not a randomized controlled trial and few studies have been conducted on the outcome of email-delivered CBT-I for young adults with insomnia in Asian countries. The aim of this study was to conduct a randomized controlled trial of email-delivered CBT-I through the REFRESH program for insomniac students at an Asian university, and to examine the effect of the intervention on insomnia, anxiety and depression.

Materials and methods: We recruited participants from January 10 to December 20, 2018, via advertising on campus in Japan. One hundred and twenty-nine students completed an informed consent form and online questionnaires. Forty-eight participants (67% female, 19.56 [SD=1.86] years), all with a total Insomnia Severity Index (ISI) score greater than 11 and no medical history of mental disorders, were randomly assigned to either the REFRESH group ($n=24$) or a self-monitoring group recording their sleep diaries ($n=24$) for 8 weeks. Of them, one dropped out and six did not complete the questionnaires at post-intervention. Primary outcomes were the ISI and DASS-21 (Depression Anxiety Stress Scale).

Results: The results of analysis using mixed-effect model for repeated measures showed a significant effect of interaction for the ISI score ($p < 0.001$). In the results of the post-hoc test, the REFRESH group significantly improved on insomnia symptoms at the post-intervention period, compared with the self-monitoring group ($p < 0.05$; Hedges' $g = 1.46$). In addition, the ISI score significantly improved from pre- to post-intervention in the REFRESH group ($p < 0.01$). For the DASS-depression, anxiety, and stress subscales, it showed a significant effect of time ($p < 0.05$), and these scores significantly reduced from pre- to post-intervention. The effect sizes of depression, anxiety, and stress were moderate to large ($g = 0.72$, 1.16, and 1.00, respectively) at post-intervention period, compared with self-monitoring group. The REFRESH group had a 52% remission rate (ISI < 8) of insomnia and self-monitoring group had a 0% remission rate (NNT = 1.9, 95% CI = 1.4-3.2).

Conclusions: Our findings suggest that email-delivered CBT-I is a highly effective intervention on symptoms of insomnia for college students living in Asian countries.
Acknowledgement: This work was partially supported by JSPS KAKENHI Grant Number 16K04388.

Insomnia
Board #129 : Poster session 1

PERSEVERATIVE COGNITION IS ASSOCIATED WITH INCREASED INFLAMMATION IN INDIVIDUALS WITH CHRONIC PRIMARY INSOMNIA

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Inflammatory markers levels, including pro-inflammatory cytokines interleukin (IL-6) and C-reactive protein (CRP) have been associated with a variety of disorders, including mood disorders. Recently, it has been reported that increased levels of CRP and IL-6 were associated with insomnia symptoms and short sleep duration. It has been suggested that chronic stress associated with sleep disruption might lead to dysregulation of the hypothalamic-pituitary-adrenal stress axis. However, whether the continuous thinking of about negative events (i.e., perseverative cognition) moderates sleep difficulties and IL-6 and CRP levels have never been explored.

Sixty-three participants with chronic primary insomnia (50.9 ±15.9 years old; 49 female) were recruited. The protocol included a screening polysomnography (PSG) night, a second overnight PSG one week later, blood draws and questionnaires, including the Insomnia Severity Index (ISI), Beck Depression Inventory (BDI) and Perseverative Thinking Questionnaire (PTQ). Participants also completed a sleep diary for two weeks from which total sleep time (TST), wake duration (WASO) and sleep efficiency (SE) were computed. Participants also reported daily how often they worry about their sleep during the day. Whole night PSG included EEG (17 scalp electrodes), EOG, EMG. All recordings were sampled at 512 Hz (Somnomedics, Germany) and sleep stages were scored offline according to the AASM rules. Blood plasma IL-6 (pg/ml) and CRP levels (mg/L) were assessed with enzyme-linked immunosorbent assay (ELISA) kits.

IL-6 and CRP were highly correlated ($r = 0.34$, $p=0.006$). Interestingly, there was no correlation between inflammatory markers and BDI or ISI (all $p>0.05$). There was a significant correlation between sleep variables extracted from sleep diaries and IL-6 including WASO ($r = 0.347$, $p=0.007$), TST ($r = -0.33$, $p=0.01$) and SE ($r = -0.36$, $p=0.005$). However, no associations were found with any objective (PSG) sleep variables (all $p>0.05$). The inverse relation was found with CRP, where there was no association between CRP levels and subjective sleep variables (all $p>0.05$) but significant correlation between CRP and sleep duration (total sleep period; $r = -0.29$, $p=0.024$) and time spent in deep sleep (N3%TSP; $r = -0.29$, $p=0.024$). Levels of IL-6 were associated with measures of perseverative cognition including daily frequency of worrying about sleep during the day ($r = 0.35$, $p=0.006$) and PTQ ($r = -0.30$, $p=0.02$). However, CRP levels were not correlated with any measures of perseverative cognition (all $p>0.05$).

Hierarchical regression analyses revealed that age, sex and BMI did not predict IL-6 levels ($F=2.08$, $p=0.11$, $r^2=0.109$), nor did adding ISI which revealed a trend ($F=2.5$, $p=0.051$, $r^2=0.169$). However, once introduced to the model, subjective mean sleep duration (TST; $F=3.33$; $p=0.011$; $r^2=0.254$) and perseverative cognition scores (mean daily worry about sleep and PTQ), predicted more than 32% of the variance ($F= 3.2$; $p=0.006$; $r^2=0.329$). Our results showed that IL-6 and CRP levels cannot predict insomnia severity but nevertheless correlate with subjective measures of poor sleep. We also provide evidence that continuously thinking about negative events, especially sleep difficulties might have a physiological impact, as high scores in perseverative cognition were associated with higher

IL-6 levels in individuals with chronic insomnia.

MATERNAL PRENATAL SLEEPING PROBLEMS ARE A RISK FOR POSTPARTUM DEPRESSION- RESULTS FROM THE FINNISH CHILD-SLEEP AND FINNBRAIN BIRTH COHORTS

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Introduction: Sleeping problems can precede an episode of depression. We studied whether various sleeping problems during pregnancy are associated with postpartum depression (PPD) in mothers of two Finnish birth cohorts. The FinnBrain cohort was recruited between 2011-2015 in Turku and Åland Islands area and the CHILD-SLEEP cohort between 2011-2013 in Tampere area, Finland.
Materials and methods: Altogether 2275 women were enrolled in FinnBrain (FB) and 1398 in CHILD-SLEEP (CS) cohort. The Edinburgh Postnatal Depression Scale (EPDS) and the Center for Epidemiological Studies Depression Scale (CES-D), respectively, were used to measure depression at gestational week (gw) 14, 24, 34 and 3 months postpartum (FB) and gw 32 and 3 months postpartum (CS). Prenatal sleeping problems were measured by the Basic Nordic Sleep Questionnaire in both cohorts (gw 14, 24, 34 FB; gw 32 CS). Logistic regression models were conducted using EPDS ≥11 (FB) and CES-D ≥10 (CS) three months postpartum as the dependent variable, and prenatal sleep problems as the independent variables. The analyses were adjusted for maternal education, income, parity, somatic diseases/disabilities, smoking (CS) and for prenatal depression (EPDS ≥11 during each studied trimester (FB) or CES-D ≥10 gw 32 (CS)).
Results: In both cohorts, the following prenatal sleeping problems at late pregnancy (gw 34/32) were related to PPD: poor sleep, sleep latency >20min, sleep loss ≥2h and short sleep < 7h. In the FB cohort, at gw 24, none of the studied sleeping problems were associated with PPD, whereas at the gw14 sleep latency >20min, difficulty falling asleep and night awakenings ≥3x/night were associated with PPD.
Conclusions: Sleeping problems during both early and late pregnancy were crucial for the risk for PPD, whereas sleeping problems during mid-pregnancy were not in association with PPD. Our findings suggest that screening of difficulty falling asleep and frequent night awakenings already in early pregnancy is essential in order to find the women in risk for PPD, but assessment of existence of sleeping problems should be repeated in the late pregnancy.

LUCID DREAM INDUCTION AND DREAM CONTENT OF PEOPLE WITH INSOMNIA: A SINGLE CASE STUDY

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Introduction: Insomnia is a widespread sleep disorder and has negative consequences for people suffering from it such as lower quality of life and a higher risk of depression and anxiety disorders. Higher stress levels may be portrayed in more negative dreams than that of good sleepers. According to the cognitive dream theory, dream content is continuous with wakefulness. Thus, negative dream content can in turn increase stress and decrease sleep quality. Dream content is not generally targeted with current treatment options in insomnia research. Lucid dreaming is a learnable skill and can potentially influence dream content. It merits investigation in the context of insomnia as it could provide an interesting treatment alternative. The aim of this study was thus to explore the effect of a lucid dream induction technique based on those of Tholey and LaBerge on dream lucidity, emotional valence of dreams, dream content and sleep efficacy.
Materials and Methods: This was a single case study with multiple baselines of two and four weeks followed by two weeks of treatment. The intervention, Lucidity Induction Technique, consists of learning to differentiate between waking and sleeping states via reality testing several times a day, as well as other exercises including intention setting, auto-suggestion and visualization before sleep. Two university students with insomnia, aged 19 and 20 years old, completed a sleep diary every morning, as well as a dream diary, a questionnaire on emotional valence and a lucidity scale (LuCiD) every morning following a dream recall. Participants were also asked to complete a homemade procedure adherence questionnaire for the two weeks of treatment. Visual analysis of the data was conducted.
Results: Participant 1 had a procedure adherence rate of 89.3%. Sleep efficacy went from an average of 76.9% at baseline to an average of 79.4% during treatment. Dream lucidity increased from 10.7 to 16.7. Positive emotional valence remained similar (64.7%, 71.4%) while negative emotional valence decreased from 19.9% to 3.7%. Positive dream content increased from 52.9% to 75.0% and negative dream content dropped from 47.1% to 25.0%. Participant 2 had a procedure adherence rate of 50.8% and initiated a 12-day break between baseline and treatment. Sleep efficacy went from 84.5% to 89.6%. Most variables remained stable between phases such as dream lucidity (6.1, 6.3), positive emotional valence (45.6%, 48.6%) and dream content (positive: 26.7%, 30.8%; negative: 73.3%, 69.2%). Negative emotional valence decreased from 57.1% to 38.1%.
Conclusions: Results show that a higher adherence to the Lucidity Induction Technique seems to lead to an increase in dream lucidity, a decrease in negative emotional valence of dreams, as well as a decrease in negative content proportionally to an increase in positive content. Because a change in sleep efficacy was not observed, it would be interesting to study if long-term use of this lucidity technique could increase sleep efficiency. It is hypothesized that people suffering from insomnia may benefit in gaining control over their dreams if they are bothersome. Replicating this study in a larger sample is indicated.

CLINICAL ANALYSIS OF INSOMNIA SYMPTOMS IN PATIENTS WITH SUDDEN SENSORINEURAL HEARING LOSS

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Introduction: To summarize and report on sudden sensorineural hearing loss of 167 patients with symptoms of insomnia, and discuss the relationship between the occurrence of insomnia and the sudden sensorineural hearing loss.
Materials and methods: 167 cases with sudden sensorineural hearing loss were collected from 2012 to 2014, among which 65 were male, 102 were female, age from 21 to 84 years old. The average age was 54.1 years. Psychological assessment and Cardiopulmonary Couple（CPC） sleep monitoring were conducted for some of these patients. In addition to the routine use of glucocorticoids and skinner more static drop on the basis of the treatment of SSNHL, 63 cases of patients were prescribed with zopiclone tablets or proprietary Chinese medicine as sleep intervention. Patients´ average threshold rose after an average of five days from the start of treatment, while for those without drug intervention for sleep, the hearing rising after an average of 7 days from the start of treatment.
Results: About more than 70% of the patients with sudden deafness had insomnia before the onset of sudden deaf, which may have caused by the tiredness, working pressure, tension and other mental factors. To improve sleep after drug treatment, patients´ clinical symptoms improved significantly. Besides of hearing improvement, we found that the patients who received the drug intervention for improving sleep had significantly less complaints of tinnitus and ear congestion than those who did not receive the drug intervention.
Conclusions: In the process of sudden deafness treatment, the treatment of insomnia can improve the complaints of the tinnitus and stuffy feeling.

Insomnia
Board #130 : Poster session 1

ADVERSE CHILDHOOD EXPERIENCES ARE COMMON AMONG MEDICAL PATIENTS ENROLLED IN STRESS MANAGEMENT TRAINING (SMT), ARE RELATED TO HIGHER LEVELS OF INSOMNIA AND DAYTIME SYMPTOMS OF HYPERAROUSAL, BENEFIT FROM SMT TREATMENT, BUT ARE VULNERABLE TO RELAPSE BY TWO MONTH FOLLOW-UP

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Introduction: Adverse Childhood Experiences (ACEs) have been shown to have a substantial impact on both physical and mental health problems into adulthood. This study investigated the impact of ACEs on both daytime and nighttime symptoms of hyperarousal present in medical patients attending a Stress Management Training (SMT) program. As attendance at this SMT occurred about 50 years after their childhood traumatic experiences, we explored whether the early life experience of ACEs impacted:
1) the symptom problems that patients came into CR with,
2) their response to SMT treatment, and
3) the retention of those benefits at two month follow-up.
Materials and methods: 287 participants at the Toronto Rehabilitation Institute enrolled in a seven week SMT program. All participants completed a survey of eight ACEs experienced before age 18, as well as current daytime symptoms (anxiety (BAI), psychological distress K6), depression (CES-D), and nighttime symptoms (insomnia (ISI)). Data was collected before SMT (T1), after seven weeks of SMT (T2), and follow-up after two months (T3).
Results: 44% of the 287 medical patients reported no ACEs, 26% reported one ACE, 14% 2 ACEs, and 16% 3 or more ACEs before age 18. The most prevalent ACEs in the population were: exposure to mental illness (27%), psychological abuse (23%), and exposure to substance abuse (18%).The remaining five categories were all endorsed by 10-13% of participants. ACE scores predicted insomnia scores (ISI), with a significant linear regression equation of ($F_{(1, 283)}$ = 5.74, $p < .05$), with an R2 of 0.02. The ACEs group reported more insomnia (M = 13.6 vs 11.7) than the no ACEs group ($t(283)$ = 2.4, $p < .05$). For the 142 subjects who completed the SMT program, the ACE group responded to the SMT treatment with a 3 point reduction in ISI scores (14.3 to 11.1) while the no ACEs group improved from 12.4 to 10.6. All daytime stress measures (anxiety, distress and depression) decreased similarly for both the ACE and no ACEs group. Among the 70 participants who attended the 2-month follow-up, the group with 3+ ACEs (N=10, T1=13.3, T3=11.7) did not maintain their earlier clinical improvements, while those with 1-2 ACEs (N=24, T1=15.0 T3=10.4), and 0 ACEs (N=36, T1=12.0 T3=6.9) did maintain, or continued their improvements. The majority of patients with 3+ ACEs continued to have problems with chronic insomnia after standard SMT treatment.
Conclusions: These findings provide evidence that reports of events impacting autonomic dysregulation early in life are related to both daytime symptoms of hyperarousal as well as sleep disturbance some 50 years later. While SMT was effective in reducing sleep and daytime symptoms for all patients, the group with 3+ ACEs was vulnerable to relapse of symptom improvements attained during standard SMT treatment. It is unclear whether SMT that might include CBTi interventions (targeting improvement of sleep) would improve these outcomes. Further study of autonomic dysregulation in medical patients are needed to identify patients at risk for relapse, and what additional interventions to standard SMT would improve outcomes for all patients.

DAYTIME SLEEPINESS IS ASSOCIATED WITH HIGHER BMI IN INSOMNIA WITH OBJECTIVE NORMAL SLEEP DURATION

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Introduction: Insomnia and daytime sleepiness were both associated with obesity. In this study, we aim to test whether daytime sleepiness measured by Multiple Sleep Latency Test (MSLT), a standard test of sleepiness, is associated with higher body mass index (BMI) in chronic insomnia patients.

Materials and methods: Six hundred and seven chronic insomniacs were included in this study (63.4% females, mean age = 39.46 ± 10.78 years). Chronic insomnia was defined based on standard diagnostic criteria with symptoms lasting ≥6 months. All subjects underwent 1 night in laboratory polysomnography followed by a standard MSLT. We used the mean MSLT value < 8 minutes to define daytime sleepiness. BMI was based on measured height (cm) and weight (kg) during the subjects' sleep laboratory visit. BMI≥25 kg/m^2 was defined as overweight.

Results: After controlling for age, sex, apnea-hypopnea index, diabetes mellitus, smoking, alcohol, and caffeine use, MSLT < 8 minutes increased the odds of overweight by 200% (odds ratio=2.08; 95% confidence interval=1.24-3.50) compared to those with MSLT ≥ 8 minutes. Linear regression also found a significant association between MSLT and BMI (β= -0.10; P= 0.006). A significant effect modification by sleep duration on the MSLT-BMI association was found (p=0.004), such association was only existed in insomnia with sleep duration ≥ 6 hours (β= -0.11; P= 0.018), not in those who sleep less than 6 hours (β= -0.06; P= 0.264).

Conclusions: Daytime sleepiness measured by MSLT is associated with higher BMI in insomnia patients with objective normal sleep duration.

THE IMPACT OF LEMBOREXANT TREATMENT ON INSOMNIA DISEASE SEVERITY: RESULTS FROM A POOLED ANALYSIS OF TWO PHASE 3 STUDIES

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Introduction: In clinical trials, polysomnographic and patient assessments of sleep onset and/or sleep maintenance relative to placebo (PBO) are generally used to evaluate the effectiveness of treatments for insomnia. An efficacious treatment should decrease insomnia disease severity, as measurable by the Insomnia Severity Index (ISI). Treatment with lemborexant (LEM) has demonstrated statistically significant benefits on sleep diary-based sleep onset latency and sleep maintenance variables at two doses (LEM 5 mg [LEM5]; LEM 10 mg [LEM10]) versus PBO in two Phase 3 studies. Here we present the results of a pooled analysis of the ISI from these 2 clinical studies after one month of treatment.

Materials and methods: SUNRISE-1 was a 1-month, blinded, PBO- and active-controlled (zolpidem extended release [ZOL]; results not reported here), parallel-group study that randomized 1006 female and male subjects aged ≥55y with insomnia disorder, with baseline ISI total score (TS) ≥13 after PBO run-in. Subjects were randomized to PBO, ZOL, LEM5, or LEM10. SUNRISE-2 was a 12-month PBO-controlled (first 6 months), double-blind, parallel-group study that randomized 949 female and male subjects (full analysis set) aged ≥18y with insomnia disorder, with baseline ISI TS ≥15 after PBO run-in. Here we present pooled ISI TS data from both studies collected at baseline and the end of Month 1. Changes from baseline were analyzed by an analysis of covariance model, with baseline ISI TS as a covariate, and region, age group, and study as factors. Responder rates were analyzed by Cochran-Mantel-Haenszel test stratified by study, region and age group.

Results: Mean baseline ISI TS for the pooled PBO (n=527), LEM5 (n=582), and LEM10 (n=584) treatment groups was 19.2, 19.3 and 19.0, respectively. For all treatment groups, mean ISI TS decreased at Month 1 relative to baseline. Decreases were significantly larger for the LEM5 and LEM10 groups versus the PBO group (LSM treatment difference: LEM5 -1.67, LEM10 -1.94; both $P< 0.0001$). The percentage of subjects whose ISI TS decreased by ≥7 points (considered a clinically meaningful change) was 33.6% in the PBO group versus 47.3% and 47.8% in the LEM5 and LEM10 groups, respectively. The percentage of subjects whose ISI TS was < 10 points at Month 1 (defined as the threshold for clinical insomnia) was 20.3% in the PBO group versus 33.0% and 33.4% in the LEM5 and LEM10 groups, respectively. These differences versus PBO were statistically significant ($P< 0.0001$). Lemborexant was well tolerated in both studies. Most treatment-emergent adverse events were mild to moderate.

Conclusions: The severity of insomnia symptoms was significantly decreased in subjects treated with LEM. Additionally, in approximately 1/3 of LEM-treated subjects, ISI TS was reduced below the threshold for clinically important insomnia.

Insomnia
Board #160 : Poster session 3

PATIENT-REPORTED SLEEP ONSET AND SLEEP MAINTENANCE: POOLED RESPONDER ANALYSES OF LEMBOREXANT PHASE 3 STUDIES

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Introduction: Current insomnia treatments, such as the GABA-ergic, non-benzodiazepine sedative-hypnotics, may not adequately treat both sleep onset and sleep maintenance symptoms, and are associated with fall risk, tolerance/dependence, and abuse potential, among other concerns. Drugs targeting the orexin system, like lemborexant (LEM), may dampen wakefulness, facilitating sleep with fewer potential adverse consequences. These analyses are from 1 month of pooled data from 2 Phase 3 studies in adult and older subjects with DSM-5 insomnia disorder.

Materials and Methods: SUNRISE-1 was a 1-month, double-blind, randomized, placebo (PBO)- and active-controlled, parallel-group study in 1006 subjects (aged ≥55y). Subjects were randomized to PBO, LEM 5mg (LEM5), LEM 10mg (LEM10) or zolpidem tartrate extended-release (ZOL; 6.25mg; results not reported here). SUNRISE-2 was a 12-month (6-month PBO-controlled, 6-month active-only treatment), double-blind study in 949 subjects (aged ≥18y). Subjects were randomized to PBO, LEM5 or LEM10. In both studies, subjects completed daily electronic diaries regarding time to fall asleep (sSOL), wake after sleep onset (sWASO), time in bed, among others. Both studies included a 2-week PBO run-in. Data from the first treatment month were pooled for sSOL, subjective sleep efficiency (sSE) and sWASO. Data were analyzed by mixed-effect repeated measurement model, assuming missing values were random. Sleep onset and sleep maintenance responders were analyzed via Cochran-Mantel-Haenszel test stratified by study, region and age group.

Results: A total of 527, 582, and 584 subjects were in the PBO, LEM5, and LEM10 groups respectively. Reductions in sSOL were statistically greater for both doses of LEM versus PBO for the first 7 days of treatment and end of Month 1 (all comparisons $P< 0.0001$). After the first 7 days and at the end of Month 1, the proportion of sSOL responders (≤20 minutes if baseline >30 minutes) was statistically significantly superior for both LEM doses versus PBO (first 7 days: both $P< 0.0001$; end of Month 1: both $P< 0.001$). Both doses, versus PBO, significantly increased sSE (first 7 days: both $P< 0.0001$; end of Month 1: both $P< 0.001$) and reduced sWASO (first 7 days: both $P< 0.0001$; end of Month 1: $P< 0.05$ [LEM5], and $P< 0.001$ [LEM10]). After the first 7 days and at the end of Month 1, the proportion of sWASO responders (≤60 minutes and a reduction from baseline by >10 minutes, if baseline >60 minutes) was statistically significantly superior for both LEM doses versus PBO (first 7 days: both $P< 0.01$; end of Month 1: both $P< 0.05$). Average values on sleep maintenance endpoints showed that subjects taking LEM obtained >1 hour of additional sleep per night. LEM was well tolerated, with most adverse events (AEs) being mild to moderate in severity and low rates of serious AEs.

Conclusions: LEM demonstrated efficacy on sleep onset and sleep maintenance variables in a broad age range of subjects with insomnia disorder. The numbers of sSOL and sWASO responders were significantly higher with LEM versus PBO, supporting data showing significant changes from baseline. LEM was well tolerated.

ASSOCIATION OF SLEEP CHARACTERISTICS AND RESPIRATORY SYMPTOMS AT A SMELTING FACTORY

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Introduction: Sleep disturbance including insomnia and poor sleep quality has been shown to be a major health determinant in occupational settings. Specific occupational exposures to hazards in most workplaces can lead to various health problems, especially sleep problems. A limited number of surveys have studied the detrimental effects of occupational exposures on sleep problems among non-shift workers.The current study purposed to investigate sleep characteristics, and their relationships with work-related exposures, demographics, and other related variables in workers of a smelting factory.
Materials and methods: This cross-sectional study was carried out on workers in a 40-year smelting factory located in the East of Tehran Province. A total of 200 male participants were included in the study. Among them, 110 workers were from the production process staff (furnace, sand casting, molding, surface cleaning), and the rest were office workers. Their shifts were from 6 AM to 5 PM. All the participants were asked about demographic characteristics and exposure to respiratory pollutants. All participants answered validated Persian versions of the Insomnia Severity Index (ISI) and the Pittsburgh Sleep Quality Index (PSQI).
Results: The means (SD) of age and BMI were 39.1 (8.9) years and 26.8 (4.5) kg/m2, respectively. Among all participants, 51 (25.5%) experienced exposure to a respiratory pollutant. Of those, 96 (48%) experienced poor sleep quality and 87 (43.5%) and 10 (5%) had subthreshold and clinical insomnia, respectively. The mean (SD) night sleep duration was 6.4 (0.96) hours. Data analysis illustrated a significant positive relationship between exposure to respiratory pollutants and insomnia (p-value = 0.03). However, this association between sleep quality and exposure to repiratory pollutants was not significant (p-value = 0.25). Further analysis with binominal regression showed participants with exposure to respiratory pollutants were more susceptible to clinical insomnia (p-value= 0.02, exp(B) = 0.213). A lower night sleep duration was observed among participants with exposure to inhalational material (p-value = 0.05).
Conclusions: Occupational exposures to hazardous material, including inhalational exposures, could cause sleep disturbance, which warrants more attention paid by sleep specialists.

VARIABILITY OF SLEEP AND CHRONOTYPE IN ADOLESCENTS SUFFERING FROM INSOMNIA: MEDIATING FACTORS FOR SLEEP DISORDERS AND EMOTIONAL STATE

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Introduction: This study examined a theoretical model proving the connection of insomnia, sleep variation and chronotype and emotional well-being in adolescents with chronic insomnia with regard to their diurnal preference and sleep variability. We hypothesized that in adolescents' diurnal preference sleep variability and emotional well-being would be linked.
Materials and methods: A total of 53 adolescents (23 males) who referred to our outpatient clinic due to sleep disorders participated in this study. Sleep disorders were assessed with a structured interview for adolescents and parents according to ICSD and DSM criteria. All adolescents kept a sleep diary which was used to compute scores for sleep variability. Diurnal preference was subjectively assessed via questionnaires (rMEQ) as well as emotional well-being was assessed with the Youth Self Report (YSR).
Results: E-types had elevated scores for emotional well-being in the YSR total score and in the sucscale internalizing problems, indicating less emotional well-being. Moreover, we found a significant impact of chronotype concerning sleep variability: the more an adolescent shifted towards evening preference the more irregular his or her sleep was. A conducted regression analysis revealed that sleep variability and chronotype were significant predictors of emotional well-being (YSR total score) and accounted for 42% of variance.
Conclusions: In a sample of adolescents suffering from sleep disorders we verified that E-types exhibited more emotional and behavioral problems. E-types also showed more irregular sleep habits, probably due to social requirements which are in contrast to their preferred sleep-wake schedule. While variability of sleep times was linked to emotional well-being negatively, variability of bedtimes was linked to it positively, which indicates that self-set bedtimes might act as protective strategies to regulate sleep times.
Acknowledgements: -

Insomnia
Board #132 : Poster session 1
ADMINISTERING INTENSIVE SLEEP RETRAINING TO TREAT CHRONIC INSOMNIA USING THE SLEEP ON CUE SMARTPHONE APPLICATION

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Introduction: Online treatments for insomnia offer a solution for the growing number of sleep-related concerns in the population and lack of accessible treatment services, yet concerns regarding treatment efficacy and adherence remain. Sleep On Cue is a smartphone application designed to administer Intensive Sleep Retraining: a brief but effective insomnia treatment involving a series of rapid sleep onsets facilitated by sleep deprivation over one night. To administer this treatment, the application is required to register when the user has fallen asleep and promptly wake them after 2-3 minutes in order to maintain sleep drive and the resulting rapid sleep onsets. The project aims were to assess the validity of Sleep On Cue for measuring sleep onset and to investigate the feasibility of administering the treatment protocol in the home environment.

Methods:
Study 1: 12 individuals (M = 21.7 years, range: 21-25) underwent polysomnography (PSG) recording while simultaneously using Sleep On Cue in the sleep laboratory. Participants completed as many sleep onset trials as possible within two hours following their habitual bedtime. This involved responding to low intensity tone stimuli emitted via headphones by gently shaking the smartphone. Once the participant failed to respond, the application awoke them with a high intensity vibration emitted from the smartphone. Correspondence was measured between PSG and Sleep On Cue-derived sleep onset latencies.
Study 2: 12 patients that met an ICSD-3 diagnosis of chronic insomnia (M = 29.7 years, SD = 7.7) completed sleep onset trials overnight at home, beginning at 23:00 and terminating after 40 trials. The number of trials that participants completed was calculated and actigraphy devices were used to investigate treatment adherence.

Results:
Study 1: There was a high degree of correspondence between PSG-N1 and Sleep On Cue-derived sleep onset latencies, r = .79, p < .001. On average, Sleep On Cue overestimated sleep onset by 3.17 minutes (SD = 3.04). When PSG-sleep onset was defined as the beginning of N2 sleep, the discrepancy reduced considerably (M = 0.81 min, SD = 1.96) and correspondence was stronger, r = .92, p < .001.
Study 2: On average, participants completed 36.3 sleep onset trials (SD = 6.7) within the 12-hour treatment session. One participant completed only 19 trials because they failed to wake in response to the high intensity vibration and slept until their normal wake up time. With the exception of this participant, actigraphy confirmed that participants had adhered to the instruction of getting out of bed in-between trials.

Conclusions: Drawing the findings from these pilot studies together, Sleep On Cue can accurately estimate sleep onset and deliver the Intensive Sleep Retraining protocol appropriately in the home environment. This also demonstrates that individuals are able to self-administer Intensive Sleep Retraining with the aid of an instrument that can accurately estimate sleep onset, and adhere to the treatment instructions outside of the controlled laboratory setting. Future research could examine the efficacy of self-administered Intensive Sleep Retraining in the home environment.

Acknowledgements: Michael Schwartz for technical assistance and access to Sleep On Cue.

A RANDOMIZED CONTROLLED TRIAL: TAILORED SLEEP HYGIENE INTERVENTION REDUCED HIGH SCHOOL STUDENTS´ SLEEP DISTURBANCE, ABSENTEEISM, PRESENTEEISM, AND DROPOUT

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Introduction: Sleep problems bring a massive effect on adolescent health and school achievement. Absenteeism and subsequent dropout is a serious problem for schools, students, and public health. Some of the previous studies revealed the correlation between students´ dropout and sleep problems. Our preliminary study also suggested that sleep hygiene intervention could reduce student' absenteeism. While sleep health is important, access to sleep medicine is limited and insufficient compared with the potential demand represented by the high prevalence of sleep disturbance. This study was conducted to investigate the efficacy of structured sleep hygiene intervention on sleep disturbance, absenteeism, presenteeism, and dropout.
Materials and methods: From 2017 to 2018, a parallel group, randomized, open, sham-controlled, multicenter (multi-school) study was conducted at 7 high schools in Japan. The study had 5 steps.
1) The attendance status and questionnaire survey consisted of the Pittsburgh Sleep Quality Index (PSQI), Presenteeism Scale for Students (PSS), and some additional question about school life was conducted.
2) The students who have sleep disturbance and absenteeism were extracted and offered to join the intervention.
3) The students who agreed to participate the study were randomly assigned to the intervention group and control group in a 1:1 ratio.
4) The intervention was performed by a clinician or school teachers. A student received a 45 minutes sleep hygiene counseling and 5 minutes 3 times follow up with ICT support that the algorithm suggested the improvement priority of sleep hygiene. The control group was received a sleep hygiene pamphlet which the government recommended to do was written.
5) At the next semester, the participants answered the questionnaire again and at the end of the school year, the absenteeism was objectively examined. The main outcome of the study was pre-determined as absenteeism reduction. The trial was approved by the Tokyo Medical University IRB #2017-185 and registered as #UMIN000029711
Results: In the first step sleep survey, 3,305 students gave informed consent and completed the questionnaire, 1,761 students have sleep disturbance (PSQI≥6; 53.3%), and 365 students were accompanied by absenteeism (more than 1 time absent a week). Within 365 students, 244 students (66.8%) participated to the intervention phase and randomly assigned to the intervention group and control group in 122:122. As of May. 2019, 214 participants can be followed up (104 intervention, 110 sham-control). In the intervention group, mean score of PSQI was changed from 8.47 to 6.66 (p< .001) and 5 students have dropout from the school (4.8%). In the control group, mean score of PSQI was changed from 8.56 to 8.30 (p=.102) and 15 students (13.6%) have dropout from the school (p=.0431).
Conclusions: We employed a sleep hygiene intervention, which prioritized and was tailored for each student. Our analysis demonstrated that the method might reduce absenteeism among high school students.

SELF-REPORTED INSOMNIA SYMPTOMS AND SUBCLINICAL MYOCARDIAL INJURY: DATA FROM THE NORD-TRØNDELAG HEALTH STUDY (HUNT)

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Introduction: Epidemiological studies suggest that insomnia, charecterised by difficulty falling and/or staying asleep, is a risk factor for cardiovascular disease in the general population. The nature of this association is unclear. One potential mechanism is an increase in subclinical myocardial injury. We therefore examined the association between self-reported symptoms of insomnia and subclinical injury as assessed by circulating cardiac troponin I (cTnI) in the general population.

Materials and methods: cTnI was measured with a high-sensitivity assay in 8244 individuals in a subcohort from 4 municipalities in the second survey of the Nord-Trøndelag Health Study (HUNT II). Insomnia was defined as self-reported symptoms of difficulty initiating sleep and/or difficulty maintaining sleep almost every night. The association between self-reported insomnia symptoms and cTnI was assessed by linear regression and adjusted for established cardiovascular risk factors, renal function, self-reported depression and anxiety.

Results: Concentrations of cTnI increased with frequency of insomnia symptoms. Median cTnI in individuals reporting difficulty initiating sleep almost every night was 3.8 ng/L (IQR 2.5, 5.8) vs. 3.2 (IQR 2.2, 4.9) in the reference group. Median cTnI in individuals with difficulty maintaining sleep almost every night was 4.1 (IQR 2.5, 6.3) vs. 2.9 (IQR 2.1, 4.3). We observed an association between cTnI and symptoms of difficulty initiating sleep in unadjusted linear regression model (0.177 [0.090, 0.265]) but no association between difficulty initiating sleep and cTnI in adjusted regression models for sex, age (0.101 [-0.070, 0.080]) or fully adjusted models (0.150 [-0.025, 0.326]). There was also an association between cTnI and symptoms of difficulty maintaining sleep in unadjusted linear regression model 0.331 [0.226, 0.436]) but no association between difficulty maintaining sleep and cTnI in adjusted regression models for sex, age (0.009 [-0.082, 0.101]) or fully adjusted models (0.043 [-0.054, 0.140]).

Conclusions: Although concentrations of cTnI increased with frequency of insomnia symptoms, insomnia was not associated with increased concentrations fo circulating cTnI in linear regression models. These findings do not support the hypothesis of an association between insomnia and subclinical myocardial injury with circulating cardiac troponin I (cTnI) in the general population.

INSOMNIA IN PEOPLE WITH INTELLECTUAL DISABILITIES (ID): A TREATMENT PROTOCOL

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Introduction: People with an intellectual disability are prone to sleep problems inherent to their compromised brain function. In addition, daily caregivers determine a great deal of the daily routines which may lead to conditions for a(n) (un)healthy sleep. We studied the effect of a modified insomnia protocol in ID patients.

Materials and methods: A cohort of 92 ID patients, with presumed sleep onset and or sleep maintenance difficulties were referred to our tertiary sleep wake centre. The diagnostic workup consisted of questionnaires, clinical interviews, actigraphy and polysomnography (PSG), home recording or clinical, were used. Care dependent people, like people with ID, often can`t meet the AASM criteria for insomnia, therefore insomnia was defined as a complaint of the patient and or caregiver about initiation and or maintenance of nocturnal sleep, without fulfilling the diagnostic criteria for other sleep disorders.

We developed a treatment protocol for insomnia treatment, with specific emphasis on tailored care as needed by patients with ID. First, the interventions to improve sleep can only be realized with the support of the caregivers. Therefore education, sleep hygiene, behavourial strategies and aspects of cognitive therapy are mainly targeted at the caregivers. Second, the way in which the interventions are designed take account the unique profile of each patient on the independent domains of cognitive capabilities, emotional competences, developmental disorders, somatic and psychiatric comorbidities. Finally, the therapy was administered by an ID physician, a formally acknowledged medical specialism in the Netherlands.

The effect of the treatment was evaluated by clinical interviews. A treatment was successful, when the patient and/ or caregiver experienced an substantial improvement of the complaints.

Results: Patient characteristics: age 1-70yr, 46 male/ 46 female, mild to profound intellectual disability with varying co-morbidities. Insomnia was diagnosed in 60 patients, treatment was initiated in all. 26 patients completed the protocol. 18 of them were treated successfully, 4 patients were not able to follow the treatment advices due to factors beyond their influence, 4 patients lacked measurable effect. 34 patients were lost to follow up.

Fit for age-time in bed, more (physical) activities, enhanced light/ dark regime and careful designed bed ritual were the most successful interventions.

Conclusions: Causes of sleep problems in people with intellectual disability comprises an intertwining of intrapersonal and environmental conditions. Inadequate time in bed, and lack of (physical) activities are most common and in the majority of cases treatable reasons for insomnia.

AUGMENTING CBT-I WITH BLUE-LIGHT BLOCKING GLASSES IMPROVES ANXIETY IN INSOMNIA PATIENTS

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Introduction: Insomnia is one of the most frequent sleep disorders with CBT-I considered one of the most effective treatment methods for chronic insomnia. CBT-I consists of a structured programme that includes sleep hygiene education, sleep restriction and focus on dysfunctional thought schemes. Unfortunately, small to none attention is paid to the "light hygiene" - a set of rules and recommendations to mitigate the negative impact of evening/night screen exposure on sleep quality, while many studies have shown that blue-light shield eyewear impedes the effect of evening light on melatonin suppression with possible positive effects on sleep quality and other daily symptoms, both in healthy volunteers and clinical populations.

Aims: The objective of our study was to assess the effect of combining CBT-I with wearing blue-light blocking glasses 90 minutes prior to bedtime on subjective and objective sleep parameters and daily symptoms (anxiety, depression, hyperarousal, sleepiness).

Materials and Methods: 30 patients (mean age 48.1±16.13 years, range 21-71, 15 men/15 women) completed a CBT-I group therapy programme, with groups randomly assigned to either „active" (blue-light filtering glasses) condition, or „placebo" (glasses without filtering properties) condition. The CBT-I groups were led by 2 experienced therapists with the same training background, lasting for 6 weeks in total. Patients were continually monitored by wristwatch actigraphy (MotionWatch8, CamNTech, Cambridge, UK), kept their sleep diaries and completed a standard questionnaire battery at admission and after the end of the programme. The battery consisted of several sleep and daily symptoms questionnaires, from which we evaluated the scores from BAI (Beck Anxiety Inventory), BDI-II (Beck Depression Inventory), HAS (Hyperarousal Scale), ESS (Epworth Sleepiness Scale) and subjective scores of morning alertness from the sleep diaries.

Results: After controlling for confounding variables (age, gender, therapist), statistical analyses (GLM) showed a greater reduction of BAI score in "active" (4.33±4.58) vs. "placebo" (-0.92±3.68) groups of patients (F=6.389, p=0.019, Cohen's d=1.26 - very large effect size). Differences in other measured variables remained statistically insignificant.

Conclusions: We provide further evidence that blocking short-wavelength light in the evening hours may be beneficial for patients suffering from insomnia. We think this may be partly due to changes in sleep parameters (especially sleep onset latency) that were not registered by subjective measures and actigraphy. Other possible explanation may be the fact that using active glasses consolidated patients' circadian rhythm by accelerating the onset of melatonin secretion in the evening, resulting in lower levels of sleep-related anxiety. Further research on larger samples incorporating EEG polysomnography is necessary to elucidate the mechanism in action. Nevertheless, blue-light blocking glasses may present a low-cost effective intervention for insomnia patients.

COMPARING RESULTS OF CBT-I IN KOREAN INSOMNIA PATIENTS BASED ON NUMBER OF SESSIONS

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Introduction: The purpose of this study was to review the clinical experience of Cognitive Behavioral Therapy for insomnia (CBT-I) in Korean insomnia patients and compare the resulting effects of CBT-I based on how many sessions each patient attended.

Materials and methods: We reviewed all insomnia patients who received the CBT-I in a tertiary university hospital sleep disorder center from March 2014 to December 2018. Insomnia was defined according to the International Classification of Sleep Disorders 3rd Edition (ICSD3), which includes difficulty falling asleep and/or maintaining sleep at least 3 times per week for 3 months. All insomnia patients whose severity of insomnia index was higher than 15 were included, and shift workers were excluded. Patients were divided into three groups depending on the number of CBT-I sessions they participated in. All subjects completed sleep questionnaires before receiving CBT-I treatment. Sleep diaries were kept before treatment, during treatment, and after treatment.

Results: A total 305 patients were included in analysis. Of that group, 59 patients received two sessions of CBT-I (2 CBT-I), 123 patients received three sessions of CBT-I (3 CBT-I), and 92 patients received four sessions of CBT-I (4 CBT-I). There were no significant differences in sleep and psychiatric related characteristics among the three groups before treatment. After treatment, there was a significant increase in subjective sleep efficiency and total sleep time, and a significant decrease in subjective latency to sleep onset and wakefulness after sleep onset in each of the three groups. After 4 CBT-I sessions, subjective sleep efficiency had improved by 27.76±25.41. Total sleep time and sleep onset latency also showed significant improvement, by 132.94±151.01 and -45.17±73.29 respectively. These effects increased with the number of sessions, but the effects of the third and fourth sessions were similar to each other.

Conclusion: The CBT-I showed considerable effects in insomnia patients, which is similar to Western studies. However, the observed effects were not significantly different upon receiving three sessions of CBT-I as compared to four. Thus, we should recommend insomnia patients receive at least three sessions of CBT-I.

Insomnia
Board #194 : Poster session 1
THE EFFECTS OF INSOMNIA ON MOOD AND COGNITIVE FUNCTIONING IN ADOLESCENTS: THE ROLE OF PUBERTAL DEVELOPMENT

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Introduction: Adolescence is a critical and sensitive period during which there is a substantial increase of the prevalence of sleep problems, such as insomnia, as a result of various psychosocial and physiological changes. Whilst previous research has found that insomnia is associated with poor daytime functioning in adults, there has been limited evidence on the effects of insomnia in relation to pubertal development in adolescents. The current study aimed to examine the role of pubertal status on the association between insomnia and daytime functioning in adolescents.
Materials and methods: A total of 121 adolescents (males: 31.4%, mean age: 16.2y) completed a set of questionnaires and neurobehavioural tasks. Sleep was measured by Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI) and 7-day prospective actigraphic monitoring. Insomnia cases were defined as ISI score $\geq$ 9. Pubertal status was assessed by the Tanner pubertal self-assessment questionnaire (early adolescence: Tanner 2 & 3; late adolescence: Tanner 4 & 5). Mood symptoms were measured by the Depressive Anxiety and Stress Scale (DASS-21). Sustained attention, selective attention, working memory and set shifting were measured by Psychomotor Vigilance Task, Color-Word Stroop Task, Digit Span Task and Wisconsin Card Sorting Task, respectively. General linear models were applied to examine the interaction between insomnia and pubertal status on mood and cognitive functioning, in which gender was entered as covariate.
Results: The prevalence of insomnia symptoms was 41.7% in the overall sample, and 82.6% of the sample were at late pubertal stage. Insomnia was associated with more depressive and anxiety symptoms only in the adolescents at late pubertal stage (interaction for depression: F=3.92, p=0.050; interaction for anxiety: F=4.66, p=0.033). Meanwhile, insomnia was particularly associated with poorer working memory in the adolescents at late pubertal stage (interaction: $F_{forward}$=1.35, p=0.248; $F_{backward}$ =5.76, p=0.018). No interaction effect was found on other cognitive domains.
Conclusions: The association between insomnia and impaired daytime functioning emerges during late puberty. Our findings suggested the role of pubertal maturation in relation to the adverse impacts of insomnia in adolescents and highlighted the need for early assessment and timely intervention of insomnia in early adolescence.

ACCEPTANCE AND COMMITMENT THERAPY FOR INSOMNIA: A PILOT STUDY

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Introduction: Insomnia is a frequent complaint in the general population and is associated with impairments in physical and psychological health. Although Cognitive-Behavioral Therapy(CBT) demonstrates effective results for insomnia, there are those who do not respond to this type of intervention. In addition, many individuals present difficulties in implementing behavioral strategies such as sleep restriction and stimulus control. A new therapeutic modality, Acceptance and Commitment Therapy (ACT), integrated to traditional strategies, can improve the treatment of insomnia, because it increases adherence to the behavioral treatment. In this pilot study we evaluated a protocol based on ACT for chronic insomnia in adults.

Material and methods: Participants with criteria for chronic insomnia completed a screening online through the REDCap platform and were then evaluated by the Mini International Neuropsychiatric Interview (MINI). Participants with unstable clinical or psychiatric comorbidities were excluded. Thirty-one adults with chronic insomnia (mean age=40.110.1 years, 27 females) were randomized to ACT-I or to CBT-I. For both treatments, the intervention was performed in six weekly group sessions. The common treatment elements in both protocols refer to behavioral components, which include psychoeducation on sleep, stimulus control and sleep restriction. The CBT-I protocol was developed according to Harvey et al. (2014). Beyond the behavioral components, the focus of cognitive intervention for insomnia is on the cognitive restructuring of the maladaptive beliefs regarding sleep and daytime affects of insomnia. Fot the ACT-I groups, the sessions were aimed at the behavioral components already used in the non-pharmacological treatment of insomnia, added to the therapeutic processes of acceptance, availability, values, defusion and commitment used in ACT. The present protocol was based on the ACT Manual developed by Hayes et al. (2012). The evaluation occurred in three moments - pre-treatment, post-treatment and six-month follow-up, through the instruments Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), Hospital Anxiety and Depression Scale (HADS), Acceptance and Action Questionnaire-II (AAQ-II) and Dysfunctional Beliefs and Attitudes about Sleep (DBAS). All assessments were completed online via REDCap. The insomnia, daytime sleepiness, depression, anxiety, beliefs about sleep and experience avoidance were analyzed with a mixed ANOVA (group by time).

Results: After the ACT-I treatment, significant reductions were observed in insomnia, anxiety, beliefs about sleep and experience avoidance. The reduction in scores were maintained at the 6 month follow-up. However, there was no significant difference between the groups.

Conclusion: The study suggested that integrating principles of ACT with behavioral techniques may be useful for the treatment of insomnia. Future research in larger samples is needed.

CHANGES IN INITIAL, MIDDLE AND LATE INSOMNIA SUBTYPES DURING CBT-I AND CPAP THERAPY IN CO-MORBID INSOMNIA AND SLEEP APNEA (COMISA)

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Introduction: Co-morbid Insomnia and Sleep Apnea (COMISA) is a highly prevalent and debilitating disorder, which is more difficult to treat compared to the presentation of either disorder alone. Different insomnia subtypes in COMISA (initial, middle, and late) may reflect different underlying mechanisms, which require different treatment approaches. For example, previous research has found that patients with middle insomnia experience improved sleep with CPAP therapy, whilst patients with initial and late insomnia have difficulty using CPAP, and may require CBTi to improve sleep and facilitate CPAP acceptance and adherence. We investigated changes in initial, middle, and late insomnia subtypes following both CBT-i and CPAP therapy in COMISA to determine whether insomnia subtypes showed different patterns of improvement following CBTi and CPAP therapy.

Materials and Methods: 145 patients with COMISA (AHI≥15/hr; ICSD-3 Insomnia) were recruited to a 6-month randomised controlled trial investigating the impact of CBTi followed by CPAP ($n=72$) vs. Control followed by CPAP ($n=73$). Initial, middle and late insomnia were classified as a response of ≥ 3 on the first three respective items of the Insomnia Severity Index (reflecting 'severe', or 'very severe' symptoms). Subtype classifications were repeated in each group at baseline, post-CBTi/control, after 1-month of CPAP, and 6-month follow-up. As in previous studies, only CPAP-users were retained for Generalized Estimating Equations examining changes in insomnia subtypes throughout treatment. Linear mixed model analyses were performed on an intention-to-treat basis to examine changes in each insomnia subtype score throughout treatment.

Results: At baseline, 36% of patients were classified with initial, 50% with middle, and 47% with late insomnia. These proportions were similar (±5%) between the CBT-i and control groups (all between group χ^2 analyses' $p>0.15$). In the CBT-i group, there was a significant reduction of all subtypes from baseline to post-CBTi/control (66-70% reduction, all $p≤0.001$), and there was no subsequent change in any subtype following CPAP therapy. Conversely, the control group showed no change in the proportion of insomnia subtypes by post-CBTi/control, but then showed significant improvement in each subtype (62-76% reduction, all $p≤0.002$) following CPAP. Significant linear mixed models interactions showed that those treated with CBTi and CPAP therapy experienced the greatest reduction in middle ($d=1.24$) and late ($d=1.13$) insomnia by 6-month follow-up, compared to participants receiving CPAP-alone (middle and late $d=0.83$ and 0.58, respectively).

Conclusions: Among this group of COMISA patients, symptoms of middle insomnia were not simply a secondary manifestation of OSA and were commonly amendable to CBTi. Middle insomnia subtypes showed similar responses to CPAP when compared to initial and late insomnia subtypes. Differences with previous research may be due to greater insomnia- and OSA severity in the current samples and differences in insomnia subtype definitions. Furthermore, the combination of both CBTi followed by CPAP therapy resulted in the greatest improvement in middle and late insomnia symptoms by 6-months, compared to treatment with CPAP alone. This suggests that COMISA patients should receive CBTi prior to

commencing CPAP therapy to improve insomnia symptoms and facilitate greater CPAP acceptance and use.

A PILOT IMPLEMENTATION OF A COMBINED GROUP/INDIVIDUAL, COGNITIVE-BEHAVIORAL TREATMENT FOR INSOMNIA FOR A POPULATION WITH DIVERSE CO-MORBID PSYCHIATRIC AND SUBSTANCE USE ISSUES

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Introduction: Insomnia is a highly prevalent and significant problem in populations dealing with mental health and substance use issues, and has a complex and interactive relationship with a wide variety of mental health and substance use disorders. When insomnia is present co-morbid with other conditions, insomnia-specific treatment should be provided, and treatment options should include non-pharmacological therapies. Well established and effective non-pharmacological treatment options exist, but continue to be largely unavailable to our mental health and substance use client populations. Continued efforts to identify practical and effective approaches to providing insomnia treatment within existing mental health and substance use treatment services will be important to addressing this concerning treatment gap.

Materials and methods: We conducted a single-arm pilot trial of a 7 week Cognitive-Behavioral Therapy for Insomnia treatment clinic, utilizing a combined group and individual treatment format, with a cohort of participants dealing with a diverse range of co-morbid mental health and substance use issues. The treatment cohort was solicited from clients active in treatment with the various outpatient programs of Richmond Mental Health and Addictions - public health treatment services provided by the Vancouver Coastal Health Authority in Richmond, British Columbia. A combination of quantitative and qualitative measures were utilized to inform a qualitative assessment of the feasibility of this treatment approach.

Results: Pre and post-treatment assessment of insomnia severity shows evidence of a positive treatment response, and 2 month follow up assessment indicates that these gains were maintained over time. Evaluation of participant feedback and clinician observation indicates a positive treatment experience, good engagement with the treatment protocols, and motivation to continue to use the treatment strategies in the future. Referral interest was good, and present across the range of our treatment services.

Conclusions: Although we are limited in the conclusions we can draw from our small scale study, our results are encouraging, and have led to support within our services for further insomnia treatment clinics. Our treatment format is showing itself to be a feasible approach to delivering non-pharmacological insomnia treatment within mental health and substance use treatment systems. Further clinics will allow us to continue to "fine tune" the treatment format, build a larger sample size, and pursue a more confident analysis of treatment results.

Insomnia
Board #135 : Poster session 1

PSYCHOSOCIAL INTERVENTION FOR DISCONTINUING BENZODIAZEPINE HYPNOTICS IN PATIENTS WITH CHRONIC INSOMNIA: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Long-term benzodiazepine (BZD) use is not recommended in the treatment of chronic insomnia because of the disadvantages of long-term BZD use such as cognitive decline, risk of fall, and development of dependence. Psychosocial interventions, particularly cognitive behavioral therapy for insomnia (CBT-I), are recommended in the clinical guidelines of chronic insomnia and are considered as a potential treatment option for discontinuing BZDs. The aim of this systematic review and meta-analysis was to clarify whether psychosocial interventions are effective for discontinuing BZD hypnotics in patients with chronic insomnia.

Materials and methods: A literature search of major electronic databases was conducted up to July 2018. We searched the electronic databases of PubMed, Cochrane Central Register of Controlled Trials, and Embase for reports of randomized-controlled trials (RCTs) using appropriate subject headings and search syntaxes, which were relevant to each resource. Two researchers independently selected relevant publications, extracted data, and evaluated methodological quality according to the Cochrane risk of bias assessment. We used Cochrane Collaboration Review Manager software (RevMan 5.3) for statistical analysis.

Results: Eight RCTs, all of which evaluated CBT-I, were included in this review, and meta-analyses were performed. The results indicated that short-term (≤3 months) CBT-I plus gradual tapering was more effective than gradual tapering alone for discontinuing BZDs hypnotics (risk ratio: 1.68, 95% confidence interval [CI]: 1.19 - 2.39, p=0.003) and for improving insomnia symptoms (g: - 0.69, 95% CI: - 1.09 - -0.28, p=0,0009). However, the long-term (12 months) efficacy of CBT-I for discontinuing BZDs was not significant (risk ratio: 1.67, 95% CI: 0.91 - 3.07, p=0.10).

Conclusions: The results of this review suggest that CBT-I is effective for discontinuing BZD hypnotics as well as improving insomnia symptoms in the short-term (≤3 months). However, the effects of CBT-I for discontinuing BZDs in the long-term (12 months) did not reach statistical significance (p=0.10). Further studies with larger samples and appropriate evaluations will be needed to clarify the efficacy of CBT-I for discontinuing BZD hypnotics in the long-term.

Insomnia
Board #136 : Poster session 1

ASSOCIATION BETWEEN INSOMNIA COMPLAINTS AND 24-HOUR AMBULATORY BLOOD PRESSURE IN OLDER MEN

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Introduction: Aging is associated with insomnia symptoms and elevated blood pressure. However, it is not known whether insomnia complaints are associated with variance in blood pressure and relevant cardiovascular risk factors, such as reduced nocturnal dipping in older population. Thus, we examined the association between self-reported insomnia complaints, 24-hour ambulatory blood pressure, and 24-hour ambulatory heart rate among older men.

Materials and methods: We utilized variables from 995 men who participated in the investigation at age 70 years of the Uppsala Longitudinal Study of Adult Men (Uppsala, Sweden). Insomnia complaints were asked by two questions that assessed difficulty initiating sleep (DIS) and early morning awakenings (EMA). Blood pressure and heart rate were recorded by 24-hour ambulatory blood pressure monitoring. A reduced or non-dipping pattern of blood pressure or heart rate was defined as nighttime (2300-0600h): daytime (0600-2300) blood pressure or heart rate ratio greater than 0.90. Analysis of covariance or logistic regression adjusted for age, body mass index, diabetes status, smoking status, leisure-time physical activity, and hypertension status was used to test the difference between men with and without insomnia complaints regarding blood pressure and heart rate variables.

Results: Compared to those without DIS, men who reported DIS (10% of the cohort) had a higher risk of insufficient nocturnal diastolic blood pressure dipping (OR [95%CI]:1.88 [1.22, 2.88], P=0.004). Men who reported EMA (19% of the cohort) exhibited a 2.1% higher nighttime diastolic blood pressure (P=0.030), and higher risk of insufficient nocturnal diastolic blood pressure dipping than those without EMA (OR [95%CI]: 1.62 [1.15, 2.29], P=0.006). In contrast, no difference in systolic blood pressure and heart rate was found between men with and those without insomnia complaints, nor did these groups differ in their risk of hypertension.

Conclusions: Our study is the first to investigate the association between insomnia complaints and 24-hour blood pressure pattern in older population. Our results suggest that nocturnal diastolic blood pressure is independently associated with difficulty initiating sleep and early morning awakenings in older men.

CBT-I FOR CO-MOBID INSOMNIA AND SLEEP APNEA

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Introduction: Despite the high prevalence of chronic insomnia disorder comorbid with obstructive sleep apnea OSA (COMISA), there is no established treatment strategy. To the best of our knowledge, meta-analysis about cognitive behavior therapy for insomnia comorbid with psychiatric and medical conditions focused insomnia comorbid with mild sleep apnea. Furthermore, continuous positive airway pressure therapy (CPAP) is not effective for insomnia symptoms, and whose adherence is insufficient. The aim of this study was to clarify clinical feature of insomnia comorbid with moderate and severe sleep apnea, and to evaluate the effect of CBT-I for COMISA.

Materials and methods: Eligible criteria were for insomnia patients, outpatients of Gifu Mates Sleep Clinic who were diagnosed as chronic insomnia according to the International Classification of Sleep Disorders, not having any subjective symptoms about sleep apnea, and moderate or severe insomnia (Insomnia Severity Index (ISI) > 15). All of the insomnia patients filled in the questionnaires (ISI, Quality of Life Scale for Insomnia (QOL-I), Japanese version of the Epworth Sleepiness Scale (JESS), Self-rating Depression Scale, Ford Insomnia Response to Sleep Test (FIRST), Dysfunctional Beliefs and Attitude about Sleep Scale (DBAS), and Hyper Arousal Scale (HAS)) in the first session of individual CBT-I. Moreover, they underwent polysomnography after 2 days since first session, and they completed remaining CBT-I sessions regardless of the degree of sleep apnea. Furthermore, they kept writing them sleep wake log until final CBT-I session.

Results: (1) Age, gender, ISI, Quality of Life Scale for Insomnia, Dysfunctional Beliefs and Attitude about Sleep Scale (DBAS), self assessment parameters on sleep wake log (sleep efficiency, sleep latency, and time in bed), were different significantly among three groups. (2) Age, gender were different between COMISA (apnea hypopnea index; AHI ≥ 15) and insomnia disease (ID, AHI < 15) groups significantly (60.0±11.1yo vs 51.4±16.4yo, P = 0.007, M/F = 20/16 vs 11/33, P = 0.001). DBAS was not different between COMISA and ID groups, and those scores were more than each scale's cut-off. Both COMISA and ID groups' ISI , QOL-I were decreased significantly from 19.6 ± 3.1 to 9.1 ± 5.3 (P < 0.001), 20.1 ± 3.1 to 8.5 ± 5.2 (P < 0.001). Similarly self assessment parameter were also improved significantly. Furthermore, the number of CBT-I sessions were not different between COMISA and ID groups (4.5 ± 3.6 vs 4.9 ± 3.6, P = 0.421), and hypersomnolence did not appear in spite of sleep restriction therapy. Nine patients of COMISA group agreed CPAP therapy, and 5 patients continue CPAP therapy over 3 months (average usage duration was 48 months).

Conclusions: COMISA was frequent among moderate or severe chronic insomnia, and clinical feature of COMISA was a little different from common insomnia. CBT-I was predominant therapeutic strategy for COMISA, however, additional CPAP adherence was poor.

CO-OCCURRENCE OF INSOMNIA WITH MIGRAINE: A POPULATION-BASED STUDY IN A LARGE WORKING POPULATION IN JAPAN

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Introduction: Several studies have demonstrated a co-existence of insomnia and migraine, though, little studies have focused on its relation to subtypes and severity. The present study aimed to examine the cross-sectional association of insomnia subtypes (difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), and early morning awakening (EMA)) and severity of insomnia with migraine among Japanese employees.

Material and methods: We distributed a self-administered questionnaire to 227 companies/organizations throughout Japan from 2007 to 2012. We collected questionnaires from 108,055 employees representing various industries and occupations (response rate of 89.3%). After we excluded insomnia- and headache-related illnesses as defined by the international classification of headache disorders (ICHD-3, 2013) (mental disorders, stroke, cancer, CVD, hypertension, arrhythmia) as well as those with missing values, a total of 88,356 participants was submitted for the final analysis. Insomnia subtypes (DIS, DMS, EMA) were asked by "1=never or rarely" to "6=almost every day", and we identified the presence of insomnia by at least one subtype 'more than three times a week' and the severity by numbers of subtypes. Similarly, migraine without aura was identified by the questionnaire based on ICHD-3. We used the chi-square test to calculate the prevalence of insomnia and migraine, and multivariable logistic regression to examine the association of insomnia subtypes and the severity with migraine controlling for age, drinking habit, smoking, physical exercise, BMI, data collection year, data collection season, industry sector, overtime/month, job control, quantitative workload. Since both insomnia and migraine are known to have sex differences, we performed analyses separately by sex.

Results: The prevalence of insomnia was 9.5% for men and 11.0% for women ($p < .05$). Among insomnia subtypes, DIS was 6.3% for men and 8.2% for women; DMS was 4.0% and 4.5%, and EMA was 3.9% and 3.4% (all $p < .05$). The prevalence of migraine was 1.1% and 5.5% for men and women, respectively. Those who were experiencing both insomnia and migraine were 0.2% for men and 1.0% for women. All individual subtypes showed increased adjusted odds ratio (aOR) with migraine in both sexes; men had the highest aOR (95% confident intervals) of 2.13 (1.63-2.77) on DMS, while women had the highest aOR on EMA (1.46 (1.09-1.95)). The aOR of insomnia severity with migraine was 2.44 on two subtypes for men ($p < .01$) and between 1.36 to 1.55 on one to two subtypes for women ($p < .05$).

Conclusions: In this study of a large Japanese working population, we observed significant associations of individual insomnia subtypes and severer insomnia to an increased risk of migraine. Although we could not identify the causal mechanism, these findings suggest that improving insomnia may reduce the risk of migraine, and vice versa. In addition, men and women had different strengths of association between insomnia subtypes and migraine, thus, a separate treatment by sex may be needed to improve both insomnia and migraine for working population.

Insomnia
Board #137 : Poster session 1

INSOMNIA, SLEEP DURATION AND ACADEMIC PERFORMANCE: A NATIONAL SURVEY OF NORWEGIAN COLLEGE AND UNIVERSITY STUDENTS

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Introduction: The aim of this study was to evaluate the associations between insomnia, sleep duration and self-reported academic performance/failure in a large sample of Norwegian college and university students.
Materials and methods: This cross-sectional survey comprised 50,054 full-time students (69% women) aged 18-35 years (mean age 23.2, standard deviation (SD) = 3.3), with a response rate of 31%. Binary logistic regression analyses were conducted to examine the associations between the independent variables, an approximation of the insomnia disorder and sleep duration, and the dependent variables, self-reported failed examinations and delayed study progress.
Results: The results showed that insomnia was associated with a higher risk of failed examinations (adjusted for background variables, odds ratio (ORadjusted) = 1.31, 95% confidence interval (CI) 1.25-1.37, $p < .001$) and delayed study progress (ORadjusted = 1.32, 95% CI: 1.22-1.42, $p < .001$). A curvilinear relationship between sleep duration and risk of academic failure was demonstrated, where both sleeping less than 5 h, and 10 h or more, were associated with higher odds of failed study examinations, compared with sleeping 7-9 h (ORadjusted = 1.46, 95% CI: 1.33−1.63, $p < .001$ and ORadjusted = 1.53, 95% CI: 1.33−1.75, $p < .001$, respectively).
Conclusions: Insomnia and deviations from an optimal sleep duration may have notable consequences for academic success in higher education.

SLEEP AND WAKE ARE SHARED AND TRANSMITTED BETWEEN PARTNERS OF BED-SHARING COUPLES

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Introduction: Bedpartners influence each other's sleep, but our understanding of how this occurs in couples with and without sleep disorders is incomplete. For example, there is no established way to assess or quantify the process by which an individual either disturbs, or is disturbed by, the other bedpartner. Here, we: 1) characterized how bedpartners influence each other's sleep, both in couples without sleep disorders, and those where one partner experienced insomnia; and 2) identified factors predicting measures of such bedpartner influence on sleep.

Materials and methods: Fifty-five couples without evidence of sleep disorders, and 52 couples where one individual sought treatment for insomnia, participated. Participants completed the Morningness-Eveningness Questionnaire-reduced version. Couples then monitored naturalistic sleep/wake patterns via actigraphy and sleep diary for seven nights. Epoch-by-epoch sleep and wake concordance (shared sleep/wake minutes), number of wake transmissions received (number of awakenings immediately preceded by a bedpartner's wakefulness), percent transmissions received (percentage of total awakenings which were transmissions), transmissibility (percentage of all bedpartner awakenings transmitted to an individual), and percent minutes resistant to transmission (ability to sleep through bedpartner wake), were calculated. Mixed-effects modeling assessed within-couple bedtime and chronotype differences as predictors of dyadic sleep for each sample.

Results: For each of the three theoretically defined groups (partners in non-sleep-disordered couples, Insomnia Patients, Insomnia Partners), we described rates of sleep concordance ($M = 63.4 - 66.8\%$), wake concordance ($M = 6.5 - 6.9\%$), number of transmissions received ($M = 5.4 - 6.9$), percent transmissions received ($M = 18.7 - 23.6\%$), transmissibility ($M = 17.9 - 23.2\%$), and percent minutes resistant to transmissions ($M = 50.8 - 58.6\%$). Partners of individuals with insomnia received wake transmissions at 1.25 times the rate of both patients and couples without sleep disorders.

Percent transmissions was highest in couples with approximately shared bedtime in both samples. In both samples, shared bedtime was associated with elevated wake transmissions at the start of the rest interval compared with couples who had different bedtimes. For couples with insomnia, couples who shared the same chronotype had fewer transmitted wakes and increased resistance to transmission, compared with couples with different chronotypes. For those without sleep disorders, the impact of within-couple chronotype difference differed according to bedtime order (most transmissions received by individuals more evening-type than bedpartner, on nights with shared bedtime).

Conclusions: Wake transmission provides unique characterisation of dyadic sleep. Measures of wake transmission show different rates and different predictors, depending on whether both partners of a couple are good sleepers, or one partner experiences insomnia. Across both groups, individuals can only sleep through 50-60% of their bedpartner's wake minutes. These data provide preliminary insights into mechanisms of insomnia initiation and maintenance and suggest the Insomnia Partners may be more disturbed by the Insomnia Patients than vice versa. Understanding modifiable risk factors may provide ways to personalise insomnia treatments and/or develop preventative strategies.

Insomnia
Board #008 : Poster session 3

ADVERSE EVENTS OF PLACEBO FOR PARTICIPANTS IN PHARMACOLOGICAL RCTS FOR INSOMNIA - A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Double-blind randomized controlled trials (RCTs) are considered the gold standard of evidence-based medicine. As such, the RCT results guide decisions regarding publicly funded treatments. One problem with RCTs is unblinding due to side-effects, where participants guess (correctly or incorrectly) they are in the treatment group, leading to better outcomes through increased expectations. Unblinding leads to an *overestimate* of the efficacy of treatment. However, it is unknown whether the presence of nocebo effects could increase the placebo effect, which would potentially lead to an *underestimate* of the 'real' treatment effect. This meta-analysis aims to evaluate whether the rate and profile of side-effects experienced in the placebo condition differs depending upon the drug under investigation; and whether nocebo effects influence the degree of improvement in placebo arms in the insomnia literature.

Materials and methods: A systematic literature search was conducted in the following databases: EMBASE, PsycINFO, MEDLINE, CENTRAL, and Web of Science. Additional searches for grey literature were undertaken. The inclusion criteria were a double-blind RCT comparing pharmacological interventions against a matched placebo in adult insomnia patients up until 23rd June 2018. Two independent researchers screened studies and extracted data. Adverse events were aggregated for their overall rate and for specific types of adverse events.

Results: The literature search resulted in 4229 studies. The full texts of 253 articles were retrieved. We included 83 articles with 87 distinct RCTs (n=27,558) from 1973 until 2018. Studies reported a mean participant age of between 29.6 and 81.0 years. RCTs tested most typical drug classes used in the treatment of insomnia, including benzodiazepines (k=26), non-benzodiazepine hypnotics (k=25), melatonin agonists (k=11), antidepressants (k=4), orexin receptor agonists (k=5), and herbal remedies (k=3).

When comparing the rate of specific adverse events in placebo groups across studies investigating different drug categories we found a statistically significant difference ($F(7,366)=6.12$, $p< .0001$). Similarly, the rate of adverse events experienced in the placebo group was significantly correlated with the rate of the same adverse event in the treatment group ($r(1587)=.34$, $p< .0001$), indicating that the profile of adverse events in placebo groups differ consistently with the adverse events experienced in the treatment arm. There was some indication that the size of the placebo effect was associated with the rate of reported adverse events in the placebo group

Conclusions: Our results clearly show evidence of a drug-specific nocebo effect in the placebo groups in double-blind RCTs for insomnia. This is an important finding because if participants falsely believe that they are in the treatment group, it is likely that due to their expectations, the placebo group will improve more than groups without this belief. If this is the case, the more adverse events expected (and experienced) will potentially lead to a larger placebo effect, which will lead to an *underestimation* of the efficacy of the investigational drug in treating insomnia.

DADS VS MUMS: IS THERE REALLY A DIFFERENCE IN THE WAY THEY EXPERIENCE INFANT CRYING?

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Introduction: Research suggests that there may be a difference in the perceptions and experiences mothers and fathers of infants have with infant crying and infant sleep problems. Not only is it cited that females perceive infant sleep problems to be worse than males, but females also tend to have a lower cry tolerance[1]. This research suggests that targeting the experiences and perceptions of Mums may be more beneficial when considering barriers in the uptake and adherence to interventions for infant sleep problems such as graduated extinction. This study aimed to assess the role of parent gender, presence of infant sleep problems, and other individual factors such as co-sleeping status on parental tolerance for infant crying.

Materials and methods: 215 mothers (n=102) and fathers (N=113) of infants (aged 6-24 months) were recruited via MTurk and completed a 10-minute survey with mixed qualitative and quantitative questions asking parents of their experiences with infant sleep and infant crying.

Results: Cry tolerance was predicted by gender, with mothers reporting being less able to cope with their infants crying than fathers (p= .04). It was also predicted by sleep problem, with parents of infants with a sleep problem being less able to cope with their infants crying (p= .003). Both mothers and fathers had similar opinions on whether they allowed their infant to self-soothe (p = .466) and found graduated extinction equally as helpful (average 6/10 for both sexes, p= .65). Interestingly, both described anxiety and worry as the primary emotions experienced when hearing their infant cry at night (figures 2 and 3). Parents described feelings of guilt, worry and wanting to tend to their child when they hear their child cry during the night, examples of qualitative responses can be found in table 1.

Conclusions: These findings emphasise what needs to be considered when thinking about infant sleep and interventions that can be used to assist parents with a better night's sleep. Differences in cry tolerance have been replicated and this study highlights the need to consider individual characteristics such as gender, cry tolerance, co-sleeping status, whether or not their infant has a sleep problem and breastfeeding when considering the use of behavioural interventions such as graduated extinction which require parents to endure infant crying.

GRADUATED EXTINCTION AND ITS BARRIERS FOR INFANT SLEEP PROBLEMS: AN INVESTIGATION INTO THE EXPERIENCES OF PARENTS

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Introduction: Behavioural interventions (e.g., extinction-based methods) have been cited as some of the most efficacious evidence-based techniques in the treatment of infant sleep disturbance1, 2 with a lack of evidence for harm3, 4. Despite this, parents are still reluctant to try or adhere with such best practice techniques, specifically extinction-based interventions. The study´s aim was to explore the potential barriers, experiences and opinions parents of infants have with behavioural interventions for infant sleep.

Materials and methods: Method: 215 mothers and fathers of infants (aged 6-24 months) were recruited via MTurk and completed a 10-minute survey asking parents of their experiences with infant sleep and graduated extinction (GE), associated barriers to conducting GE, as-well-as solutions to reduce resistance and increase adherence.

Results: About one third (34%) of parents reported that they co-sleep with their infant and of those who co-sleep, a greater number of parents (20%) reported that their infant had a sleep problem in comparison with those who did not co-sleep (p= < .001). Almost half of respondents had tried GE (43%), and a significant proportion (83%) reported they experienced difficulty implementing graduated extinction (p= < .001). The main themes were extracted from each open-ended response. Key barriers experienced when implementing graduated extinction can be found in figure 1, with low cry tolerance being the primary barrier. When considering techniques that might help distract themselves from listening to their infant's cry, many parents suggested both audio and visual distraction. Other suggestions can be found in figure 2. Interestingly, mothers who co-slept with their infant were significantly less motivated to try graduated extinction compared to fathers who co-slept with their infant (p= .003; figure 1), as were mothers who breastfed (p= .012).

Conclusions: Results demonstrated that a large number of parents who had tried GE found it difficult to implement and/or adhere to. It seems addressing the uptake of GE is just as important as addressing adherence to the technique. The results highlight that cry tolerance and concerns regarding this appear to be a significant barrier to parents successfully implementing GE. Responses from parents also suggest there is potential for the use of visual and audio distraction techniques to increase adherence. Future research should evaluate the ability of distraction techniques to reduce resistance and increase adherence to behavioural interventions for infant sleep problems.

Acknowledgements: Flinders University College of Education, Psychology and Social Work.

CHANGES OF COGNITIVE AND BEHAVIORAL FACTORS AND AROUSAL LEVEL ASSOCIATED WITH TREATMENT EFFECTS OF CBT-I IN INSOMNIA WITH SHORT AND LONGER OBJECTIVE SLEEP DURATION

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Introduction: Insomnia with short and longer objective sleep duration were proposed to be different phenotypes that were associated with higher physiological hyperarousal and cognitive/behavioral factors, respectively. Cognitive behavioral therapy for insomnia (CBT-I) was found to be less effective for insomnia with short objective sleep duration in one study (Bathgate et al, 2017), but not in the other study (Lovato, et al, 2016). The secondary analysis of our data also showed no significant differences in the effect of CBT-I between the two groups. In light of the negative findings, it is possible that the treatment effects were attained through different mechanisms since CBT-I targets both cognitive-behavioral factors and hyperarousal. The current study examined the changes of cognitive and behavioral factors and arousal level associated with improvement of insomnia following CBT-I in insomnia patients with short and longer objective duration.
Methods: 85 insomnia patients (mean age = 43.59 years, 65 females), without comorbid major psychiatric, medical, or sleep disorders, participated in this study. They were divided into a short-sleep-duration group (< 6 h; N=19, 15 females; mean age = 42.32 years) and a longer-sleep-duration group (≥6 h; N=66, 50 females; mean age = 43.96) based on one night of PSG. They all went through a 6-session CBT-I program over a 7-week period, and were required to complete the Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Pre-sleep Arousal Scale (PSAS), and Sleep Hygiene Practice Scale (SHPS) before and after treatment. The change scores for all the measures were calculated for the analyses.
Results: For patients with longer objective sleep duration, significant correlations were found between change scores of the ISI and change scores of the Sleep Practice subscale (r=.305, p< .05) and Control over Sleep subscale (r=.338, p< .05) of the DBAS, the Arousal subscale (r=.523, p< .001) of the SHPS, and both the Somatic and Cognitive subscales of the PSAS. For patients with short objective sleep duration, the improvement on the ISI showed no significant correlation with all the change scores, but near significant positive correlations with improvement on the Control of Sleep subscale of the DBAS (r=.448, p=.062) and the Cognitive subscale of the PSAS (r=.433, p=.074); unexpectedly, the ISI change score showed near-significant negative correlations with the Sleep Practice and Causal Attribution subscales on the DBAS (r=-.431, p=.074; r=-.428, p=.076, respectively).
Conclusions: The secondary analysis demonstrated that the treatment effect of CBT-I might be achieved through different mechanisms for insomnia patients with short and longer objective sleep duration. As expected, the improvement of insomnia was associated with changes in sleep cognition and behaviors, as well as reduction of cognitive and somatic arousal in patients with longer objective sleep duration. However, among those with short objective sleep duration, improvement of insomnia severity was found to be associated with the belief of control over sleep and reduction of cognitive arousal only. Different CBT-I treatment strategies might be considered to target different factors for the two subtypes of insomnia.

BELIEFS AND ATTITUDES ON SLEEP AND RELATED FACTORS IN INSOMNIA PATIENTS COMORBID WITH DEPRESSION

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Introduction: To study sleep characteristics of comorbid insomnia of depression;To explore beliefs and attitudes on sleep in a sample of insomnia patients comorbid with depression and to analyze its influencing factor;To analyze the differences in beliefs and attitudes on sleep among depressive disorder, primary insomnia and good sleepers.

Materials and methods: 61 patients with depression comorbid with insomnia ,62 patients with primary insomnia and 64 good sleepers were recruited according to DSM-IV. The three groups were measured by Dysfunctional Beliefs and Attitudes about Sleep Scale（DBAS）and Pittsburgh Sleep Quality Index(PSQI). Depressive patients were also measured by the Hamilton Depression Scale(HAMD).

Results: "The hypnotic drug" factor(2.21±1.23) and "the day function" factor(1.93±0.90)of PQSI for the depressive patients were significantly higher than those for the primary insomniacs(1.42±1.39;1.32±0.99) (p< 0.05);"The sleep quality" factor of PQSI for the primary insomniacs (2.31±0.62) was significantly higher than schizophrenic patients (2.07±0.66); The depressive patients and primary insomniacs showed no significant difference on DBAS total and all factor scores except for the" beliefs in ways to improving sleep"factor(p< 0.01); The total scores of DBAS were negatively correlated with the total scores of PSQI in depressive group（r =-0.395,p< 0.01）, primary insomnia group(r=-0.609,p< 0.01) and the good sleepers(r=-0.274,p< 0.05). Multiple linear regression analysis of PSQI scores showed that the DBAS factor "catastrophic thoughts on the consequences of insomnia", the total score of HAMD as well as age were influencing factors on sleep quality in depressive patients. As to primary insomniac patients, the DBAS factor "catastrophic thoughts on the consequences of Insomnia"、the factor "sleep control and prediction" and age were influencing factors on sleep quality.

Conclusions: Compared with good sleepers，patients with depression comorbid with insomnia have more dysfunctional beliefs about and attitudes towards sleep. Their cognitions will greatly affect the quality of sleep.Catastrophic thoughts on the consequences of insomnia and the severity of depression affect their sleep quality.

DARIDOREXANT (ACT-541468), A NEW DUAL OREXIN RECEPTOR ANTAGONIST, FOR THE TREATMENT OF INSOMNIA DISORDER IN THE ELDERLY: RESULTS FROM A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, 5-PERIOD, 5-TREATMENT CROSSOVER DOSE-RESPONSE PHASE 2 STUDY

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Introduction: Most hypnotic treatments for insomnia disorder negatively impact next-day functioning, which is a particularly important consideration in the elderly population. Daridorexant (ACT-541468) is a potent and selective dual orexin receptor antagonist that has shown minimal residual next-day effects in healthy subjects in Phase 1 studies. The present study assessed the dose-response of daridorexant on sleep parameters in elderly subjects with insomnia disorder.

Materials and methods: Eligible elderly ($\geq$65 years) subjects with insomnia disorder (Diagnostic and Statistical Manual of Mental Disorders, 5th edition criteria) who had wake after sleep onset (WASO) $\geq$30 min, latency to persistent sleep (LPS) $\geq$30 min and total sleep time (TST) < 6.5 h were randomly allocated (Latin square design) to one of five treatment sequences. Double-blind treatment (5 mg, 10 mg, 25 mg, 50 mg daridorexant and placebo) per the assigned treatment sequence was administered on two consecutive PSG nights (Days1&2) during each of the five treatment periods, separated by 5-12-day washout periods. The main efficacy endpoints were the change from baseline (mean of the two placebo run-in PSG nights) in WASO (primary) and LPS (secondary) to Days1&2 (mean of the two PSG nights for each treatment). The dose-response of daridorexant on WASO and LPS was evaluated using generalized MCP-Mod methodology. Other efficacy endpoints were TST and subjective parameters (subjective WASO [sWASO], subjective latency to sleep onset [sLSO], subjective TST [sTST]), which were analysed descriptively. Safety, including next-morning sleepiness (Karolinska Sleepiness Scale, KSS) was also assessed.

Results: Of 149 subjects screened, 58 (67% female; median age 69 years [range 65-85]) were randomized. A dose-response relationship was demonstrated for the change from baseline to Days1&2 in WASO (p< 0.0001) and LPS (p=0.004), with significant reductions from baseline for doses above 5 mg, compared with placebo (WASO: -18.4, -31.5, -47.8 min; LPS: -10.4, -9.2, -10.8 min; for 10, 25, and 50 mg, respectively, p$\leq$0.025). TST was increased with each daridorexant dose and dose-dependent improvements were observed for sWASO, sLSO and sTST for the change from baseline to Days1&2. The most frequent treatment-emergent adverse events were fatigue, nasopharyngitis, gait disturbance, and headache (all $\leq$7%), with no apparent relationship to dose (except fatigue [50 mg], 7%). Self-reported KSS scores were lower (i.e. improved) from baseline across all treatment groups.

Conclusion: In elderly subjects with insomnia disorder, a significant dose-response was established for daridorexant in the reduction of WASO and LPS. Dose-dependent reductions in WASO and LPS were significant for doses above 5 mg. Subjective sleep parameters were consistent with objective PSG data. Daridorexant treatment was well tolerated with no dose-limiting safety events or next-morning sleepiness. Phase 3 studies of daridorexant (dose range 10-50 mg) in elderly subjects with insomnia disorder are ongoing (ClinicalTrials.gov: NCT03575104, NCT03545191, NCT03679884).

EXPLORING SLEEP-DEPENDENT PROCEDURAL MEMORY DURING AN AFTERNOON NAP: AN EEG EXPLORATION OF SIMPLE AND COMPLEX IMPLICIT SEQUENCE CONSOLIDATION

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Introduction: Sleep plays a role in memory, particularly with the process of consolidation. Explicit, fact-based (e.g., declarative) memory consolidation benefits from both nocturnal sleep and daytime napping, presumably due to non-REM slow oscillations and sleep spindles contained in both long and short sleep periods. In contrast, the role of sleep for implicit, skill-based (e.g., procedural) memory is mixed. Evidence shows procedural memory can benefit from nocturnal sleep, but the relationship between naps and procedural memory is less established. The first aim was to investigate if procedural memory consolidation can be enhanced by an afternoon nap. Additionally, mixed findings regarding sleep and procedural memory consolidation may be because different procedural memory tasks are sensitive to different stages of sleep. The second aim of our study was to explore if such task-dependent findings may be due to the neural underpinnings recruited by different procedural memory tasks. To this end, we used an implicit procedural memory task modulated to recruit different brain regions during pre-sleep acquisition by comparing "simple" versus "complex" motor-sequence consolidation.

Materials & Method: We used the 'Serial Reaction Time Task' (SRTT) to measure procedural memory. The SRTT involves participants implicitly acquiring knowledge of visuo-motor sequences as they rapidly press the button on a response pad corresponding to the location of visual stimuli on a monitor. Unbeknownst to participants, the locations of stimuli follow a repeating 12-location pattern that can be implicitly acquired with prolonged exposure. Two versions of the SRTT was used in this study: one containing a "simple" and one containing a "complex" hidden sequence.

Healthy adults aged between 18 and 35 took part in two sessions in which SRTT performance was assessed before and after (a) a 90-minute afternoon nap or (b) a corresponding period of wake (i.e., control). Participants were randomly allocated into either the simple or complex sequence group. Hence, there were four experimental conditions: (i) Simple/ Nap; (ii) Simple/ Wake; (iii) Complex/Nap; and (iv) Complex/Wake. The main outcome of interest was the difference in SRTT performance for simple and complex sequences following napping. Electroencephalography (EEG) was recorded during both napping and waking consolidation periods, and the resulting EEG spectra were analysed against SRTT performance.

Results: Preliminary data from 31 participants (simple - n = 15; complex - n = 16) revealed that implicit sequence learning of both simple and complex sequences occurred before the consolidation period. There were non-significant differences in SRTT performance following napping for both simple and complex sequences; thus, napping did not benefit consolidation of sequence learning. Exploration of sleep EEG data did indicate a potential dissociation between groups. Specifically, increased Delta (0.5-4 Hz) power across frontal and central regions during non-REM sleep stages correlated with improved SRTT performance only for the simple sequence group.

Conclusions: Napping had no effect at a behavioural level on procedural memory consolidation of the SRTT, suggesting a potential dose dependent relationship between sleep and procedural consolidation. Associations within EEG data during napping consolidation suggest a dissociation of neural processes underlying simple and complex implicit sequence learning.

LOSING CONTROL: SLEEP DEPRIVATION IMPAIRS THE SUPPRESSION OF UNWANTED THOUGHTS

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Introduction: Unwanted memories often enter conscious awareness when we confront reminders. People vary widely in their talents at suppressing such memory intrusions; however, the factors that govern suppression ability remain poorly understood. We tested the hypothesis that inhibitory memory control depends on sleep.

Materials and methods: Following an interval of overnight sleep (n=29, 13 male, 19.79 ± 1.63 years) or total sleep deprivation (n=30, 12 male, 20.20 ± 1.75 years), healthy adults attempted to suppress intrusions of emotionally negative and neutral scenes when confronted with reminders. Participants rated how successful they were at suppressing memory intrusions on a trial-by-trial basis. Emotional ratings and skin conductance responses (SCRs) to scene images were acquired before and after the overnight delay to assess suppression-induced changes in affective reactivity. Electrocardiography recordings were also acquired to assess the high-frequency component of heart rate variability (HRV): a marker of top-down prefrontal engagement during inhibitory control.

Results: The sleep-deprived group experienced significantly more intrusive thoughts (unsuccessful suppressions) than did the sleep group. Strikingly, even when sleep-deprived participants succeeded initially, they suffered more relapses in which previously suppressed memories intruded again. Deficient control over intrusive thoughts had consequences: whereas in rested participants suppression reduced negative affect and SCRs for aversive memories, it had no such salutary effect for sleep-deprived participants, allowing the unpleasantness of intruding content to persist unabated. The ability to regulate negative affect for aversive scenes through suppression was linked to the high-frequency component of HRV in rested, but not in sleep-deprived participants.

Conclusions: Our findings raise the possibility that sleep deprivation disrupts prefrontal control over medial temporal lobe structures that support memory retrieval and emotion, and, consequently, suppression-induced changes in affective memory. These data point to an important role of sleep disturbance in maintaining and exacerbating psychiatric conditions characterised by persistent, unwanted thoughts.

SHORT-DURATION REPETITIVE TRANSCRANIAL ELECTRICAL STIMULATION DURING A DAYTIME NAP IMPROVES MEMORY CONSOLIDATION

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Introduction: While asleep, our brain reprocesses and reorganizes prior learning. Slow oscillations (SOs) are purported to play a key role in this sleep-related memory consolidation process. Enhancing SOs during sleep is thought to improve subsequent memory performance and several studies have shown that transcranial electrical stimulation (tES) during sleep can modulate SOs and facilitate memory consolidation. Here we investigated whether short duration repetitive tES (SDR-tES) during daytime sleep can facilitate the consolidation of declarative memory in healthy individuals.

Materials and methods: In a within-subjects design, 17 participants completed a SDR-tES and a sham session. In both sessions, participants took a 90-min nap during which we used am EEG-based closed-loop system to detect in real-time the occurrence of SOs. In the SDR-tES condition, we delivered the electrical stimulation (4s of 0.75-Hz oscillating current) during stage N2 and N3, about 5s after the detection of a SO. In the sham condition, the setting was identical but no stimulation was delivered. Before the nap, all participants performed had to learn 60 facts of 20 locations around the world. Just after the encoding and the nap, as well as 48-hrs later, they performed a recall test (baseline, post-nap, and delayed test). During each experimental session, we used 60 different locations. The two conditions and the locations were counterbalanced across subjects and separated by at least 1-week.

Results: The stimulation induced enhancement in memory performance compared to sham both after the nap and 48hrs later. SDR-tES also increase in the proportion of time spent in N3 sleep and enhanced the rate of SOs. Change in the SO rate was associated with greater memory performance 48hrs after the initial learning. Our results also suggest that a stimulation presented during asynchronous and quiet EEG periods during N3 is more efficient in increasing SOs, whereas stimulating during an ongoing slow wave activity may result in fewer SOs.

Conclusions: We showed that our SDR-tES approach can induce positive memory and neurophysiological effects with an average stimulation dose of fewer than 5 minutes over the course of a daytime nap. Our findings demonstrate that SDR-tES is a feasible approach to improve memory-related sleep physiology and memory consolidation.

Board #147 : Poster session 2

PATTERN SEPARATION IS NOT STABILIZED BY A DAYTIME NAP

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Introduction: Sleep is considered the optimal state to consolidate hippocampal-dependent traces of memory encoded during wakefulness. A particular hippocampal memory process is pattern separation, defined as the ability to form non-overlapping orthogonal neural representations from similar inputs. Previous findings showed that pattern separation performance is impaired by sleep deprivation, while the same is enhanced after a night of sleep, compared to a similar period of wakefulness. This evidence may suggest a stabilizing role for overnight sleep on this process. Here we tested whether even a daytime sleep can impact pattern separation as assessed by the Mnemonic Similarity Task (MST).

Materials and methods: Forty participants were presented with 256 images of unique everyday objects at 12:00 PM. After fifteen minutes they performed an immediate recognition test: they were presented with 192 images, 64 *targets* (Old), 64 *foils* (New) and 64 *lures* (Similar to targets) and they had to respond whether each image was: 1) already been presented during the encoding; 2) similar to one presented at the encoding; 3) never presented before. Then the sample was split into two groups: participants in Nap group (N=20) spent 90 min in bed, while participants in Wake group spent 90 min playing a low arousing game. At 3:00 PM all participants performed a delayed recognition test, similar to the immediate one but with different images.

Results: Our data revealed an overall performance reduction in the delayed compared to the immediate test for all behavioral parameters considered (pattern separation, recognition memory, total accuracy). However, no significant differences between the two groups were found. Moreover, within the Nap group, no association was observed between changes in performance level and sleep parameters.

Conclusions: Our results suggest that a daytime nap may not be enough to modulate pattern separation.

COUPLING OF AUTONOMIC AND CENTRAL EVENTS DURING SLEEP BOOSTS WORKING MEMORY IN HEALTHY YOUNG ADULTS

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Introduction: Sleep has been shown to facilitate the improvement of working memory (WM). However, the precise mechanism for this improvement is not known. Some studies have identified associations between WM increases and slow-wave activity (SWA; 0.5-1Hz) during sleep, whereas other studies have reported Autonomic contributions to WM during sleep[1]. Recent studies in our group have identified a novel physiological phenomenon during sleep in the temporal coupling of Autonomic and Central Events (ACEs)[2], and that these ACEs predict long-term memory improvement. Hence, building on these previous results, we examined whether ACEs may also benefit gains in WM in the current study.

Materials and methods: We tested 109 young adults (Age:17-23 [Mean=20.7, SD= 2.95]) in an Operation Span (OSpan) task in the morning and evening, with a nap or wake period between 1-3PM. During the nap, we measured electroencephalography (EEG) and electrocardiography (ECG). Similar to Naji et al, we detected heart rate bursts (HRB), defined as the RR time-series with amplitude greater than two standard deviations below the mean of the RR time-series. In order to calculate changes in SWA around the HRB, the Hilbert transform was applied on filtered EEG signals in bands of interest (0.5-1 Hz). We investigated ACE coupling during sleep by tracking fluctuations in the EEG in a 20-sec window from 10-sec before to 10-sec after the HRB peak. Repeated measures ANOVAs were performed to test changes in SWA around the HRB during the 20-sec window. We utilized a hierarchical, linear regression approach to compare the predictive power of ACE versus non-ACE sleep features for WM improvement. The reduced model included WM baseline performance and overall SWA, while in the full model we added HRB-related changes in SWA.

Results: We replicated ACE activity previously reported by Naji et al, i.e., increases in SWA 5 secs prior to peak of the HRB (all ps < 0.001). Furthermore, using regression analyses, we showed that sleep-related WM improvement was better predicted by ACE SWA than non-ACE sleep parameters (change in adj R^2 all> 0.071).

Conclusions: Consistent with previous findings, the current study suggests a dynamic relationship between the Central and Autonomic Nervous Systems, specifically between cardiovascular and cerebral functions. We provide the first evidence that coordinated autonomic and central events (ACE) play a significant role in sleep-related WM plasticity. Both WM and cardiac autonomic activity rely on frontal lobe function. We hypothesize that robust frontal SWA temporally coupled with HRBs represented increased functioning of the frontal lobe during NREM sleep, which benefits frontal lobe functioning, including working and long-term memory.

Reference: 1. Chen, P., Sattari, N., Whitehurt, L., Naji, M., & Mednick, S. (2018) Parasympathetic activity during sleep, but not wake, facilitates working memory improvement: A comparison of young and older adults. Manuscript submitted for publication. 2. Naji, M., Krishnan, G. P., McDevitt, E. A., Bazhenov, M., & Mednick, S. C. (2019). Coupling of autonomic and central events during sleep benefits declarative memory consolidation. *Neurobiology of Learning and Memory*, *157*, 139-150. https://doi.org/10.1016/j.nlm.2018.12.008

PARASYMPATHETIC ACTIVITY DURING SLEEP, BUT NOT WAKE, FACILITATES WORKING MEMORY IMPROVEMENT: A COMPARISON OF YOUNG AND OLDER ADULTS

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Introduction: Recent investigations have implicated parasympathetic activity during wake in higher-order cognitive functions, including working memory ability (WM). Compared with wake, sleep is a period with substantially greater parasympathetic tone in young adults, whereas older adults show less parasympathetic activity during sleep. Sleep contributes to improvement in WM in young adults. However, the role of parasympathetic activity during sleep in WM improvement is not known. Here, we examined the role of cardiac parasympathetic activity during sleep on WM improvement in young and older adults (Younger: Mean=20.7, SD= 2.95; Older: Mean=68.93, SD= 6.43).

Materials and methods: 107 young (Age:17-23) and 101 older adults (Age: 60-85) were randomized to either have a 2-hour nap opportunity monitored with polysomnography (PSG) (Young: n=58; Older: n=54) or stay awake (Young: n=49; Older: n=47), where subjects engaged normal daily activities with actigraphy monitoring. We tested WM using the Operation-Span task in the morning and evening, and measured cardiac parasympathetic activity, as measured by heart rate variability (HRV: variation in the beat-to-beat interval), during the inter-test period containing a nap or wake period. To assess HRV, we used linear-mixed effect models (LME), with a within-subjects factor of stage (Resting, Stage 2, SWS, REM) and a between-subjects factor of age (Young vs. Older).

Results: Our analysis revealed a significant interaction between age and sleep stage, where young adults showed the expected boost in parasympathetic activity during sleep, while older adults showed a marked loss of parasympathetic tone during NREM sleep. Also, young adults demonstrated sleep-dependent WM improvement, which was associated with relative parasympathetic power during sleep. In contrast, older adults showed no beneficial effect of nap and no correlation between parasympathetic activity and WM.

Conclusion: Parasympathetic activity during sleep, but not wake, has substantial implications for WM in young adults, but no such relation was found in the elderly, potentially due to decreased amplitude of parasympathetic activity in this older age group.

Memory
Board #206 : Poster session 3
DO YOU REMEMBER? SLEEP FRAGMENTATION AND IMMEDIATE MEMORY RECALL IN SICKLE CELL ANAEMIA

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Introduction: A good night's sleep can improve cognitive functioning the next day. An accumulation of disrupted sleep over time can impact on concentration and memory consolidation. Cognition is impaired over time in sickle cell anaemia (SCA) but mechanisms remain unclear. Sleep disturbances (e.g., sleep fragmentation, sleep disordered breathing) are common in SCA but there is little existing research examining any effect on cognition. Our objective was to compare sleep fragmentation and immediate memory recall in people with and without SCA.

Materials and methods: Adolescents and young adults (AYA) of African heritage (Mean$_{age}$= 21.21 [range 16-29 years], N$_{control}$ = 12 [3 male], N$_{SCA}$= 10 [1 male]) were recruited from the community in London, UK. Sleep was measured with an Actiwatch for 7 days. Sleep data were collected with a sleep diary app developed for the study. Neuropsychological assessment from the Wechsler scales of Intelligence and Memory for adults (i.e., WAIS & WMS) was undertaken within 7 days of data collection. Data was analysed using hierarchical multiple regression to understand predictors of immediate memory recall in SCA.

Results: Both groups slept on average 7 hours, but AYA with SCA experienced greater sleep fragmentation (SF; 34%) compared to controls (24%; $p < 0.05$) and had a non-significantly greater sleep latency of 54 minutes compared to 33 minutes in controls ($p = 0.29$). Their Central Phase Measure (CPM) was 327.4 minutes compared to 254.1 minutes in controls. ($p < 0.001$). The mean full scale IQ and Immediate Memory Index (IMI) were lower in SCA compared to controls: FSIQ$_{SCA}$ = 94.6 (SD= 9.9) and FSIQ$_{controls}$= 108.4 (SD= 11.1), and IMI$_{SCA}$ = 96.2 (SD= 6.5) and IMI$_{controls}$ = 102.9 (SD= 10.3), $p < 0.05$ for both comparisons. Hierarchical multiple regression revealed that the full model of age, health status (i.e., with and without SCA), socioeconomic status (SES) and SF predicted IMI and was statistically significant, $R^2 = 0.597$, $F (4, 16) = 5.9$, $p < 0.004$, adjusted $R^2 = 0.496$. The addition of SES to age and health status as predictors of IMI led to a statistically significant increase in R^2 of 0.50, $F (1, 17) = 10.93$, $p= 0.004$. The addition of SF to the prediction of IMI led to a trend increase in R^2 of 0.597, $F (1, 16) = 3.78$, $p= 0.07$.

Conclusions: SES and sleep fragmentation appear to be contributing factors to the difficulties seen in immediate memory recall in AYA with SCA. Sleep fragmentation might be associated with sleep disordered breathing in SCA. It is not only important to understand what causes sleep fragmentation, but to develop interventions early on for people with SCA to reduce the risk of developing cognitive difficulties and to improve quality of life.

Acknowledgements: Thanks to all participants for their time. This research was supported by the NIHR Great Ormond Street Hospital Biomedical Research Centre (GOSH BRC). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

NAP-ENHANCED MEMORY CAN OCCUR IN THE ABSENCE OF CHANGES IN ATTENTION

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Introduction: Sleep is important for learning and memory. Prior work has shown that learning ability deteriorates following extended wakefulness. A brief nap has also been shown to restore learning capacity. It has been proposed that sleep may achieve this via synaptic downscaling, a process which restores hippocampal capacity for new learning. However, as sleep is also known to enhance aspects of attentional performance, which is important for memory encoding, the benefits of sleep on memory may have been partially driven by improvements in attention. Here, we addressed the role of attention by investigating whether a nap would benefit learning in well-rested participants, and whether this effect is associated with attentional performance at encoding.

Materials and methods: Forty-seven adults (mean age ± SD: 22.62 ± 2.99 years; 19 males) arrived well-rested prior to their experimental session. They underwent a 90-minute interval napping (n=24) or awake (n=23) before performing an incidental encoding task. Polysomnography (PSG) was administered to participants in the nap group to assess sleep macrostructure. During encoding, participants were presented with images of object-scene pairings and were instructed to imagine a scenario involving both the object and the scene before rating the vividness of their imagery. Response times (RT) for their ratings were used as a proxy for attentional performance. In addition, the psychomotor vigilance task (PVT) and self-reported sleepiness scale provided objective and subjective measures of alertness respectively. Following a ~24-hr delay, participants performed a surprise recognition memory test where they had to make old/new judgements regarding object images and indicate which scene it was associated with.

Results: We found that the nap group had better item memory performance, remembering more object images compared to the wake group ($t(34.82) = 2.59$, $p = .01$). Despite the nap group reporting to be less sleepy during the task as compared to the wake group ($t44.61) = -2.79$, $p = .01$), their level of subjective sleepiness was not correlated with their memory performance. In addition, there were no group differences in attentional performance as measured by RT during encoding and performance on the PVT (p's >.05). Taken together, the results suggest that the benefit of a nap on memory could not be accounted for by nap-related enhancement of vigilance/attention.

Conclusions: We demonstrated that a nap before learning in well-rested individuals is beneficial for memory encoding supporting previous work. The absence of a group difference in PVT performance and task-RT suggests that a nap can enhance learning independent of its influence on attention.

SLEEP FRAGMENTATION, ACCELERATED AGING AND INCREASED ACTIVATION OF MICROGLIA, AND COGNITIVE IMPAIRMENT IN OLDER ADULTS

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Introduction: Cognitive impairment and dementia are a growing public health concern. The global prevalence of dementia is estimated at 35.6 million individuals and is predicted to nearly double in 20 years. Thus, measures to prevent or delay cognitive impairment and dementia are urgently needed. In older adults, sleep disruption is associated with cognitive decline; however, the underlying mechanisms are unclear. In rodents, sleep disruption increases activation of microglia, the brain's innate immune cells, and inhibiting this activation improves cognition. These findings suggest that microglia may play a central role in the relationship between sleep fragmentation and cognitive impairment. However, human data relating sleep, microglial biology, and cognition is lacking - an important gap given differences in microglial biology between mice and humans. We tested the hypotheses that greater sleep fragmentation is associated with higher microglial marker gene expression and microglial activation, and that these are in turn associated with poorer cognition.

Materials and methods: We studied 685 older adults from two cohort studies-the Rush Memory and Aging Project (MAP) and the Religious Orders Study (ROS). We assessed sleep fragmentation using actigraphy and related this to postmortem dorsolateral prefrontal cortex microglial marker gene expression measured by RNA-sequencing, neocortical microglial density assessed by immunohistochemistry and antemortem cognition measured by a neuropsychological battery of tests.

Results: Individuals with greater antemortem sleep fragmentation had higher composite microglial gene expression, particularly of genes characteristic of aged microglia ($P = 0.00014$), and a greater proportion of morphologically activated microglia ($P = 0.034$), independent of chronological age and dementia-related neuropathologies. There was no significant change in total microglial density ($P = 0.66$). Expression of aging-enriched microglial genes was associated with the proportion of activated microglia (Spearman R = 0.27, $P = 0.009$), and controlling for composite expression of these genes significantly attenuated the association between sleep fragmentation and microglial activation ($P = 0.004$). Higher expression of aging-enriched microglial genes ($P = 0.0095$), greater proportion of activated microglia ($P = 0.00066$) and sleep fragmentation ($P = 0.0004$) were all associated with poorer composite global cognition proximate to death, independent of dementia-related neuropathologies. The association between sleep fragmentation and cognition was partially attenuated when controlling for the microglial measures.

Conclusions: Sleep fragmentation in older adults is accompanied by accelerated aging and increased activation of microglia, which may underlie its association with cognitive impairment and dementia. These data suggest that agents targeting microglial aging and/or associated activation may improve cognition in the context of sleep fragmentation in older adults.

HIPPOCAMPAL-THALAMO-CORTICAL COUPLING BETWEEN RIPPLES AND SPINDLES DURING NREM SLEEP IN HUMAN: A SEEG STUDY

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Introduction: Sleep is supposed to play a key role in memory consolidation. According to the Active System Consolidation hypothesis, information is progressively transferred from hippocampus to neocortex during NREM sleep. Animal studies have shown that this hippocampal-neocortical dialogue is mediated by the coupling between cortical slow waves, thalamo-cortical spindles and hippocampal ripples. In human, few studies have investigated this coupling and have focused on hippocampal and parahippocampal regions. We aim to study the interaction of these oscillations between and within the hippocampus, thalamus and neocortex using intracranial recordings.

Materials and methods: We included eight patients who underwent intracranial recording with stereoelectroencephalography for presurgical investigation of drug-resistant focal epilepsy in Timone hospital, Marseille, France. Inclusion criteria were: 1) electrode implantation including ipsilateral hippocampus, thalamus (mostly pulvinar) and middle frontal gyrus, 2) sleep recording of NREM sleep during the first part of the night, 3) epileptic spike frequency inferior to 15 spikes/min, 4) background activity with physiological features (spindles). We automatically detected spindles, ripples and spikes in hippocampus, thalamus and frontal channels (Delphos, Roehri et al, 2016) and visually checked and corrected spindles to reject spindle-like epileptic activities. We rejected ripples associated with epileptic spikes for further analysis. We computed both the grand average of time frequency analysis time-locked to the ripple peaks and to the maximal spindle troughs in the three regions. Within and between regions, we studied co-occurrence between ripples, between spindles, and between ripples and spindles. Group level statistics were obtained via a permutation test on resampled data corrected with the FDR procedure. We computed a synchrony index which consists in calculating event modulation phase between ripples and spindles.

Results: Visual analysis of the grand average of the time-frequency analysis showed an increased power in the spindle band in the three regions when triggered on the ripples and inversely in the ripple band in the three regions when triggered on the spindles (with a higher power in the hippocampus). Co-occurrence rates between spindles were statistically significant between hippocampal and frontal spindles and, to a lesser extent, between frontal and thalamic spindles. Those between ripples were significant between the three regions, with a stronger co-occurrence rate between frontal and hippocampal ripples. Finally, those between spindles and ripples were significant within the three regions with higher values in the hippocampus. Hippocampal ripples significantly co-occurred with both thalamic and frontal spindles, with higher rates with the frontal spindles. The synchrony index showed that frontal and hippocampal ripples occurred during the troughs of the spindles.

Conclusions: These results showed that spindle-ripples events are not limited to the hippocampus but also exist in thalamus and frontal regions. These oscillations are coupled within and between the three regions with higher spindles-ripples events in the hippocampus and higher co-occurrence rate between hippocampal ripples and frontal spindles. This coupling may reflect the physiological processes of hippocampal-neocortical transfer in humans.

Memory
Board #149 : Poster session 2

THE EFFECTS OF SLEEP ON PROSPECTIVE MEMORY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Prospective memory (PM) enables us to execute previously conceived intentions at a later time and is used when remembering to call a friend or submitting a proposal in a timely manner. Evidence that sleep benefits PM is presently mixed. Further, where a benefit is observed, it is unclear if this is achieved through improvements in strategic monitoring or spontaneous retrieval processes. While strategic monitoring involves attentional processes associated with holding the intention in mind and looking out for the appearance of the PM cue, spontaneous retrieval occurs when the PM cue automatically delivers the intention to mind without engaging top-down monitoring processes.

Materials and methods: We conducted a meta-analysis of 24 independent samples (N = 165,432) to quantify the effect of sleep on PM, as well as to gain clarity regarding the retrieval process benefitted by sleep. Cohen's d with 95% confidence intervals (CI_{95}) were derived using random-effects models.

Results: We found that while sleep significantly benefitted PM, the effect was in the small to medium range ($d = 0.41$, $CI_{95} = 0.25 - 0.56$) and varied depending on age and PM type whereby studies performed in younger participants ($d = 0.61$, $CI_{95} = 0.35 - 0.87$) and employing time-based PM tasks ($d = 0.61$, $CI_{95} = 0.22 - 1.00$) yielded larger effect sizes compared to those involving older participants ($d = 0.18$, $CI_{95} = -0.01 - 0.36$) and event-based PM tasks ($d = 0.39$, $CI_{95} = 0.21 - 0.57$). In addition, observed sleep improvements were not accompanied by increased monitoring ($d = -0.11$, $CI_{95} = -0.40 - 0.17$). Rather, we found that sleep's benefit on PM was greater when the likelihood of spontaneous retrieval was high ($d = 0.94$, $CI_{95} = 0.44 - 1.44$) compared to low ($d = 0.45$, $CI_{95} = -0.02 - 0.93$), suggesting that sleep may tap on spontaneous retrieval processes to produce an enhancement of PM.

Conclusions: These findings inform theoretical models of sleep and PM that could sharpen strategies to improve memory function in everyday settings as well as in vulnerable populations, such as older persons.

Acknowledgements: This work was supported by the National Medical Research Council Singapore (STaR/0015/2013).

THE EFFECT OF NOCTURNAL SLEEP MANIPULATIONS ON THE ACCESSIBILITY AND FIDELITY OF NEWLY-ACQUIRED MEMORIES: TARGETED MEMORY REACTIVATION

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Introduction: Post-learning non-REM sleep can aid retrieval of newly-acquired memories, but the nature of this effect is not entirely clear. Non-REM sleep may promote the accessibility of newly-formed representations, thus increasing the likelihood of their retrieval. Non-REM sleep may also benefit the fidelity at which representations are stored, thus allowing greater precision of retrieval. Using targeted memory reactivation during slow-wave sleep and measuring the overnight change in memory for newly-learned item locations, we examined the hypothesis that non-REM sleep processes primarily increase memory accessibility rather than memory fidelity.

Materials and methods: Thirty-six healthy, good-sleeping, young adults (mean age: 20.72; 31 female) learned the locations of 200 items on a circular grid as unique sounds were paired with each item. Half of these paired sounds were played to participants during slow-wave sleep. Before and after sleep, participants were tested on their ability to place each item in its proper location using a continuous wheel of 360 possible locations. We estimated the frequency at which participants successfully recalled the approximate location from memory and the precision of their reports when recall was successful.

Results: Contrary to expectation, performance for cued items was not significantly different than performance for non-cued items, and induced sigma (12-15.5 Hz) electroencephalographic (EEG) power following nocturnal sound cues was associated with less retention of all item locations. Still, there was evidence of the predicted link between non-REM slow-wave activity and greater memory accessibility; a significant interaction indicated that for those with high delta (1-3.5 Hz) EEG activity, more time in slow-wave sleep was associated with greater retention of approximate item locations. An unexpected association was observed between maintenance of memory precision and delta power within slow-wave sleep, but not time spent in slow-wave sleep.

Conclusions: Slow-wave activity of non-REM sleep appears to primarily promote the accessibility of newly-acquired memories while having less impact on the precision at which these accessible memories are retrieved. The results also raise questions about the effectiveness of sound-mediated targeted memory reactivation for improving memory performance over a full night of sleep.

THE EFFECT OF NOCTURNAL SLEEP MANIPULATIONS ON THE ACCESSIBILITY AND FIDELITY OF NEWLY-ACQUIRED MEMORIES: SELECTIVE REM SLEEP DEPRIVATION

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Introduction: Retrieval of newly-acquired memories can benefit from post-learning sleep, and both non-REM and REM sleep may contribute to this effect. Previous work suggests non-REM sleep primarily promotes the accessibility of newly-formed representations, thus increasing the likelihood of their retrieval, while having little impact on the precision of retrieval. We examined the hypothesis that REM sleep maintains the fidelity of memory of storage, allowing memories to be retrieved with precision. We studied the effect of selective REM sleep deprivation and targeted memory reactivation during slow-wave sleep on the overnight change in memory for newly-learned item locations.

Materials and methods: Thirty-seven healthy, good-sleeping young adults (mean age: 19.35, 25 female) learned the locations of 200 items on a circular grid as unique sounds were paired with each item. Half of these paired sounds were played to participants during slow-wave sleep. Half of the participants received selective deprivation of REM sleep through targeted awakenings, and the other half received equivalent awakenings during light non-REM sleep. Before and after sleep, participants were tested on their ability to place each item in its proper location using a continuous wheel of 360 possible locations. We estimated the frequency at which participants successfully recalled the approximate location from memory and the precision of their reports when recall was successful.

Results: Despite predictions, there was no clear effect of either REM sleep deprivation or targeted memory reactivation on overnight change in recall performance. In the REM sleep deprivation group, the little REM sleep obtained was associated with greater item location retention. In replication of our previous work, we found that better retention of approximate item locations was associated with time spent in slow-wave sleep for those with high delta (1-3.5 Hz) electroencephalographic (EEG) power during slow-wave sleep. Likewise, greater induced sigma (12-15.5 Hz) EEG power following nocturnal sound cues was again linked to performance decline, associating with worse retention of approximate item locations and worse maintenance of precision in the group awakened during non-REM sleep.

Conclusions: The results further illustrate a robust association between slow-wave activity of non-REM sleep and later accessibility of newly-acquired memories. The ineffectiveness of targeted memory reactivation during non-REM sleep and selective REM sleep deprivation informs our understanding of possible boundary conditions regarding the effectiveness of sleep manipulations on memory performance.

COMBINED EFFECTS OF ACUTE EXERCISE AND SLEEP ON RECOGNITION MEMORY IN YOUNG, SEDENTARY ADULTS

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Introduction: Previous studies have evaluated the memory benefits of exercise and sleep independently, showing that both exercise and sleep improve memory retention. Whether the combination of exercise and sleep can further boost memory performance remains unknown. We aimed to test the hypothesis that a NonREM nap and a single aerobic exercise session may have synergistic, complementary effects on long-term memory in young sedentary adults.

Methods: A total of 115 healthy participants (M_{age}23±3.3.9SD yrs) with low-to-moderate level of physical activity and no history of sleep disorders were included the study, which involved a between-subject design with four groups: 1) exercise+nap (ExNap), 2) nap only (NoExNap), 3) exercise only (ExNoNap) and 4) no exercise or nap (NoExNoNap). During the experimental procedure, participants were provided with a light lunch after undergoing 40min of moderate-intensity cycling (ExNap, ExNoNap) or sedentary procedure in those groups who did not exercise (NoExNap, NoExNoNap). This was followed by a study session (13h30), and a 60min NonREM nap (ExNap, NoExNap) or not (ExNoNap, NoExNoNap)(14h00). At the test session (17h00), the participants completed a visual recognition task whereby 45 of the previously studied photos were intermixed with 45 "foils". The participant's task was to indicate the previously presented photos by pressing a key on a computer keyboard. Polysomnography was used to monitor sleep during the nap. Our primary outcome variable was task recognition accuracy. Secondary exploratory variables included NonREM sleep metrics (total sleep time, awakenings, sleep latency, sleep efficiency, WASO, microarousals and sleep stages (N2, N3), as well as N2/N3 spindle density and N2/N3 slow-wave activity.

Results: There was a significant group difference on recognition accuracy (p =0.019). Follow-up posthoc tests revealed that the ExNap group was more accurate than the NoExNap and ExNoNap groups (M±SD 83.8±2.9 vs. 81.1±5.4, p=0.027; 78.6±10.3, p =0.012, respectively). A *trend* was observed between the ExNap vs. NoExNoNap (81.9±4.1, p=0.058). Furthermore, higher task accuracies were associated with higher NonREM sleep spindle densities across the ExNap group (r=0.46, p=0.02). No significant associations were seen between memory performance and other sleep variables.

Conclusion: These data show that an acute exercise session and a daytime NonREM nap improve recognition over a nap or exercise alone in young adults with a sedentary lifestyle. Our results therefore demonstrate a synergistic effect between exercise and sleep, which may not be independent factors operating separately upon memory but rather work together to enhance long-term recognition memory.

LEARNING-INDUCED ENHANCEMENT OF SIGMA-GAMMA PHASE-AMPLITUDE COUPLING IN NON-RAPID-EYE-MOVEMENT SLEEP

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Introduction: The hierarchy of oscillations that mark non-rapid-eye-movement (NREM) sleep are hypothesized to mediate the link between sleep and memory consolidation. In the active consolidation triple-interaction model, cortical slow oscillations (SO) bias the occurrence of thalamocortical sleep spindles, which themselves nest hippocampal ripples that broadcast memory reactivations throughout the cortex. In keeping with this model, recent work has found successful memory consolidation to be predicted by the precise phase-amplitude coupling (PAC) between these oscillations. However, because these studies did not record a non-learning control night, it remains unclear whether the observed variations in PAC between individuals are dynamic responses to information gathering and encoding, or whether they are more stable, trait-like attributes of individual brains.
Materials and methods: We recorded the sleep electroencephalogram (EEG) of 15 healthy adults (9 F, 18-30 years old) on non-consecutive nights preceded either by a declarative word pair learning task or a non-learning control task, in a counterbalanced repeated measures design. Participants completed actigraphy, questionnaires and a first night of polysomnographic screening and habituation to ensure they had normal sleep. We automatically detected slow waves and spindles centrally throughout NREM sleep and measured the PAC between slow oscillation (SO), sigma and gamma bands in the detected signal. To quantify PAC strength, we used the Kullback-Leibler divergence method.
Results: We found a significant increase in the strength of sigma-gamma coupling over detected spindles on the learning task night compared to the non-learning task night. Importantly, we ran parallel comparisons of EEG power in SO, sigma and gamma bands between learning and non-learning conditions and found no significant differences. We also found that sigma and gamma amplitudes were tightly bound to the phase of the SO, and that in the case of gamma, amplitude peaks occurring later in the SO up-state were associated with better pre- to post-sleep change in recall score on the word pair task. Lastly, we tested whether EEG power or coupling strength predicted pre-to-post-sleep change in recall score, and found no significant relationship.
Conclusions: Our finding of learning-dependent spindle-gamma coupling increases, in the absence of changes in sigma or gamma power, provides experimental evidence that declarative learning enhances PAC [SBD1] during NREM sleep. Furthermore, this result together with our finding of an association between SO-gamma coupling phase and memory performance lend support to the triple-interaction model of memory consolidation.
[SBD1]Not defined.

A 90-MIN NAP RESTORES HIPPOCAMPAL CAPACITY AND BOOSTS DECLARATIVE LEARNING

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Introduction: Naps have been linked to improved learning outcomes - both for the consolidation of previously learnt material, as well as for the learning of new material. One theory underlying enhanced encoding following a nap is via the synaptic downscaling of neurons potentiated during wake. This process is thought to be facilitated by slow oscillations - a hallmark of slow wave sleep. In this study, we sought to confirm this using a combination of PSG and fMRI methods to study encoding following a nap compared to an equivalent waking period.

Materials and methods: 40 healthy undergraduates (M = 23.3 y, SD = 2.96 y; 10 males) who slept normally the previous night encoded word pair lists in an MRI scanner at 1PM and 4.30PM. Lists were repeated twice within each encoding session. In between encoding sessions, participants either stayed awake and watched a documentary (Wake group; N=20) or napped for 90-min (Nap group; N=20) while undergoing polysomnography. Approximately 40 min after each encoding session, memory of these word lists were assessed in a cued-recall fashion. Performance in each session was measured by percentage of correct responses.

Results: There were no baseline differences in encoding performance. However, a Session x Group interaction effect ($p < 0.001$) was observed whereby performance significantly improved only in the Nap but not the Wake group in the second encoding session (Nap: 20 ± 19% vs. Wake: -1 ± 13%). Concurrent to this, fMRI analyses revealed a Session x Run x Group interaction effect in the hippocampus (peak voxel MNI coordinates: [-23 -14 -23], $p = 0.002$) whereby hippocampal activation during encoding of the word lists increased from the end of Session 1 to the beginning on Session 2 only in the Nap group. In addition, although there was no association between degree of performance improvement in the nap group with duration of sleep or the various sleep stages (N1, N2, N3, REM), spindle count (12-15 Hz) in the Nap group correlated significantly with both performance improvement ($r_s = 0.46$) and increase in hippocampal activation between encoding sessions ($r_s = 0.46$).

Conclusions: These results confirm the benefit of a nap on encoding processes. Hippocampal activation also increased following the nap, which could indicate renewed hippocampal capacity to store new information as consolidation processes that take place preferentially during a nap would have aided transfer of previously learnt material from the short-term hippocampal store to the neocortex for long-term storage. While we hypothesized that slow wave sleep would aid in this transfer, we instead found a relationship between spindle count and both degree of performance improvement and hippocampal activation increase. These findings could be specific to a 90-min nap period, where duration of slow wave sleep is short. Further work should confirm the complex interplay between NREM sleep oscillations, hippocampal downscaling and encoding performance.

IDENTIFICATION OF MEMORY REACTIVATION RELATED ACTIVITY IN HUMANS USING EEG AND SOURCE RECONSTRUCTION

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Introduction: Consolidation refers to the stabilization of memories in specific neural networks (Diekelmann and Born 2010). Memory consolidation occurs through reactivation of neural networks implicated in information encoding (Rasch et al. 2007). In this context, sleep has been shown to be a crucial element of this reactivation process (Rudoy et al. 2009; Rasch et al. 2007). Studies in rats show that neuronal assemblies activated during encoding of declarative memories are reactivated during Slow Wave Sleep (Maquet et al. 2000), and rely on specific cortical and subcortical wave patterns such as Slow Oscillations (SO), spindles and their phase coupling (Klingzing et al., Nature Neuroscience (in press)). Reactivation of memory-related networks can also be induced by using a sensorial cue, and Targeted Memory Reactivation (TMR) has shown to be effective to improve performance in participants after being stimulated during sleep (Rasch et al. 2007). Here, we attempt to analyze EEG recordings of a TMR experiment in humans, and identify specific neural patterns associated with the reactivation.

Materials and methods: A total of 20 subjects participated during 2 different nights and learned two different versions of an object-location task before going to sleep. Each task was performed in the presence of an odor, linking this odor (A) to the content and context of the learning task. Two hours before the object-location task, they performed a finger-tapping task linked to a different odor (B). All participants were presented during one night with odor A and with odor B in the other night in a randomized way. The odor was presented in a cyclic way of 15 sec on, and 15 sec off, having a placebo odor (non-associated with any task) in between odor presentations. EEG signals of 129 channels were recorded during learning and sleep, and anatomical images were also taken for each subject.
Volume sources were computed and the signal from cortical and subcortical regions or scouts were selected using the AAL Atlas. Time-frequency and coherence analyses were applied over the scouts time series as well as phase locking correlation between SO and sleep spindle features.

Results: By using volume source estimation we have been able to extract time-series of source signals originating in thalamus and prefrontal cortex. We successfully detected spindles and SO events in these two areas. We observed a higher power of spindle events in the thalamus in cue conditions compared to the control condition. However, the number of spindle events did not show apparent differences across conditions. Remarkably, our analysis revealed that the thalamic sleep spindle events were phase-locked with the upstate of cortical SO, as has been reported before (Klingzing et al., Nature Neuroscience (in press), (Feld and Born 2017)).

Conclusions: Volume Source estimation allowed us to detect TMR related-patterns in both thalamus and prefrontal cortex. As seen in the literature, the detected spindles were coupled to the up-state of the slow oscillations. Our results suggest that TMR could be occurring through an increase in spindle power.

AFFECTIVE MODULATION OF SLEEP-DEPENDENT MEMORY CONSOLIDATION ACROSS THE LIFESPAN

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Introduction: Studies examining the benefit of sleep for emotional memory have predominantly focused on constrained age ranges, despite known changes in the effect of emotion on memory across the lifespan. Moreover, most studies investigating neurophysiological mechanisms have focussed on sleep activity exclusively, with few studies examining the effect of sleep on emotional stimuli recall by assessing event related brain responses during task performance. The aim of this study was to examine the relationship between emotional memory and sleep from childhood through to older adulthood, and potential electrophysiological markers of this relationship.

Materials and methods: A repeated-measures design was used with individuals ranging from 7-72 years of age. Participants included 42 volunteers (25 female), of which 28 were adults (M = 33.82 years, SD = 17.19) and 14 were children (M = 12.14 years, SD = 3.01). Participants were required to complete a declarative old/new memory task using emotionally valenced (positive, neutral, negative) stimuli before and after periods of sleep and wake. Affective stimuli were adapted from Bennion and colleagues (2014) and comprised of static visual images of valenced foreground objects, plausible neutral backgrounds, and composite scenes of the background and foreground objects. Baseline memory was tested immediately after encoding, followed by either a 2 hour nap opportunity or restful wakefulness, and a subsequent delayed recall test. Electroencephalography (EEG) was recorded during memory tasks, and was also used to quantify sleep in the nap opportunity.

Results: A linear mixed model of the behavioural data showed a significant interaction effect between condition (sleep, wake), valence (negative, positive, neutral) and age on memory performance (d'). Results suggest memory performance in the sleep condition was greater than the wake condition, and a decrease in performance from learning (baseline) to delayed recall was observed, regardless of condition and age. As expected, overall memory performance also decreased as a function of age, and memory performance for all ages was consistently better for positive and negative stimuli when compared to neutral items. Considering these preliminary findings, neural activity associated with memory performance and developmental differences will be further explored, specifically the early frontally located old/new effect (FN400), and a late parietal old/new effect (Late Positive Component).

Conclusion: Results support the concept that emotional information is preferentially consolidated over neutral regardless of developmental life stage, and that sleep benefits this process. It is important to further understand how aging can influence mnemonic success, in addition to better understanding how emotion may lead to optimization of desired memory formation. Identification of neural factors underpinning the affective modulation of sleep-dependent learning could lead to greater understanding of how sleep disturbances may play an active role in promoting mental health conditions.

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ENHANCING OR DEPRESSING MEMORIES, WHILE DEEPENING SLEEP, BY EEG-GUIDED NEUROSTIMULATION

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Introduction: Over recent years we have developed a pioneering technique that allows us to interact with the sleeping brain in real-time. An automated loop, involving real-time modeling and prediction of electrophysiological brain signals, targets stimuli to specific patterns in ongoing brain activity. This sophisticated form of manipulation, termed closed-loop neurostimulation (CLNS), enables innovative experimentation and exciting applications.

Materials and methods: We used CLNS to test the hypothesis that sleep-related memory reactivation and consolidation are specifically linked to the depolarized phase of slow oscillations (SO's). Participants were exposed to a foreign vocabulary-learning task in the evening and tested for vocabulary acquisition the next morning. During sleep, memory reactivation was induced through subtle, auditory presentation of foreign words, locked to a specific phase of the slow oscillation.

Results: Using this approach, we showed that the alignment of memory cues to the SO depolarising slope enhances memory for cued vocabulary items. Conversely, cues targeted to the down-going slope promote forgetting. Moreover, subtle auditory stimuli locked to SO zero-crossings can boost the slow oscillation dynamic, inducing long SO trains that effectively increase the duration and percentage of deep sleep across the night.

Conclusions: These results provide strong evidence for the notion that sleep-related memory consolidation occurs during the depolarised phase of slow oscillations. Moreover, they show that declarative memory traces can be either enhanced or suppressed during sleep, depending on the precise alignment of reactivating cues to specific neural activity patterns. Finally, we show for the first time that sleep, as whole, can be deepened using intermittent, SO phase-locked sound stimulation during NREM sleep.

These findings provide important insights into sleep-related memory reprocessing and point the way to possible applications of CLSN in the treatment of sleep problems and disorders involving maladaptive memories, such as PTSD, phobia and addiction.

Memory
Board #141 : Poster session 1

DOES SLEEP PROTECT MEMORIES AGAINST INTERFERENCE? A FAILURE TO REPLICATE

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Introduction: Retention of newly learned declarative memories (e.g., fact-based information) benefits more from a training-retest interval filled with sleep as opposed to wake. However, there is still considerable debate about how to characterize the role of sleep in this process of consolidation. One line of reasoning suggests that if sleep plays an important role in memory consolidation, then memories acquired prior to sleep should not just be better remembered following sleep (compared to wake), but should also be more resistant to the interfering effects of new learning that occur after sleep has consolidated the memory. The alternative perspective is that sleep plays a more passive role, which leads to better memory retention of information learned prior to sleep, but not the consolidation required to protect memories against new (interfering) learning? In this well-powered study, we attempted to replicate the work of Ellenbogen, et al. (2009)[1], who found that interference learning following wake had a dramatic negative influence on memory compared to when interference learning followed sleep. We also examined the relationship between intrinsic motivation and memory performance in sleep and wake participants.
Materials and methods: Participants (97 university students (age: 23.2±1.9yrs, range: 18-28, 59 female)) learned three sets of 20 word pairs and were immediately tested on 20 of the word pairs (A-B) prior to a night of sleep or a day of wake. At retest 12hrs later, participants were tested on a different set of 20 of the originally learned word pairs (without interference). Following this retest, participants learned a set of 20 word pairs that overlapped with the remaining 20 word pairs that were learned during the training session, in which the first word of the pair was the same, but paired with a different word (A-C; interference learning). Participants were then tested on the original target words (learned during training) and the interference target words.
Results: Consistent with the results of Ellenbogen, et al., we found that those who slept retained more word pairs at initial retest (without interference). However, we did not replicate their main interference x sleep condition interaction: wake participants did not perform worse following interference than those who slept. We also found that greater intrinsic motivation was associated with better word pair acquisition. However, greater intrinsic motivation did not preferentially benefit those who slept, v. those who stayed awake.
Conclusions: In this well-powered replication study we were unable to show that sleep protects memories from the negative influence of interference after sleep has had a chance to initially process the memory, suggesting that sleep may not support an important aspect of memory consolidation by providing greater resistance to interference.
[1]Ellenbogen, et al. (2009). The sleeping brain´s influence on verbal memory: boosting resistance to interference. PLoS One. 4: e4117

Memory
Board #216 : Poster session 2
SLEEP QUALITY, QUALITY OF LIFE, AND COGNITIVE PERFORMANCE AMONG ADOLESCENTS WITH TYPE 1 DIABETES

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Introduction: Adolescents with Type 1 Diabetes (T1D) experience sleep disorders like poor sleep quality, longer stage 2 sleep and shorter deep sleep. Sleep is crucial for working memory as well as for establishing and consolidating long-term memory. T1D adolescents may be affected more by fatigue and a lower quality of life, and may struggle with a loss of cognitive performance, primarily executive functions and language capabilities. The association between T1D and decreased cognitive function in the literature are inconsistent. We aimed to assess the sleep quality, quality of life, and cognitive performance in adolescents with T1D in comparison to an age- and sex-matched healthy control group.

Method: Sixty-two participants aged 12 to 20 (mean age 14±2.31) from both sexes (38.7 % male) were divided into two groups: 1) Thirty-one T1D individuals, recruited from Pediatric Endocrine Clinic at Ha´Emek Medical Center and from the community in northern Israel. 2) Thirty-one age- and sex-matched healthy control adolescents. Participants were given subjective sleep quality (School Sleep Habits Survey) and quality of life (The Pediatric Quality of Life Inventory - PedsQL) questionnaires. Moreover, sleep was measured objectively for one week (by Actigraph, Respronix Pro-Plus, Philp), and participants were asked to perform various computerized cognitive-function and pencil-and-paper tests. The study was approved by the institution's Helsinki committee.

Results: The two groups (T1D and healthy adolescents) had a shorter sleep duration (7:33±0:53 hours) than recommended for this age (< 8.00). They did not differ in sleep quality: sleep duration (7:47±1:03 vs. 7:20±0:41), sleep efficiency (85±4 % vs. 85±5 %), or sleep latency (15±19 vs. 13±10 min), and in subjective sleep pattern and quality of life overall score (72±21 vs. 73±15).

In contrast to these results, significant differences were found in several cognitive computerized indices. Specifically, the T1D group presented lower performance compared to the healthy control group in memory (198.3±127.6 vs. 384.8±103.5; $p < 0.001$), attention and concentration (266.9±141.3 vs. 384.8±103.5; $p < 0.001$), coordination (268.7±148 vs. 415.6±104.6; $p < 0.001$), perception (315.1±108.3 vs. 425.6±65.5; $p < 0.001$), and overall score (318.2±103.7 vs. 388.3±61.7; $p < 0.001$). Considerable differences were found in partial executive functions, processing accuracy, and speed using pencil-and-paper tests.

Discussion: The lack of disparities in sleep quality between T1D and healthy control group may be explained by the fact that the differences are more pronounced in sleep stages; however, all adolescents experienced significant sleep pattern changes, in transition to adolescence (like short sleep duration, and late sleep onset). Thus, the results for all participants were sleep deprivation, feelings of fatigue, and lower quality of life. Contrastingly, the T1D group was more affected with regards to cognitive performance; the results of the participants in the T1D group are lower in several cognitive tests, compared to the control group.

In conclusion: The present study highlights the difficulties in cognitive functioning among T1D adolescent, not necessarily in relation to quality of sleep or quality of life.

MANIPULATING MEMORY DURING SLEEP

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Introduction: Targeted Memory Reactivation (TMR) is the deliberate reactivation of a memory trace by presenting learning-related cues during sleep. TMR is thought to selectively enhance memory consolidation during Slow-Wave Sleep (SWS). The hallmark of SWS is the slow-wave, characterized in the electro-encephalogram (EEG) as a wave with amplitude >75 μV and frequency around 1 Hz. The slow-wave reflects global synchronous neuronal depolarisation and increased excitability in the so-called up-state, followed by a widespread neuronal hyperpolarisation in the down-state. In this study, our aim was to present learned stimuli during either a slow-wave up- or down-state. Our expectations were that stimuli cued during the up-state would enhance vocabulary memory the most, since the up-state is associated with neuronal depolarisation and increased excitability.

Materials and methods: 65 Native Dutch speakers participated in the study. They learned 120 Danish nouns before sleep. We developed a closed-loop method that allows targeting stimuli to any oscillatory phase by modelling and predicting the oscillatory brain activity. We used this method to predict either up- or down-states in slow-waves. In the "Up" group (N=23), half of the learned words were aurally cued again during predicted slow-wave up-states. In the "Down" group (N=19), half of the learned words were cued during predicted slow-wave down-states. The "Sham" group (N=23) did not receive any cues during the night. Auditory TMR started at the beginning of SWS and continued for 3 hours. The following morning, participants had to retrieve all 120 words in a cued recall test.

Results: Our results show that memory for words cued in the up-state of a slow-wave was improved, i.e. on average participants knew more of the cued words after sleep (107%±12%) compared to the uncued words (99%±10%, p=.03). Moreover, we are the first to show that memory traces seem to deteriorate when cued in a slow-wave down-state (95%±11%) compared to uncued words (102%±10%, p=.04). The sham group knew on average the same amount of words after sleep compared to the learned amount before sleep (100%±8%). Event-Related Potentials (ERPs) show an induced slow-wave-like pattern after cueing at the beginning of a slow-wave up-state, which is not present in an ongoing "sham" slow-wave. Presenting a cue at the beginning of a down-state seems to disrupt this pattern, resulting in a phase shift of the induced slow-wave-like pattern. Time-frequency analysis reveals an early enhancement in the fast spindle/beta power range (14-21 Hz) for the up-state cued words compared to the down-state cued words. Interestingly, both TMR cued groups show more SWS (17%±6%) compared to the sham group (11%±7%, p=.01).

Conclusions: Applying TMR in an ongoing slow-wave up-state enhances post-sleep memory, whereas reactivation in the slow-wave down-state depresses memory. Thus, by taking into account the oscillation phase of the slow-wave, it is possible to manipulate the fate of a memory trace during sleep. These results open perspective for exciting future research, such as strengthening deliberate memory traces with a device wearable at home when learning, or even deteriorating memory traces in PTSD patients.

THE EFFECT OF A DAYTIME NAP ON MEMORY CONSOLIDATION OF NOVEL WORD LEARNING

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Introduction: Sleep plays an important role in memory consolidation of word learning. Previous research has indicated that explicit memory for novel words, as well as the integration of novel words into existing knowledge networks (indexed by lexical competition), benefits from non-rapid eye movement (NREM) sleep. Such findings can be explained by systems consolidation, which supports the transfer of new memories from hippocampal to neocortical memory networks. However, studies of vocabulary consolidation have tended to focus on nocturnal sleep. The present study addresses whether a daytime nap has similar effects on newly learned words.

Materials and methods: Adult participants (N = 31; mean age = 20.91, SD = 1.55) were trained on two lists of spoken novel words (e.g., "dolpheg") in two different training sessions, once followed by a daytime nap and once followed by an equal period of daytime wake (with nap/wake conditions counterbalanced). Training procedures were adopted from a previous overnight study. Participants were explicitly instructed to learn the novel words, and training included repetition of novel words, as well as phoneme monitoring. Sleep was monitored using polysomnography (PSG) in the nap condition. Both immediately after training and after the nap/wake period, explicit novel word memory was measured using stem completion and recognition tasks. Lexical integration was measured via a pause detection task, in which participants made speeded decisions about the presence or absence of a pause to existing words that overlapped with the trained non-words (e.g., "dolphin") and untrained control words. Novel word learning was expected to initiate lexical competition (i.e., slower responses to trained competitors than untrained control words) after sleep, but not wake, as a consequence of lexical integration.

Results: Recall accuracy on the stem completion task decreased following wake, but not following sleep. Recognition of the novel words was high immediately after training, and did not differ following wake or nap. Crucially, there was no evidence that a nap initiated lexical competition effects. Analyses relating behavioral changes over the nap to NREM sleep features measured with PSG (e.g., sleep spindles and slow oscillations) will be presented.

Conclusions: While a daytime nap benefited explicit retrieval of newly learned novel words (as evidenced by preserved stem completion accuracy), there was no clear evidence for lexical integration following a nap. The findings indicate that a longer, possibly nocturnal, period of sleep-dependent consolidation may be necessary for lexical competition effects to emerge (at least under the present training regime). Ongoing research is examining whether daytime naps have a similar enhanced effect in children aged 10-12 years, and if nap benefits in children are associated with structural white matter connections in, for example, networks involved in sleep spindle activity and memory consolidation.

EMOTIONAL ENHANCEMENT OF MEMORY EFFECT IN OBSTRUCTIVE SLEEP APNEA SYNDROME - PRELIMINARY RESULTS

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Introduction: Changes of sleep architecture are often observed in Obstructive Sleep Apnea Syndrome (OSAS). However, the effect of Emotional Enhancement of Memory (EEM) in OSAS is still not well described. This is a poster presenting preliminary results of a study dealing with this subject.

Materials and methods: Adult participants under 55 with diagnosed moderate to severe OSAS no other important somatic and psychiatric conditions (contributing to cognitive functioning decline) underwent assessment of EEM effect using computer program developed for this purpose (EEM-Test), using pictures chosen from International Affective Picture System (IAPS). Participants were exposed to a set of 75 pictures with low, medium and high valence, then their memorization was verified before and after sleep. Each time they were shown a different set of 60 pictures (half from the first set and half new) and their task was to determine if each picture is a new one or previously seen. For each correctly recognized picture they scored 1 point. During the night full video-polysomnography (video-PSG) was conducted. Sleep stages and events were scored using American Academy of Sleep Medicine (AASM) criteria. Control group of healthy individuals was recruited and underwent the same procedure.

Results: So far n=5 participants were enrolled to study group and n=10 to control group. As groups count to few participants to perform full statistical analysis, it was done only on a basic descriptive level. Mean Apnea/hypopnea index (AHI) equalled 28,4 in the study group, n=2 participants met criteria of severe OSAS (AHI>30), the rest had moderate OSAS (AHI 15-30). REM percentage of total sleep time (TST) equalled 18.06% in study group (15,2% in severe OSAS, 20% in moderate OSAS) and 24.2% in control group. In EEM-Test, regarding proper memorization the study group scored mean=26.8 points (out of 30) before sleep and 23.4 points after sleep. Considering the valence of pictures, the scores before sleep for low, medium and high valence were: 9.2, 9.0, 8.6 points, respectively (out of 10 points). After sleep the scores equalled to: 8.4, 7.4, 7.6, respectively. Control group scored mean=29.22 points (out of 30) before sleep and 27.00 points after sleep. Considering the valence of pictures, the scores before sleep for low, medium and high valence were: 9.78, 9.78, 9.67 points, respectively (out of 10 points). After sleep the scores equalled to: 8.67, 9.56, 8.78 points, respectively.

Conclusions: Pilot findings were inconsistent with only 5 participants examined in the study group. This might be related to the fact, that patients with severe OSAS had lower REM percentage of TST than patients with moderate OSAS. Sleep microstructure has to be considered while comparing study and control groups in terms of EEM effect. Although the preliminary results are inconsistent due to low number of participants, EEM-Test is a promising tool that allows to assess EEM effect for different sets of pictures in terms of valence (low, medium, high). Further recruitment (focused on severe OSAS patients) is needed in order to increase statistical power of the study.

SELECTIVITY IN FEAR EXTINCTION LEARNING AND MEMORY

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Introduction: Rats acquire conditional fear via sequent tones (>3) pairing with electrical shocks. Applying sequent tones (conditioned stimulus, CS) alone extinguishes conditioned fear (extinction learning). Here we investigate whether rats prefer fear learning and memory on information of sequent tones to single tone, and whether the acquired memories affect new conditioned fear learning and new fear extinction learning and memory.
Materials and methods: We first did two sets of conditioning and extinction learning and memory with a month apart. Each set consists of 1 conditioning (day 1) and 2 extinction trials (day 2 and 3). In conditioning trials, rats received 3 auditory tone presentations, each concomitant with a foot-shock at the last 2s of the tone. In extinction trials, rats were exposed to 15 same tone presentations. In the third set 2 months later, we measured freezing time to 15 tones to evaluate the consolidation of extinction memory. To answer if extinction learning codes information of tones with environments, we exposed rats to 5 same tones in their home cages and measured freezing times to the tones.
Results: Our results showed that the rats particularly coded and memorized fear of sequent tones, and extinction learning and memory also favored sequent tones over the single tone. The prior extinction memories influenced new conditioning learning and memory as well as new extinction learning and memory of sequent tones. The consolidation of extinction memory test showed that freezing time to tone 1 remained high while freezing time to tone 2-15 remained low, compared to results of previous two months. Our final test on home cage freezing showed that both pre-tone and tone freezing time remained extremely low during the whole process of trials, indicating almost no fearing response.
Conclusions: Adult rats selectively code and memorize fear information with sequent tones. Extinction learning and memory also favor the sequent tones. Extinction memories on sequent tones are well preserved, while extinction memories spare freezing time to the first tone. Spatial memory in conditional environment is precondition for fear response and memories.

Board #143 : Poster session 1
THE EFFECT OF ZOLPIDEM ON MEMORY CONSOLIDATION AND SLEEP FEATURES OVER A NIGHT OF SLEEP

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Introduction: Neocortical slow oscillations (SO, 0.5-1Hz) and thalamo-cortical spindles (12-15Hz) have emerged as two prominent features of non-REM (NREM) sleep that are associated with hippocampus-dependent memory consolidation. More recent studies suggest the temporal coupling between SOs and spindles may also play a role. Interventional studies have suggested a causal relationship between increased SOs and improved performance in hippocampus-dependent memory recollection. However, interventional studies that directly increase spindles are scarce. We administered zolpidem, a GABA-A agonist that is known to boost spindles, over a night of sleep to investigate its effect on 1) spindles and spindle-SO coupling, and 2) memory consolidation.

Materials and methods: This study employed a double-blind, placebo-controlled, within-subject design, in which every subject (N=28) experienced both zolpidem and placebo. At each visit, participants were tested on a word paired-associates task before and after sleep, recorded with a 32-channel electroencephalogram (EEG) cap. Due to the short half-life of zolpidem (1.5-4.5hr), we divided the night of sleep into four quartiles. We measured power in sigma (11Hz-15Hz), theta (4-7Hz), delta (1-4Hz), slow oscillation (0-1Hz), and calculated spindle density and phase amplitude coupling between SO-spindles for Stage 2 and slow wave sleep separately. We performed paired t-tests comparing zolpidem to placebo for retrieval difference scores and sleep, and used Pearson's r to probe linear relations between changes in performance and power spectra at each electrode. Cluster-based permutation and the Benjamini-Hochberg procedure were used to control for multiple comparisons.

Results: Participants in zolpidem condition had better verbal memory retention for overnight retention (t(27)=2.78, p< 0.01) tests. Data showed an increase in sigma power in the zolpidem condition compared to placebo in Stage 2, and a decrease in theta and delta power in the zolpidem condition compared to placebo in Stage 2. Pearson's r suggests a positive relationship between theta power and memory performance, as well as spindle density and memory performance. Phase amplitude coupling was associated with overnight retention in zolpidem (r=0.48, p< 0.01) but not placebo (r=-0.13, p=0.50)

Conclusions: Consistent with one prior nap study, participants showed better memory performance with zolpidem overnight, compared to placebo. We found that theta power and spindle density positively contributed to better performance. Surprisingly, even though zolpidem leads to a decrease in theta power globally, participants who had the least reduction in theta tend to have a better memory performance. More research is needed to understand the role of theta in memory consolidation. In addition, memory improvement with zolpidem, but not placebo, was associated with increased occurrence of spindles during the SO Up state, suggesting that zolpidem improved cortical-hippocampal communication during NREM sleep.

RHYTHMIC MASTICATORY MUSCLE ACTIVITY (RMMA) INDEX <u>DOES NOT</u> DECREASE WITH AGE, CONVERSELY TO SELF REPORTS OF SLEEP BRUXISM: DATA FROM SLEEP LABORATORIES OF 3 CONTINENTS

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Introduction: Sleep bruxism (SB) prevalence is usually assess by self-reports of jaw clenching/tooth grinding awareness and by a biomarker, masseter or temporalis muscle activity, using polysomnography (PSG) expressed as rhythmic masticatory muscle activity index (RMMA)/hr. Prevalence of SB self-report decrease with age. We hypothesise the RMMA index will follow the same trajectory.

Materials and Methods: Retrospective analyses of PSG-RMMA sleep laboratory data were collected in 3 centers (Montreal, Canada; Osaka, Japan; Sao Paulo, Brazil). SB subjects (18-70 y.o.) were recruited: i) for experimental-physiological studies (Montreal and Osaka), ii) from a general representative population (Sao Paulo-EPISONO study). The n was 428 subjects: 100 SB and 125 control in Montreal, 32 SB and 44 controls in Osaka and 127 SB in Sao Paulo. PSG data from second night in Montreal and first night in Osaka and Sao Paulo were analyzed. Data were collected under medical supervision using standard methodology (Rompre et al, 2007; Maluly et al, 2013; Haraki et al 2019). The RMMA episodes were scored based on AASM 2007&2015 criteria. Distribution of RMMA/hour of sleep, over age and below/over 40 years old were analyzed with linear regression according to RMMA cut off index below and => 2/hr of sleep for control and SB subjects. Analyses were done i) with clinical diagnosis (+ tooth grinding history & PSG) and ii) only with PSG cut off RMMA index.

Results: Pooled clinical and PSG data from Montreal and Osaka revealed a marginal decrease in RMMA index prevailing in subjects below 40 years with the Pearson analysis for SB subjects (R^2=0.048, p=0.015; explaining 4.8% of variability) and with a decrease Spearman for both controls and SB subjects (Rho=-0.249, p=0.009 and Rho=-0.193, p=0.03; respectively)**.** The overall age analysis did not reveal any global decrease in RMMA index for either control and SB subjects with Pearson analysis although a significant but marginal decrease with Spearman for controls only (Rho=-0.287, p< 0.001).Taking in consideration the PSG RMMA index cut-off alone, < 2 or =>2:

1) In the experimental- physiological studies, a mild drop in number of RMMA episodes/hr for all ages for the < 2 group reached significant value (R^2=0.085, p< 0.001; Rho: -0.34, p< 0.001). This explain 8.5% of variability in RMMA index drop (0.8 to 0.3 RMMA/h from 20 to 60 years of age). This effect was again positioned in the group below 40 years (Rho=-0.264, p=0.01). With the RMMA/hr => 2, a nonsignificant rise (4.5 to 6.0 RMMA/h) was noted between 20 and 60 years without age effect.

2) In the Sao Paulo sample, the RMMA episodes/hr < 2 also did not reach significant value; with the RMMA episode/hr =>2, a nonsignificant 35% rise (+1.7 RMMA/h) between 20 and 70 years of age was noted.

Conclusions: Contrary to the decrease of SB self-reports with aging, the PSG-RMMA index remained relatively stable over ages. It remains to be investigated if presence of critical sleep conditions, e.g., insomnia and apnea, influence or bias how patient respond to SB self-report surveys.

Movement Disorders
Board #155 : Poster session 2
THE PREVALENCE OF RESTLESS SLEEP DISORDER IN A SINGLE SLEEP CENTER

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Introduction: Restless sleep disorder is a newly described sleep disorder in children characterized by large body movements and repositioning that lasts all night with at least 5 body movements per hour and a significant impact in daytime behaviors. The authors have previously identified and described the syndrome and compared the sleep parameters and sleep related movements to children with restless legs syndrome, normal controls and snorers.

Methods: Three-hundred consecutive patients were included in this retrospective study. All patients had been referred to the Sleep Disorders Center of the Seattle Children's Hospital, Seattle, WA during the period between April 2018 and March 2019, because of a suspected sleep problem. Video-polysomnography, was obtained in 252 out of the 300 patients, in the remaining 48 it was declined, not tolerated or not indicated, based on the individual clinical picture of the patients. For each patient, the following data were tabulated: age, sex, presence/absence of a series of hypnological condition: RSD, restless legs syndrome (RLS), periodic leg movements during sleep or periodic leg movement disorder (PLMS/PLMD), obstructive sleep apnea (OSA), habitual snoring, insomnia, parasomnia, excessive daytime sleepiness, narcolepsy, bruxism, and other sleep disorder). Also the presence/absence of epilepsy or a different neurologic, psychiatric (anxiety, depression, post-traumatic stress disorder or PTSD), neurodevelopmental (autism/attention-deficit hyperactivity disorder or ADHD), or syndromic (Down syndrome and other malformative and/or genetic conditions) comorbidity was assessed.

Results: In total 175 boys and 125 girls (mean age 7.9 years, range 0.33-19 years) were enrolled into the analysis. A syndromic condition was present in 46 (15.3%) patients, ADHD/autism in 30 (10.0%), a neurological disorder in 24 (8%), a psychiatric disorder in 25 (8.3%), and epilepsy in 5 (1.7%). RSD was found to affect 7.7% of participants. As expected, the most prevalent diagnosis was OSA (44%), followed by habitual snoring (25%), parasomnia (13.3%), RLS (10.7%), and PLMS/PLMD (9.3%). Other sleep disorders were found in 10% of the patients enrolled

Conclusions: The current study has identified the prevalence of RSD to be 7.7% in children referred to a sleep disorders center for evaluation of sleep concerns. Our study also demonstrates the possibility of co-existence of RSD with other sleep related complaints; in particular snoring and parasomnia.

Movement Disorders
Board #144 : Poster session 1

SLEEP DISORDERS IN PEOPLE SUFFERING FROM PARKINSON'S DISEASE

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Aim: To assess the frequency and nature of sleep disturbances in persons with Parkinson disease(PD).

Methodology: The sample selected was made up of 153 patients hospitalized with PD in Neurology Department at "Mother Teresa" University Center, in Tirana, Albania. Besides their clinical evaluation, a questionnaire made up of 23- question was used to assess sleep patterns.

Results: Average age of PD participants was 58,37 years(SD 10,45) and with the average 5,7 years has passed since the initial diagnoses (SD 3,85).

The mean age of control group was 56,50 years(SD 11,45); $(p>0,05)$.

Sleep problems were seen in 66(42%) PD patients as compared to 12% of control group.

According to the data gathered: - Insomnia is present in 32% of PD patients as compared to 5% of control group.

- Nightmares was referred from 32% of PD patient compared with 5% of control group.

- Excessive day time sleepiness was seen in 15% of PD patients as compared with 6% of control group $(p< 0,025)$.

Presence of nightmares was significantly associated with higher Hoehn and Yahr score$(p< 0,002)$, high UPDRS score$(p< 0,000)$ and Levodopa dose$(p< 0,0025)$.

Excessive daytime sleepiness correlated with higher hoehn and Yahr stage $(p< 0,004)$, and Levodopa dose$(p< 0,04)$.

the state of excessive sleep during the day was longer in PD patients as compared to control group $(p< 0,000)$.

Conclusion: Multiple logistic regression analysis showed association of sleep disturbances with UPDRS Part III, Levodopa dose, Hoehn and Yahr Score.

Sleep problems are much more common in PD patients compared to control group $(P< 0,001)$, and correlate with increased severity of disease.

Improvement of sleep quality has been reported in patients with PD who were undergoing specific nursing interventions.

DECREASED THALAMO-CORTICAL ACTIVATION DURING SLEEP IN PATIENTS WITH PARKINSONISM

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Introduction: Sleep spindles are presumed to be generated through thalamo-cortical neuronal network activity, and may be considered to represent a marker of the functional integrity of diencephalic and cortical structures. Sleep spindle density may provide insight on the pathophysiology and cerebral structures impacted by progressive neurodegenerative disorders. Relatively few studies have analyzed sleep spindle density in different synucleinopathy phenotypes.

Materials and methods: A total of 98 polysomnograms were retrospectively selected (26 = idiopathic rapid eye movement sleep behavior disorder (iRBD), 15 = Parkinson disease with rapid eye movement sleep behavior disorder (PD+RBD), 23 = Multiple system atrophy with rapid eye movement sleep behavior disorder (MSA+RBD), 11 = Multiple system atrophy without rapid eye movement sleep behavior disorder (MSA-RBD), 23 = obstructive sleep apnea controls) from the Mayo Clinic clinical polysomnography registry. Within the MSA cohort, 21 were diagnosed with a predominant cerebellar subtype (MSA-C) and 13 with a parkinsonian subtype (MSA-P). Automatically detected overall and stage-specific sleep spindle density (spindles per hour) were compared across these groups with appropriate non-parametric statistical tests.

Results: The PD+RBD group had a significantly lower spindle density than all other cohorts during overall NREM sleep and specifically during N2 and N3 (all $p < 0.05$). MSA-P also had a significantly lower spindle density than MSA-C during NREM and specifically during N2 sleep ($p < 0.05$).

Conclusions: Patients with parkinsonism had significantly lower spindle densities than those without parkinsonism, suggesting a greater burden of neurodegenerative disease involving thalamo-cortical structures for those with parkinsonism. Additionally, sleep spindle density was lower in MSA-P vs. MSA-C, implying that involvement of thalamo-cortical structures may be a differentiating marker for these often overlapping MSA subtypes. Future research will be necessary to determine whether sleep state markers can accurately differentiate specific synucleinopathy phenotypes.

ANALYSIS OF SLEEP-RELATED RHYTHMIC MOVEMENT DISORDER IN CHILDREN USING AUTOMATIC 3D DETECTIONS

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Introduction: Sleep-related rhythmic movement disorder (RMD) is a poorly understood disorder characterized by episodes of whole-body rhythmic movements occurring during sleep onset and sleep. RMD can cause injury, impaired sleep quality and daytime adverse effects. Diagnosis of rhythmic movements during sleep is currently based on visual inspection of 2D video data. We used contactless and automatic 3D video to analyze rhythmic movements and compared it to conventional 2D video expert scoring. We further developed novel indices to quantify RMD severity with the goal to set out the basis for future international standards of assessment.

Materials and methods: One ceiling-mounted camera captured 3D depth images using the time-of-flight of the light while another camera recorded 2D infrared video. Movements of the participant lying in bed cause changes in the 3D depth image allowing for the detection of rhythmic movement episodes using our algorithms. We applied cross-validation and random forest classification to separate general movements from rhythmic ones. According features were obtained from frequency analysis using the short-time Fourier transform (STFT) with non-overlapping windows of three seconds size. 2D videos were annotated manually by two human scorers to obtain the ground truth. Movement episodes were defined as rhythmic when they contained 3 or more movements performed with a frequency of 0.5 to 2.0 Hz.

We recruited 6 children (2 female) with expert somnologist confirmed rhythmic movement disorder between age 5 and 14 y (M: 9.0 y, SD: 4.2 y). Data of two nights in a sleep laboratory was analyzed. We developed new indices to provide a standardized way of extracting additional information of rhythmic movements: The rhythmic movement index (RMI) represents the number of episodes per hour and is based on indices used to characterize other sleep disorders like the periodic limb movement index or apnea/hypopnea index, the duration index (DI) indicating the percentage of time spent in rhythmic movements and the frequency index providing details on how fast rhythmic movements were executed.

Results: Automatic 3D video analysis and manual 2D annotations demonstrated high levels of agreement, as indicated by a F1-score > 0.9 and a Cohen's Kappa > 0.9. Automatic 3D tended to discriminate rhythmic episodes more sensitive as represented in a higher rhythmic movement index (RMI-3D: 2.6 episodes/hour, RMI-2D: 0.77 episodes/hour) showing that 3D detects more episodes, while simultaneously a similar duration index (DI-3D: 6.04 %, DI-2D: 5.93 %) displays that total episode duration is just slightly different. Newly introduced severity indices demonstrated how rhythmic movement assessment can be improved.

Conclusions: We introduced automatic detection of rhythmic movements during sleep using a contactless 3D sensor. Body sizes and movement semiologies were diverse, regardless of this, the agreement of expert annotated 2D and automated 3D videos was high. Automatic 3D analysis provided reliable quantitative information about rhythmic movements, reducing the burden of time expensive manual scoring. Furthermore, the proposed novel indices offer

a means to standardize measurement of rhythmic movement disorders in both clinical and research practice, which allows us to better compare literature on this topic in the future.

REM SLEEP WITHOUT ATONIA DISTINGUISHES PARKINSON'S DISEASE FROM ESSENTIAL TREMOR

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Introduction: Essential tremor (ET) and tremor associated with Parkinson's disease (PD) can be difficult to distinguish in some cases when other parkinsonian features are absent. Objective diagnostic tools differentiating tremor types are limited, and despite FDA approval, dopamine transporter uptake SPECT scans have several limitations, including need for expert interpretation and the risk of radioisotope exposure. A previous study has suggested that the presence of concurrent symptoms of REM sleep behavior disorder may distinguish PD from ET; and polysomnographic REM sleep without atonia (RSWA) differentiates alpha-synucleinopathies from other neurodegenerative disease types. We aimed to determine whether quantitative RSWA analysis could also aid distinction of PD from ET.

Materials and methods: We analyzed quantitative RSWA in 73 patients: 23 with PD, 23 with ET, and 27 age-sex matched controls. No patients had a history of dream enactment behaviors and none were taking medications known to cause RSWA (i.e. antidepressants). Phasic, tonic, and 'any' muscle activity percentages and phasic burst durations were calculated in the submentalis (SM) and anterior tibialis (AT) muscles. The automated REM atonia index (RAI) was also determined in SM. Statistical analysis was performed using ANOVA to compare continuous variables. Receiver operator characteristic curves were developed to determine optimal cutoffs distinguishing PD from non-PD patients.

Results: SM phasic RSWA was significantly greater for PD than ET patients and controls (all $p < 0.05$; 12.5 ± 12.8% vs. 4.9 ± 6.7%, 3.9 ± 2.6%), as was SM 'any' (13.54 ± 14.30% vs. 5.2 ± 7.6%, 4.2 ± 2.6%). AT phasic and 'any' muscle activity were similar between the three groups. RSWA was similar between ET and control patients in all measures, except for AT duration. Optimal RSWA diagnostic cutoffs distinguishing PD from ET were an SM phasic cutoff of 5.9%, an SM 'any' cutoff of 8.8%, and an SM tonic cutoff of 0.05%.

Conclusions: Elevated submentalis RSWA distinguished PD from ET in patients without clinical dream enactment symptoms. Quantitative RSWA may be an additional useful objective diagnostic test for differentiating patients with tremor. Prospective studies evaluating the presence of RSWA in PD and ET patients are necessary to further validate these findings.

PERIODIC LIMB MOVEMENT DURING SLEEP AND THE INCIDENCE OF CARDIOMETABOLIC OUTCOMES: THE HYPNOLAUS STUDY

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Introduction: Periodic limb movements during sleep (PLMS) are prevalent in the general population, but their association with cardiometabolic disorders are still controversial. This study aimed to evaluate whether PLMS is a risk factor for the incidence of hypertension, diabetes, metabolic syndrome and cardiovascular (CV) events in a middle to older aged general population.

Materials and methods: 2,162 subjects (51.2% women, mean age: 58.8±11.1 years-old) of the population-based HypnoLaus study (Lausanne, Switzerland) underwent a full polysomnography at home and were followed up over 4.1±1.0 years. PLMS index (PLMSI) and mean duration were determined at baseline according to 2016 WASM standards. PLMSI≥15/h was considered as significant. Evaluations at both baseline and follow-up comprised sociodemographic data, laboratory tests, and clinical assessment. Cardiometabolic outcomes included the incidence of hypertension, diabetes, metabolic syndrome and adjudicated CV events (acute coronary syndrome, myocardial infarction and stroke).

Results: At baseline, participants with PLMSI≥15/h (n=620) presented higher rates of men, elderly, obesity, diabetes, hypertension, metabolic syndrome and history of previous CV events. After excluding participants having each respective cardiometabolic outcome at baseline, PLMSI≥15/h group, when compared to PLMSI< 15/h group, presented similar incidence rates of hypertension (20.1% vs 16.0%, p=0.121), diabetes (3.7% vs 2.6%, p=0.189), metabolic syndrome (8.1% vs 7.7%, p=0.793) and CV events (4.6% vs 3.5%, p=0.282), respectively. Multivariate analysis adjusting for confounding factors confirmed the lack of association between PLMSI≥15/h and the incidence of hypertension (OR=1.058 [0.695-1.609]), diabetes (OR=0.876 [0.443-1.732]), metabolic syndrome (OR=0.807 [0.491-1.327]), and CV events (HR=0.797 [0.472-1.344]). However, PLMS mean duration was significantly associated with increased risk of developing diabetes (OR for 1s increase=1.413 [1.109-1.802]) and CV events (HR for 1s increase=1.304 [1.064-1.597]).

Conclusions: In our large middle-age population-based sample, PLMSI≥15/h was not found to represent a risk factor for the development of cardiometabolic outcomes over 4 years of follow-up. Nevertheless, longer PLM mean duration was independently associated with increased risk of diabetes and CV events, regardless of PLMS severity.

A RANDOMIZED CONTROLLED TRIAL OF BOTULINUM TOXIN FOR TREATING SLEEP BRUXISM: A POLYSOMNOGRAPHIC EVALUATION

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Study Objectives: To investigate the effects of botulinum toxin type A (BoNT-A) injection on sleep bruxism(SB) episodes during sleep in SB patients who did not respond to oral appliance treatment.
Methods: Twenty three subjects with a clinical diagnosis of SB completed this study. Thirteen subjects received bilateral BoNT-A injections (25 U per each) into the masseter muscles (experimental group), and the other 10 received bilateral saline injections into the masseter muscles (control group). Video-polysomnographic (vPSG) recordings were made before, at 4 weeks and at 12 weeks after injection. SB episodes and Rhythmic masticatory muscle activity (RMMA) were scored and analyzed for several parameters (e.g., frequency of episodes, bursts per episode, episode duration). The peak amplitude of electromyographic (EMG) activity in the two muscles was also measured.
Results: BoNT injection did not reduce the frequency, duration for SB episodes. In BoNT group, the injection reduced the bursts per hour, peak amplitude of EMG burst of the masseter during maximal voluntary clenching tasks and during sleep bruxism. It differed significantly before and 4, 12 weeks after the injection.($p < 0.001$, repeated measure ANOVA). At 4 weeks after injection, the greatest changes occurred. However there was no significant differences between before and at any time period in saline injection group.
Conclusions: The injections of BoNT on masseter failed to the prevent the genesis of bruxism episodes. But, BoNT-A injection is an effective strategy for reducing the intensity of muscle contractions during SB for at 4 weeks and at 12 weeks after injection. Future investigations on the efficacy in larger samples over a longer follow-up period are needed.
Keywords: Sleep bruxism(SB), botulinum toxin(BoNT), polysomnography(PSG), rhythmic masticatory muscle activity(RMMA)

SEASONAL VARIATIONS OF NON-MOTOR SYMPTOMS ON PARKINSON'S DISEASE PATIENTS IN SOUTHEASTERN CHINA

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Introduction: Previous studies have described seasonal variations in PD motor symptoms, but few studies focused on seasonal changes in non-motor symptoms, and the results remained to be confirmed.

Materials and methods: A cross-sectional retrospective study on 210 PD patients recruited at The 2nd affiliated Hospital of Soochow university between November 2016 and December 2018.Patients were divided into different groups based on date of assessment, which was then grouped by monthly mean sunshine-hours and temperature according to meteorological datas from National Meteorological information center website (1981 - 2010). Sunshine-hours groups: group I : 80-120 h/ mon (Nov to Feb) (n = 79); group II : 120-160 h/ mon (Mar to Jun) (n = 6); group III:160-200 h/ mon (Jul to Oct) (n=62); Temperature groups: groupA: below 10 ℃ (Dec to Mar) (n = 80);groupB: 10 to 20 ℃ (Apr/May/Oct/Nov) (n = 73); groupC: above 20 ℃ (Jun to Sep) (n = 57).Non-motor symptom scales and PSG study have been assessed.

Results: All groups were identical concerning onset age, disease duration, gender, H-Y stage, and Levodopa equivalent dose.Divided by mean sunshine-hours, there were seasonal differences in NMSQ total scores (p = 0.020) and domain4 (perceptual problems) (p = 0.018), with the highest total scores of (9.20 ± 5.728) in group III. A trend was observed in domain2 (sleep/fatigue) (p = 0.056). FSS was more severe (27.27±15.068) in group III (p = 0.001).Thirty-seven patients finished PDSS evaluation, with the highest scores of (113.53±29.809) in group II (p =0.045).Twenty patients completed PSG study, with the longest sleep latency of [28.00(3.375-56.25)] in group II (p = 0.047).Divided by temperature**,** seasonal variations of NMSS total scores (p = 0.012) and SCOPA-AUT total scores (p = 0.045) were highest of (9.52±5.679) and (15.33±13.513) respectively in groupC. NMSQ domain4 (perceptual problems) (p = 0.013),domain5 (attention/memory)(p = 0.037) and domain2 (sleep/fatigue) (p = 0.024) showed the same pattern. FSS was the most severe of (29.44±14.54) in groupC (p < 0.001).As to sleep, seasonal tendency was observed in PSQI domain3 (sleep time)(p = 0.053), with the highest scores of (1.35±1.148) in groupB. Sleep latency (p=0.040) became longer [23.50(4.50-32.50)] in groupB and Respiratory Related Arousal Index (p = 0.007)was higher [0.700(0.400-1.600)] in groupC by PSG study. RBD-HK results were worse with (18.35±5.921) in dreaming part in group A(p=0.037)

Conclusions: NMS in PD fluctuated throughout the year. Symptoms of autonomic function and fatigue became worse with abundant sunlight and hot weather. Sleep problems were most severe in medium sunshine-hour / temperature months. RBD symptoms aggravated in cold season. These findings suggested seasonality in body rhythm response to sunlight and temperature. Such variations must be accommodated with in daily care.

Movement Disorders
Board #146 : Poster session 1

DO WOMEN COMPLAIN MORE ? ONLY PERIODIC LIMB MOVEMENTS APPEAR TO HAVE SIMILAR IMPACT ON REST PROPENSITY IN BOTH GENDERS

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Introduction: Recent research suggested that perception of sleep impairments and associated daytime complaints may present with gender related effects. In comparison to men, women appeared to be more prone to report fatigue rather than sleepiness. The latter has especially been evidenced in sleep related breathing disorders. On the other hand, it has been suggested that sleep related movement disorders may also be associated to fatigue rather than to sleepiness. Whether gender-related differences would be similar irrespective of diagnosis remains unclear. Difficulties of previous studies are mainly given by the absence of fatigue measurement instruments that share a comparable approach with respect to clinical dimensions than the common assessment tools for sleepiness and sleep propensity.
Methods: During a one-year period, systematic clinical evaluation by means of structured symptom scales, was performed for a cohort of 921 consecutive patients attending an academic sleep center for polysomnography. A newly developed instrument, the Brugmann Fatigue Scale (BFS), designed for the assessment of rest propensity was used among other scales (Epworth Sleepiness (ESS) and Hospital Anxiety and Depression scales; Pittsburgh Sleep Quality Index). The BFS shares a similar structure than the ESS and investigates a fatigue-related equivalent concept to sleepiness/sleep propensity, namely fatigue and its behavioural impact in terms of rest propensity. According to inclusion and exclusion criteria, 420 men and 376 women, were finally included in the study and retained for data analysis.
Results: While men and women presented with similar age, BMI, total sleep time and sleep efficiency ratios, men presented with higher levels of respiratory events and more periodic limb movements. Nonetheless, irrespective of diagnosis, women presented with statistically significantly higher levels of sleep associated complaints on all symptom scales. Comparative stratifications of daytime symptoms per diagnostic groups of Sleep Related Breathing (SRBD), Movement (SRMD) or Insomnia (ID) Disorders, revealed significant main effects for diagnosis alongside with main effects of gender. Associations between common markers of disease severity for SRBD and SRMD respectively and sleep or rest propensity only showed significant correlation between Periodic Limb Movements and rest propensity. The strength of association was similarly significant for both sexes.
Conclusion: While men displayed more objective impairment on PSG and complained less, women presented higher levels of daytime complaints and lower severity of disease. Solely the statistically significant association, between SRMD severity (PLMSI) and physical fatigue, also appeared to present similar association strengths for both men and women. Whether female patients over-report sleep related complaints or male patients under-report them, remains of course to be determined in the light of diagnosis-defining PSG parameters being above thresholds in both genders.

ARE THE THERAPEUTIC EFFECTS OF DENTAL APPLIANCES IN SLEEP RELATED BRUXISM GOING WAY BEYOND PHYSICAL TEETH-PROTECTION?

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Introduction: We have previously shown that (the total duration of) sleep related bruxism (SB) may have an otherwise independent impact on (perceived) sleep quality. Whether a physical dental treatment alone (with a dental guard) positively affects sleep quality or sleep-wake patterns on a day-to-day basis is largely unknown. The objective of the present study was to compare sleep-wake patterns, sleep durations and sleep efficiency along with associated daytime symptoms between treated and untreated SB patients.
Materials and methods: 20 patients with SB, were selected during a cross-sectional study after an ambulatory full dental (exo- and endo-oral) examination. 2 groups of similar age, with corroborating medical history and anamnesis (10 untreated SB and 10 treated SB patients) were assigned to ambulatory sleep-wake behavior recordings and further comparison. The dental guards in the treated SB subgroup, were custom-made dental appliances for all subjects. All patients were monitored for at least 5 consecutive nights by means of a wearable and connected activity tracker device with a built-in validated sleep estimation algorithm. All patients also underwent structured assessments of sleep quality, insomnia and fatigue and sleepiness symptoms.
Results: Both groups showed similar total sleep time and similar (estimated) REM and NREM proportions. Daytime sleepiness and affective symptoms did also not show significant differences between both groups. Untreated SB patients did however not only display significantly greater sleep quality impairment (p=0.03) along with significantly higher levels of physical fatigue (p=0.02), but also significantly higher percentages of wake-time-after-sleep-onset (p= 0.039) and significantly longer time-in-bed durations (p= 0.02).
Conclusions: These preliminary cross-sectional results in real-life dental patients, confirm previously suggested sleep quality alteration and associated daytime fatigue untreated SB patients. Actigraphic measurements suggest here, that the non-pharmacological treatment of SB patients with a dental guard, may not only have a physically protective value but that the latter may also improve sleep efficiency, perceived quality and consecutively daytime fatigue

THE COGNITIVE DYSFUNCTION IN EARLY PARKINSON'S DISEASE WITH OBSTRUCTIVE SLEEP APNEA HYPOPNEA SYNDROME

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Objective: This study aimed to investigate the cognitive function in early Parkinson's disease (PD) with Obstructive sleep apnea hypopnea syndrome (OSAHS) and determine the relationship between cognitive function and sleep apnea.
Methods: We recruited 152 early PD patients, 44 age- and sex-matched OSAHS patients and 17 controls. All participants underwent clinical investigation, Mini-mental state examination (MMSE), Montreal cognitive assessment Beijing version (MoCA) and polysomnography (PSG). All PD patients were assessed motor and non-motor symptoms by unified Parkinson's disease rating (UPDRS), Hoehn and Yahr Stage (H-Y), Hamilton rating scale for depression (HRSD), Hamilton rating scale for anxiety (HAMA), Epworth sleepiness scale (ESS), 39-items Parkinson's Disease Questionnaire (PDQ-39). Then, we investigated the clinical characteristics especially the cognitive function and determine the relationship between cognitive function and sleep apnea in early PD patients with OSAHS.
Results: The incidence of OSAHS in early PD was 34.9% (53/152). The percentage of mild OSAHS was 54.7% (29/53) and the percentage of moderate and severe OSAHS was 45.3% (24/53). The body mass index (BMI) of PD patients with OSAHS was higher than PD patients without OSAHS. The MMSE score and MoCA score were both lower in PD with ((25.72 ± 2.13) and (23.02 ± 2.38)) and without OSAHS patients ((26.43 ± 2.26) and (23.43 ± 2.72)). The MMSE score of PD patients with OSAHS was significant lower than PD patients without OSAHS. There was a lower trend of the scores of visuospatial/executive, attention, and delayed recall domains in PD patients with OSAHS compared to PD patients without OSAHS. The MMSE score and MoCA score of PD patients with mild OSAHS ((24.63 ± 2.08) and (22.21 ± 2.55)) were significant lower than PD patients with moderate and severe OSAHS ((26.62 ± 1.74) and (23.69 ± 2.04)) ($p=0.001$ and $p=0.039$). Decreased MoCA scores in early PD patients with OSAHS were significantly associated with higher apnea and hypopnea index (AHI) and oxygen desaturation index (ODI) ($p=0.002$ and $p< 0.001$). There were no significant differences on total sleep time (TST)、sleep efficiency (SE)、sleep latency (SL)、awakenings、percentage of time spent in NREM and REM sleep, the index of periodic limb movements, the tonic chin electromyography activity density and the phasic chin electromyography between PD patients with and without OSAHS.
Conclusion: The incidence of OSAHS in early PD was high. The severity of OSAHS in early PD patients was mild dominated. Compared to PD patients without OSAHS, the PD patients with OSAHS had lower MMSE scores and a trend of decline on the scores of visuospatial/executive, attention, and delayed recall domains. Decreased MoCA scores were significantly associated with higher AHI and ODI in early PD patients with OSAHS. OSAHS played an important role in cognitive dysfunction by chronic intermittent hypoxia in early PD patients.

SLEEP STRUCTURE IN ADULT SLEEP BRUXERS - A POLYSOMNOGRAPHIC STUDY

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Introduction: Effects of sleep bruxism (SB) on sleep structure were described before, though the trials were often underpowered and resulted in inconsistent conclusions. Observations of possible increase of REM sleep were published as well. The aim of our study was to explore and describe sleep architecture in SB subjects.

Materials and methods: Adult participants with SB suspected and no other important medical conditions underwent sleep evaluation including full overnight video-polysomnography (video-PSG). Sleep stages and events were scored using American Academy of Sleep Medicine (AASM) criteria. As changes in sleep architecture have been previously described in cases of severe obstructive sleep apnea syndrome (OSAS), participants with moderate and severe OSAS were excluded from the study.

Results: Total number of 140 participants (n=37 male, n=103 female) were enrolled (mean age=34.5 ± 10.4 years). They have been divided into 3 subgroups based on Bruxism Episode Index (BEI) value: severe SB (BEI ≥ 4, n=56), moderate SB (2 ≤ BEI < 4, n=43) and controls without SB (BEI < 2, n=41). There were no significant differences between subgroups in terms of age and Apnea-Hypopnea Index (AHI). Total n=24 participants met criteria for mild OSAS (AHI ≥ 5, n=4 controls, n=7 in moderate SB subgroup, n=13 in severe SB subgroup). ANOVA showed significant differences between the subgroups in REM percentage of total sleep time (TST) (p=0.012). Post-hoc analysis showed significant difference between moderate and severe SB subgroups (Tukey's HSD test for unequal groups, p=0.027) and when comparing severe SB subgroups to controls (Dunnet's test, p=0.039). No significant difference was found between controls and moderate SB subgroups. No differences in terms of NREM1, NREM2 and NREM3 percentage of TST was found between the subgroups. In Spearman's rank correlation, significant correlation of BEI and NREM1 percentage was found (r=0.19, p=0.024) as well as BEI and REM percentage (r=0.21, p=0.012). These correlations persisted when participants with mild OSAS were excluded (r=0.24, p=0.011 and r=0.21, p=0.026, respectively). No significant correlations were found in mild OSAS participants. Arousal Index (AI) in Spearman's rank correlation in severe SB subgroup correlated positively with NREM1(r=0.6, p=0.000001) and NREM2 (r=0.29, p=0.032) and negatively with NREM 3 (r=-0.46, p=0.00037) and REM percentage (r=-0.27, p=0.042). Significant correlations of AI in with moderate SB and control subgroups were found only with NREM1 percentage (r=0.54, p=0.00016 and r=0.6, p=0.00004, respectively). All described significant correlations of AI with sleep stage percentages persisted with similar coefficients when participants with mild OSAS were excluded from analysis.

Conclusions: Presented results suggest that SB may contribute to significant changes of sleep architecture, especially to elongation of REM sleep. This effect seems to be present in cases of severe SB, while moderate SB does not affect sleep architecture. Also, comorbidity of mild OSAS might negate the effect of SB on sleep architecture, though this study might be underpowered to prove it due to limited number of participants with comorbid mild OSAS. Further studies are needed to determine neuropshysiological aspects of these findings as well as the role of comorbid OSAS.

SLEEP AND OTHER NON MOTOR ABNORMALITIES IN INDIAN PATIENTS WITH CERVICAL DYSTONIA

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Introduction: Cervical dystonia have been shown to be associated with many non-motor symptoms such as depression, poor quality of life and impaired sleep. The objective of the study was to study the sleep disturbances in Indian patients with idiopathic cervical dystonia.

Materials and methods: The study was conducted at the department of Neurology, National Institute of Mental Health and Neurosciences (NIMHANS) hospital, Bangalore, India, as a cross sectional study. Patients with cervical dystonia (CD) were assessed by a questionnaire to evaluate severity, depression, restless leg syndrome, sleep quality, self-esteem and daytime sleepiness. Overnight polysomnography was carried out in 22 patients and 15 age matched controls.

Results: Sixty patients of CD were recruited of which 37(61.7%) were males and 23 (38.3%) females. Age of presentation was 43.1 ± 11.4 years and duration of symptoms was 2.5 ± 3.2 years. The sleep disturbances were seen in 30%. Poor sleep quality correlated with depression as well as with severity of cervical dystonia, particularly with disability and pain. Excessive daytime sleepiness was found in 18.3% of the patients with cervical dystonia. Depression was reported in 61%, and anxiety was observed in 26% of the patients. Restless leg syndrome in 6.6% (4) and REM behaviour disorder in 10% (6). Polysomnography was available for analysis in 13 patients and 13 controls after the quality checks. Significant technical challenges were noted during polysomnography. REM sleep duration was significantly reduced compared to that of the controls. Patients with cervical dystonia had decreased propensity for spindle generation and maintenance. Depression also correlated with sleep impairment ($r=0.59$, $p< 0.05$) self-esteem ($r=0.58$, $p< 0.05$), number of unhealthy days ($r=0.48$, $p< 0.05$), correlated with excessive daytime sleepiness ($r= 0.25$, $p=0.05$).

Conclusions: This study describes the high prevalence of sleep abnormalities in Indian patients with cervical dystonia which have important implications in the management. These patients have poor quality of life, with premature termination of their career and also have difficulty in carrying out their activities of daily living.The non-motor symptoms may contribute towards the disturbance in sleep and severity of cervical dystonia.

SODIUM OXYBATE TREATMENT REGIMEN AND DOSING PERSONALIZATION AMONG PATIENTS WITH NARCOLEPSY IN A REAL-WORLD SETTING

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Introduction: A prior cross-sectional study presented real-world evidence on usual dosing practices and perceptions about dosing adjustment among adult patients with narcolepsy taking sodium oxybate (SXB) (Bae, 2019). Recommended dosing of SXB is twice nightly, equally divided. This prospective, longitudinal real-world study examined patients' usual SXB dosing regimens, captured real-world SXB dosing practices among patients, evaluated patient perceptions regarding the importance of adjustments to SXB dose and/or regimen, and assessed the impact of dosing on treatment outcomes and goal attainment.

Materials and methods: This IRB-approved, prospective study enrolled adult patients diagnosed with narcolepsy taking SXB for ≥12 months. Participants were recruited through online patient communities, social media and patient panels. Participants were asked about their usual SXB dosing regimens, real-world reasons and methods for dosing adjustments, impact of adjustments on goal attainment and also about the impact of narcolepsy in their daily lives. Participants also provided voice responses regarding the potential impact on their lives if they were unable to adjust their SXB dosing regimen. Upon enrollment, participants downloaded a smartphone application to provide informed consent and questionnaire responses. At study initiation, participants were provided an ActiGraph watch to wear throughout the 31-day study to capture sleep and activity metrics. On Day 1, participants completed a baseline survey. On Days 2-31, participants completed morning and evening questionnaires including SXB dosing, sleep quality, ratings of cataplexy, and daytime sleepiness. On Day 31, participants completed a follow-up questionnaire via the app and automated voice response. This abstract presents baseline survey findings. Descriptive statistics summarize responses.

Results: The cohort (n=102) was 88% female with a mean (±SD) age of 36.8 (±9.9) years. Participants reported multiple limitations due to narcolepsy, including socializing (73%), performing at work/school (69%), and sleeping through the night (63%). On average, participants reported taking SXB for 4.2 (±3.2) years. Most (87%) patients reported a twice-nightly usual dosing regimen; 4% once-nightly, and 9% thrice-nightly. Of those with twice- or thrice-nightly usual dosing regimens, 89% reported taking equally divided doses, and 11% unequally divided doses. Similarly, 38% reported taking the second dose 2.5-4 hours after the first dose, while 16% reported taking their second dose < 2.5 hours, and 46% reported taking the second dose >4 hours after the first dose. Most participants (85%) reported adjusting their SXB dose and/or regimen in the past 6 months. The majority of participants (70%) reported satisfaction with the ability to adjust SXB dosing, and 69% rated the ability to adjust SXB dosing as important or very important. Half of the participants (50%) reported having initiated a SXB dosing discussion with their doctor, and 28% reported their doctor initiated a SXB dosing discussion with them.

Conclusions: Most participants reported twice nightly usual SXB dosing regimens, while others reported once nightly or thrice nightly usual SXB dosing. Some patients reported taking unequally divided usual doses. Most patients reported their ability to adjust as important. Analyses of prospective data from this study will examine associations between SXB dosing, treatment outcomes, and goal attainment.

Acknowledgements: Jazz Pharmaceuticals

CSF AND SERUM FERRITIN LEVELS IN NARCOLEPSY TYPE 1 COMORBID WITH RESTLESS LEGS SYNDROME

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Introduction: To investigate whether cerebrospinal fluid (CSF) and serum ferritin levels differ between patients with narcolepsy type 1 (NT1) comorbid with restless legs syndrome (RLS) or periodic leg movements during sleep (PLMS), and patients with NT1 or controls without comorbid RLS or PLMS.

Materials and methods: Sixty-six drug-free patients with NT1 (44 males, age 38.5 years[14-81], BMI=26[19-37]) were enrolled, including 20 with RLS diagnosed on the 5 international criteria, 18 with PLMS index ≥15/hour (six with both RLS and PLMS). Thirty-eight drug-free patients (12 males, age 22.5 years[12-61]) without central hypersomnia, RLS, PLMS were included as controls. Clinical, electrophysiological and biological (CSF and blood samples) data were collected for all participants. CSF ferritin, serum ferritin and CSF orexin levels were determined.

Results: NT1 patients with and without RLS did not differ for age, gender and BMI. No between-group differences were found for CSF ferritin (5.82 vs 6.82 ng/mL), orexin (6 vs 10.5 pg/mL), and serum ferritin levels (95 vs 102 ng/mL). No CSF ferritin, orexin, and serum ferritin level differences were found between NT1 patients with and without PLMS, or with RLS or PLMS versus not. CSF-ferritin levels were not different between NT1 and controls in adjusted analyses. CSF ferritin levels in the whole population correlated positively with age (r=0.59,p=0.0001), serum ferritin levels (r=0.38, p=0.0002), BMI (r=0.3, p=0.002), and negatively with orexin levels (r=-0.26, p=0.007), but not with PLMS index. In NT1, CSF-ferritin levels correlated with age and serum-ferritin but not with PLMS.

Conclusions: The absence of CSF ferritin deficiency in NT1 with comorbid RLS or PLMS indicates normal brain iron levels in that condition. This result suggests that the frequent association between RLS, PLMS and NT1 is not based on alterations in brain iron metabolism, a pathophysiological mechanism involved in primary RLS.

THE SAFETY AND TOLERABILITY OF PITOLISANT IN THE TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS AND CATAPLEXY IN ADULT PATIENTS WITH NARCOLEPSY: AN OPEN-LABEL, EXPANDED ACCESS PROGRAM IN THE UNITED STATES

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Introduction: Pitolisant Expanded Access Clinical Evaluation (PEACE) provides adult patients with narcolepsy access to treatment with pitolisant (an investigational medication in the United States).

Materials and methods: Enrolled patients are titrated to pitolisant 35.6 mg/day (or the highest tolerable dose) over a 3-week period. Dose adjustments are permitted at the discretion of the treating physician based on patient response with regard to efficacy and/or tolerability. Treating physicians follow their standard-of-care and are required to report adverse events (AEs) and the use of concomitant narcolepsy medications. Results from an interim data collection are presented here (presentation will include updated data, if available).

Results: As of February 12, 2019, 366 patients were enrolled with >1200 patient-months of exposure to pitolisant (>105 patient-years of exposure). Patients were 65.3% female, 85.5% white, mean age of 40.5 years, and 53.8% with narcolepsy type 1. Nearly all patients (98.6%) had been previously treated with other narcolepsy medications (89.1% with ≥2 narcolepsy medications) prior to starting pitolisant. To date, 309 patients have completed the titration period, 201 have completed ≥3 months, and 86 have completed ≥6 months of treatment. During the program, most patients (68.0%) are on treatment with ≥1 concomitant narcolepsy medication, including traditional stimulants (48.4%), sodium oxybate (29.5%), modafinil (14.5%), armodafinil (13.1%), and antidepressants (4.4%). Overall, 17.5% of patients have discontinued from the program; 10.1% due to an AE and 2.5% for lack of effect. A total of 222 AEs were reported among the 366 patients; the most commonly reported AEs were headache (7.7% of patients), insomnia (4.1%), nausea (4.1%), and anxiety (3.8%). AEs were generally mild or moderate in intensity (94.3% of AEs), and often occurred early in treatment.

Conclusions: In the PEACE program, patient characteristics have been generally reflective of the US narcolepsy patient population. Thus far, the safety/tolerability profile of pitolisant is consistent with that observed in the clinical development program and the postmarketing setting in Europe, with no new safety signals identified.

Acknowledgements: Bioprojet Pharma and Harmony Biosciences, LLC

A QUALITATIVE EVALUATION OF THE PSYCHOSOCIAL IMPACT OF PEDIATRIC NARCOLEPSY

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Introduction: Narcolepsy is a non-curative, lifelong sleep disorder, with typical onset in childhood or adolescence. In the pediatric population, narcolepsy presents with distinct challenges with regards to social development, familial relationships, and mental health. Specifically, pediatric narcolepsy has been associated with poor social functioning, depression, and anxiety. This study addresses the impact of narcolepsy on daily functioning, mood, self-esteem, and social relationships in a sample of Canadian adolescents with narcolepsy.

Materials and Methods: In-depth, one-on-one interviews with pediatric narcolepsy patients were conducted from May to August 2019, using a semi-structured set of questions. The interviews explored a constellation of themes pertinent to lived experiences and mental health outcomes in pediatric narcolepsy, including 1) patient's feelings regarding narcolepsy diagnosis and treatment, 2) patient's mood and self-esteem, 3) impact of narcolepsy on daily function, 4) challenges at home and school, 5) relationships with friends, peers, and teachers, and 6) avenues for future support. Interviews were digitally audio-recorded for verbatim transcription, coded by two researchers via a line-by-line transcript analysis, and analyzed using NVivo qualitative data computer software.

Results: Sixteen adolescents with narcolepsy (age range = 10-17, mean age = 14.5 $\pm$ 2.1, 68.8% male) participated. The findings suggest that the effects of narcolepsy go beyond the physical impact of excessive daytime sleepiness, cataplexy, and other symptoms. Specifically, the study highlights the psychosocial impact of narcolepsy on day-to-day functioning, and reveals the diversity of personal coping mechanisms, including engaging in physical activity, drinking water, doodling, and pinching oneself, among others. Emerging themes highlight the prevalence of future-oriented worries (including obtaining jobs, gaining independence, and driving cars) and the importance of narcolepsy in one's self-concept (i.e. narcolepsy as a core part of one's identity). Further, findings emphasize the importance of ongoing support from family, friends, teachers, and healthcare professionals throughout pre-diagnosis and post-diagnosis.

Conclusions: While there is variation in the symptomatic experience, coping mechanisms, and self-understanding of narcolepsy among adolescents with narcolepsy, almost all patients recognize the importance of both formal and informal support in improving the lived experience of narcolepsy. Thus, in order to support pediatric narcolepsy patients, we recommend increased social support by implementing early intervention of adolescent medicine specialists, standardized training manuals for teachers and parents, and informal support groups for adolescents with narcolepsy.

PHARMACOKINETICS, RELATIVE BIOAVAILABILITY AND FOOD EFFECT OF JZP-258 AND SODIUM OXYBATE: RESULTS OF TWO PHASE 1, OPEN-LABEL, RANDOMISED CROSSOVER STUDIES IN HEALTHY VOLUNTEERS

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Introduction: Sodium oxybate (SXB) is a standard of care for the treatment of cataplexy and excessive daytime sleepiness in patients with narcolepsy. JZP-258 is an oxybate product candidate with a unique composition of cations resulting in 92% less sodium. JZP-258 contains the same active moiety as SXB at the same concentration and is expected to be dosed similarly. Because previous studies demonstrated a food effect for SXB, dosing instructions require SXB to be taken ≥2 hours after eating. Pharmacokinetic (PK) parameters and food effects for JZP-258 and SXB were evaluated.

Materials and methods: Studies 13-010 and JZP258-101 were phase 1, open-label, randomised crossover studies in healthy adults. Participants in 13-010 received, on separate days, either JZP-258 4.5 g or SXB 4.5 g, diluted in 240 mL of water following either a high-fat breakfast (fed) or after a 10-hour fast (fasting), for a total of 4 sequential treatment periods (≥24 hours apart). Participants in JZP258-101 received JZP-258 4.5 g and SXB 4.5 g diluted in 60 mL (fed and fasting) and 240 mL of water (fasting only), for a total of 6 sequential treatment periods (≥24 hours apart). Blood samples were collected pre-dose and up to 8 hours post-dose, and PK parameters were evaluated, including area under the plasma concentration-time curve (AUC), maximum plasma concentration (C_{max}) and time to reach C_{max} (T_{max}). Safety also was assessed.

Results: PK parameters were evaluated in 30 participants (study 13-010) and 42 participants (study JZP258-101). In study 13-010, under fasting conditions, C_{max} of JZP-258 was lower than C_{max} of SXB (101.8 vs 135.7µg/mL) and T_{max} of JZP-258 was longer than T_{max} of SXB (0.75 vs 0.5 h); AUC was comparable between JZP-258 and SXB. Under fed conditions, JZP-258 and SXB were bioequivalent. Fed conditions reduced C_{max} for both, but the impact of food was lesser with JZP-258 than with SXB ($P< 0.05$). These findings were comparable in study JZP258-101. Volume of water diluent (60 vs 240 mL) did not affect PK parameters of JZP-258 or SXB. The most common adverse events for JZP-258 and SXB included somnolence, dizziness, nausea and headache. In 13-010, under fasting conditions, the incidence of both nausea and vomiting was lower for JZP-258 than for SXB (31.4% vs 47.2%, nausea; 2.9% vs 13.9%, vomiting). Safety findings were similar in JZP258-101. Exploratory analyses indicated a positive relationship between C_{max} and incidence of nausea and vomiting for both JZP-258 and SXB. Nausea and vomiting were reported less frequently under fed conditions than under fasting conditions for both JZP-258 and SXB in both studies.

Conclusions: JZP-258 is an oxybate product candidate with a unique composition of cations that contains the same active moiety as SXB. These PK findings demonstrate that JZP-258 had a lower C_{max}, longer T_{max} and similar AUC compared with SXB. Results suggest a lower C_{max} was associated with lower incidences of nausea and vomiting. The effects of food on C_{max} were lesser with JZP-258 than with SXB.

Acknowledgements: These studies were supported by Jazz Pharmaceuticals.

SEVERE CATAPLEXY IN A MOUSE MODEL OF CHILDHOOD NARCOLEPSY

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Introduction: Narcolepsy is a sleep disorder caused by selective death of the orexin neurons, and it often begins in childhood. Orexin neuron loss disinhibits REM sleep during the active period and produces cataplexy, an abnormal behavioral state between REM sleep and wake. Cataplexy is often more severe when narcolepsy develops in children compared to adults, but the underlying mechanisms remain unknown.

Materials and methods: We used orexin-tTA/TetO-DTA mice to model narcolepsy at different ages. When doxycycline is removed from the diet, the orexin neurons of these mice express diphtheria toxin A and die within 1-2 weeks. We removed doxycycline at 4 weeks (young-onset) or 14 weeks (adult-onset) of age. We implanted EEG and EMG electrodes for sleep recordings one week later and then recorded EEG/EMG/video for 24h at 3 and 13 weeks post-doxycycline removal. Age-matched controls had access to doxycycline chow for the entire experiment.

Results: At 3 weeks post-doxycycline removal, both young-onset and adult-onset mice developed cataplexy and the sleep-wake fragmentation characteristic of narcolepsy. Young-onset mice exhibited much more cataplexy than adult-onset mice at this early time point. Adult-onset mice had more REM sleep compared to age-matched controls in the active period, but orexin neuron loss in young mice did not produce this REM sleep disinhibition. At 13 weeks post-doxycycline removal, both groups exhibited similar amounts of cataplexy.

Conclusions: Orexin neuron loss in young mice results in severe cataplexy, whereas orexin neuron loss during adulthood increases REM sleep in the active period but produces only mild cataplexy. This difference parallels the pattern seen in children and adults with narcolepsy and provides opportunities to study the underlying mechanisms.

LONG-TERM EVALUATION OF SAFETY AND EFFICACY OF PITOLISANT IN NARCOLEPSY: HARMONY 3 STUDY

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Introduction: Pitolisant is a potent, highly selective histamine 3 (H_3)-receptor antagonist/inverse agonist that increases histaminergic activity in the brain. HARMONY 3 is a long-term (up to 5 years) study of the safety and efficacy of pitolisant in patients with narcolepsy.

Materials and methods: This pragmatic, open-label, multicenter study evaluated the effect of pitolisant in adult patients with narcolepsy (with or without cataplexy) diagnosed according to ICSD-2 criteria. All patients experienced excessive daytime sleepiness (EDS; Epworth Sleepiness Scale [ESS] score ≥12). The pitolisant dose was individualized (to a maximum of 35.6 mg once daily) based on efficacy and tolerability. Concomitant use of stimulants and anticataplectic agents was permitted. The 1-year results are presented here.

Results: Of 102 patients who received study drug, 73 were not previously treated (*de novo*) with pitolisant; 29 were previously treated (compassionate use program [n=16], another pitolisant trial [n=13]). Mean age was 36 years; 44.1% were male. At baseline, mean ESS was 17.1 ± 3.1; 73.5% of patients had cataplexy. Sixty-eight patients completed ≥12 months of treatment. Mean pitolisant exposure was 260 and 548 days for *de novo* and previously treated patients, respectively; 72% of patients received pitolisant 35.6 mg/d. During this 12-month period, 56.9% of patients reported adverse events: headaches (11.8%), insomnia (8.8%), weight gain (7.8%), anxiety (6.9%), depression (4.9%), and nausea (4.9%). Mean ESS reduction was 4.3 points overall; 4.9 ($P < 0.01$) in *de novo* patients and 4.2 in previously treated patients. Overall, 63.2% (43/68) of patients were responders (ESS final ≤10 and/or ESS baseline - ESS final ≥3) and 36.8% (25/68) were normalized (ESS final ≤10); mean ESS decreased from 15.3 to 6.6 in normalized patients. Partial and total cataplexy attacks were reduced (-65% and -76%, respectively), as were hypnagogic hallucinations (-54%) and sleep paralysis (-62%).

Conclusions: This 1-year analysis of a long-term, open-label study supports the safety and efficacy of pitolisant for the treatment of EDS and cataplexy in adult patients with narcolepsy.

EFFICACY AND SAFETY OF PITOLISANT IN PATIENTS WITH NARCOLEPSY: A REVIEW OF CLINICAL TRIALS

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Introduction: Pitolisant, a potent, highly selective histamine 3 (H_3)-receptor antagonist/inverse agonist that increases histaminergic activity in the brain, is a first-in-class medication with a novel mechanism of action. Pitolisant is approved by the European Medicines Agency for the treatment of narcolepsy with or without cataplexy in adults and under review by the US Food and Drug Administration for the treatment of excessive daytime sleepiness and the treatment of cataplexy in adult patients with narcolepsy. This analysis summarizes the efficacy and safety results from 2 pivotal trials of pitolisant in adult patients with narcolepsy.

Materials and methods: The randomized, double-blind, placebo-controlled, 7- or 8-week pivotal trials are HARMONY-1 (Dauvilliers Y, et al. *Lancet Neurol* 2013;12:1068-1075) and HARMONY-CTP (Szakacs Z, et al. *Lancet Neurol* 2017;16:200-207). Excessive daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS). The weekly (or daily) rate of cataplexy was calculated from patient diaries.

Results: HARMONY-1 included 94 patients with EDS, of whom 80.9% had a history of cataplexy. HARMONY-CTP included 105 patients, all with EDS and a high frequency of cataplexy at baseline. Baseline ESS score was 18.4 in HARMONY-1 and 17.4 in HARMONY-CTP. Mean change in ESS score was significantly greater for pitolisant compared with placebo in both HARMONY-1 (treatment effect, -3.0; $P=0.022$) and HARMONY-CTP (treatment effect, -3.4; $P< 0.0001$). The percentage of ESS responders (final score ≤10) was 45.2% for pitolisant and 13.3% for placebo in HARMONY-1 ($P< 0.001$); and 39.2% and 18.0%, respectively, in HARMONY-CTP ($P=0.035$). In HARMONY-CTP, the weekly rate of cataplexy was reduced from 9.15 at baseline to 2.27 at the end of treatment for pitolisant (75% decrease) and from 7.31 to 4.51 for placebo (38% decrease; estimated rate ratio, 0.51; 95% confidence interval [CI], 0.44–0.60; $P< 0.001$). In HARMONY 1, patients on pitolisant experienced a 65% reduction in the daily rate of cataplexy compared with a 9% reduction in the placebo group (rate ratio, 0.38; 95% CI, 0.15–0.93; $P=0.034$). The most common adverse events associated with pitolisant (incidence ≥5%) were headache, insomnia, abdominal discomfort/pain, and nausea in HARMONY-1; and headache, anxiety, irritability, and nausea in HARMONY-CTP. Across studies, 1 pitolisant-treated patient (in HARMONY-CTP) discontinued study participation due to an adverse event.

Conclusions: In these randomized, placebo-controlled pivotal trials, reduction in the cardinal symptoms of narcolepsy—excessive daytime sleepiness and cataplexy—was significantly greater in patients treated with pitolisant compared with those who received placebo. Pitolisant was generally safe and well tolerated in these studies.

Acknowledgements: Bioprojet Pharma and Harmony Biosciences, LLC.

CHANGES IN CATAPLEXY FREQUENCY BY PRIOR THERAPY IN A PHASE 3, DOUBLE-BLIND, PLACEBO-CONTROLLED, RANDOMISED WITHDRAWAL STUDY OF JZP-258 IN ADULTS WITH NARCOLEPSY WITH CATAPLEXY

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Introduction: Sodium oxybate (SXB) is a standard of care for the treatment of cataplexy and excessive daytime sleepiness in patients with narcolepsy. JZP-258 is an oxybate product candidate with a unique composition of cations resulting in 92% less sodium.

Materials and methods: This phase 3 study (NCT03030599) of JZP-258 enrolled participants (18-70 years of age) with narcolepsy with cataplexy. Participants were taking SXB and/or other antidepressant/anticataplectic medications, or were cataplexy treatment-naive at study entry. Use of stable stimulant or other alerting agent was allowed. Participants began JZP-258 treatment with a 12-week, open-label, optimized treatment and titration period (OLOTTP). Following JZP-258 initiation and titration (≥2 weeks), prior antidepressant/anticataplectic treatments were tapered and discontinued by week 10, so all participants received JZP-258 alone during weeks 11-12 of OLOTTP. Participants then entered a 2-week stable-dose period (SDP), a 2-week, double-blind, placebo-controlled, randomised withdrawal period (DBRWP), and an optional 24-week open-label safety extension. Primary efficacy assessment was the change in weekly number of cataplexy attacks from SDP to DBRWP. Given the known potential for rebound cataplexy with antidepressant taper and discontinuation, this exploratory analysis examined cataplexy frequency during OLOTTP and SDP based on prior anticataplectic therapy.

Results: Of the enrolled population (N=201), 134 participants received randomised study treatment (efficacy population); adverse events (AEs) were reported for all enrolled participants (safety population). Efficacy subgroups by prior therapy at entry were SXB-only (n=41), SXB + antidepressant/anticataplectic (n=14), non-SXB antidepressant/anticataplectic (n=21), and cataplexy treatment-naive (n=58). Median (Q1, Q3) weekly cataplexy attacks at week 1, end of OLOTTP, and end of SDP in the SXB-only group were 2.0 (0.0, 10.0), 1.0 (0.0, 7.0), and 1.0 (0.0, 4.0); in the SXB+antidepressant/anticataplectic group, 0.6 (0.0, 3.0), 2.2 (0.0, 31.5), and 2.0 (0.0, 23.0); in the non-SXB antidepressant/anticataplectic group, 3.5 (1.0, 9.3), 2.3 (0.0, 9.0), and 2.0 (0.0, 11.2); and in the cataplexy treatment-naive group, 5.8 (1.4, 12.6), 2.0 (0.0, 5.0), and 0.9 (0.0, 5.3). During DBRWP, cataplexy worsened significantly in participants randomised to placebo compared with JZP-258. Common AEs reported during any JZP-258 treatment period included headache (45/201; 22.4%), nausea (27/201; 13.4%), and dizziness (23/201; 11.4%). Serious AEs (SAEs) were reported in 7 participants, including SAEs reported 1 day after the end of placebo treatment in 2 participants and treatment-related SAEs in 2 participants.

Conclusions: As expected, initial cataplexy rates differed based on prior therapy at study entry. In participants who entered on SXB-only, cataplexy was stable with JZP-258 treatment across OLOTTP and SDP. In those who entered on SXB + antidepressant/anticataplectic, cataplexy was stable during initial titration, increased during taper, and stabilised during SDP. In participants who entered on non-SXB

antidepressant/anticataplectic, cataplexy decreased during initial titration, increased during taper and stabilised during SDP. In cataplexy treatment-naive participants, cataplexy decreased consistently from week 1 of JZP-258 titration through the end of SDP. The AE profile of JZP-258 was consistent with that observed for SXB.

EFFICACY OF PITOLISANT IN PATIENTS WITH HIGH BURDEN OF NARCOLEPSY SYMPTOMS

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Introduction: Narcolepsy is a chronic, debilitating neurological disorder of sleep-wake state instability characterized by excessive daytime sleepiness (EDS) and symptoms of REM sleep dysregulation (eg, cataplexy) intruding into wakefulness. Narcolepsy imposes a substantial burden on patients, especially those with severe symptoms. Recent literature suggests that histamine may play an important role in narcolepsy. Pitolisant, a potent, highly selective histamine 3 (H_3)-receptor antagonist/inverse agonist, increases histaminergic transmission in the brain. The efficacy of pitolisant in adults with narcolepsy was demonstrated in 2 randomized, double-blind, placebo-controlled studies. This post hoc analysis evaluates the efficacy of pitolisant in patients with high burden of narcolepsy symptoms.

Materials and methods: Data were pooled from 2 randomized, placebo-controlled, 7- and 8-week studies of pitolisant (individually titrated to a maximum dose of 35.6 g/day) in adults with narcolepsy. Analyses included 3 patient subgroups: baseline score of >16 on the Epworth Sleepiness Scale (ESS), sleep latency of ≤8 minutes on the Maintenance of Wakefulness Test (MWT), and ≥15 cataplexy attacks per week. The final value was the average of the last 2 study visits for the ESS, the last assessment for the MWT, and the stable dosing period (4 or 5 weeks) for the weekly rate of cataplexy (WRC). Treatment response on the ESS was defined in 2 ways: score reduction of ≥3 from baseline and final score of ≤10. In all analyses, the last observation was carried forward for patients who did not complete the study.

Results: The analysis populations included 108 patients for the ESS (pitolisant, n=54; placebo, n=54), 105 patients for the MWT (pitolisant, n=59; placebo, n=46), and 31 patients for cataplexy (pitolisant, n=20; placebo, n=11). Mean scores at baseline in the pitolisant and placebo groups were comparable for the ESS (19.4 and 19.6, respectively), MWT sleep latency (3.5 minutes and 3.4 minutes, respectively), and WRC (21.8 and 20.9, respectively). Mean change in ESS from baseline was significantly greater for pitolisant (-6.1) compared with placebo (-2.6) (P=0.0002). A significantly greater percentage of pitolisant-treated patients were classified as treatment responders: for ESS score reduction ≥3, 68.5% in the pitolisant group versus 35.2% in the placebo group (P=0.0006); for final ESS score ≤10, 35.2% versus 9.3%, respectively (P=0.0026). Increase in sleep latency on the MWT was significantly greater for pitolisant (7.0 minutes) compared with placebo (3.4 minutes; P=0.0089). Decrease in mean WRC was significantly greater in the pitolisant group (baseline, 21.8; final value, 3.9) compared with the placebo group (baseline, 20.9; final value, 18.2); the rate ratio was 0.35 (95% confidence interval, 0.26–0.47; P< 0.001). The adverse event profile in the analysis populations was consistent with the known safety profile for pitolisant; headache was the most common adverse event in pitolisant-treated patients.

Conclusions: In patients with severe symptom burden, pitolisant produced significantly greater improvements in EDS and cataplexy compared with placebo, further supporting the role of histamine in narcolepsy. Pitolisant may be an appropriate treatment for patients with EDS and/or cataplexy associated with narcolepsy regardless of initial symptom severity.

Board #167 : Poster session 2
PITOLISANT IN COMBINATION WITH OTHER MEDICATIONS FOR THE MANAGEMENT OF NARCOLEPSY

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Introduction: Current standard of care in narcolepsy often involves polypharmacy. To characterize potential interactions of pitolisant with other current narcolepsy medications, findings from a drug-drug interaction study and a phase 3 clinical study were evaluated.

Materials and methods: A 2-part open-label, crossover study, conducted in 16 healthy males, evaluated pharmacokinetic (PK) interactions of pitolisant (35.6 mg, single-dose) with sodium oxybate (4.5 g, divided-dose, 3 hours apart) and with modafinil (200 mg/d for 22 days). In a long-term, open-label, phase 3 study (Month 12 completers, n=68), analyses of efficacy and adverse events included subgroups of patients with narcolepsy taking pitolisant alone (PIT), with psychostimulants (PIT+STIM), with anticataplectics (PIT+AC), and with psychostimulants and anticataplectics (PIT+STIM+AC).

Results: Administration of two divided doses of sodium oxybate ($\sim$10 pm and $\sim$1 am) the night before a morning dose of pitolisant did not affect pitolisant maximum serum concentration (C_{max}) but slightly reduced the area under the serum concentration-time curve (AUC; by $\leq$14%) relative to pitolisant alone. Pitolisant did not affect sodium oxybate C_{max} or AUC after the second sodium oxybate dose; sodium oxybate C_{max} and AUC were slightly higher (15% and 12%, respectively) after the first sodium oxybate dose when used concomitantly with pitolisant. There was no overall significant difference in sodium oxybate exposure parameters (the 90% confidence intervals of total C_{max} and AUC were within bioequivalence limits [0.80-1.25]). Coadministration of pitolisant with steady-state modafinil decreased pitolisant C_{max} (by 15%) and AUC (by $\leq$20%); there was no observed effect on the PK of modafinil when coadministered with pitolisant. In the phase 3 study, mean change from baseline to Month 12 in Epworth Sleepiness Scale score was -4.7 for PIT (n=45), -3.2 for PIT+STIM (n=26), -3.6 for PIT+AC (n=14), and -4.0 for PIT+STIM+AC (n=13). Mean percentage change in daily number of generalized cataplexy attacks was -72% for PIT (n=21), -100% for PIT+STIM (n=11), -100% for PIT+AC (n=7), and -66% for PIT+STIM+AC (n=4).

Conclusions: Data from an open-label study in healthy males demonstrated that pitolisant had no clinically relevant effects on the PK profiles of sodium oxybate or modafinil. Sodium oxybate or modafinil minimally affected the PK profile of pitolisant; this implies that no dosage adjustments are necessary. In an open-label, real-world trial, pitolisant was effective as monotherapy and demonstrated incremental improvement in symptoms when dosed with anticataplectic and stimulant medications.

MONTH OF BIRTH IS A RISK FACTOR FOR NARCOLEPSY WITH CATAPLEXY IN CHINESE POPULATION, RELATIONSHIP BETWEEN BIRTH MONTH AND ONSET MONTH

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Introduction: A March peak and a September trough in the birth pattern of narcolepsy patients with cataplexy was reported in America and Europe, whether this pattern also be observed in Asia is not clear,the relationship between onsetmonth and birthmonth as well.
Materials and methods: The birth dates of 1064 patients with a clear-cut diagnosis of narcolepsy with cataplexy from sleep center of People's Hospital，Peking University，were compared with those of general population using chi-square test. span from 1970 to 2000. In addition, All patients in our center which known birth month and onset month were collected to detect the birth month pattern before, during or after 2009-2010 H1N1 pandemic(N=1373), and the relationship between birth month and onset month.
Results: Patients with narcolepsy had a significantly different seasonality of month of birth compared to that of the general population. Excess winter birth (X^2=4.901，P=0.027),OR(1.161, 1.017~1.326)and trough spring birth (X^2=9.455，P=0.002),OR(0.794，0.685~0.920）were found. The monthly distribution of birth yielded a peak in November(X^2=4.252，P=0.042),OR(1.228,1.010~1.494)and a trough in April(X^2=8.338，P=0.004),OR(0.679, 0.521~0.884). for no matter which birth month is, onset month for most patients all between March to September.
Conclusions: A birth seasonality suggests the presence of environmental factors involving in development of narcolepsy, in terms of an autoimmune process targeting the hypocretin system.

NEURAL CIRCUITS OF CATAPLEXY

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Introduction: Although the lack of orexin signaling causes the sleep disorder narcolepsy, the precise neural mechanisms by which orexin neurons prevent narcolepsy remain unclear. In a previous study, we found that targeted restoration of orexin receptor expression in the dorsal raphe nucleus (DR) and in the locus coeruleus (LC) of mice lacking both of orexin receptors inhibited cataplexy and pathological fragmentation of wakefulness (i.e., sleepiness), respectively. These results suggested that DR serotonergic and LC noradrenergic neurons play differential roles in orexin neuron-dependent regulation of sleep/wakefulness. As a next step, we used optogenetic and chemogenetic approaches to demonstrate that DR serotonin neurons suppress cataplexy by reducing the activity of the basolateral/lateral amygdala that plays an important role in emotional processing, as consistent with the fact that strong emotion often triggers cataplexy. Our results suggest that the orexin neuron-DR serotonin neuron-amygdala pathway is a critical circuit for preventing cataplexy. Furthermore, we identified a neuronal pathway that induces cataplexy when activated by optogenetic manipulation. We will discuss the role of this pathway in emotional processing as well as in REM-related muscle atonia.

Materials and methods: The 12- to 20-wk-old male mice (Orexin-ataxin3, Ox1r−/−Ox2r and Sert-Cre, et al.) were used. Implantation of an EEG/EMG electrode, optic fiber, and stereotaxic injection of AAV vectors were performed as described previously. After completing EEG/EMG recordings, we evaluated the expression by histological study. In electrophysiological recording, we used 3- to 6-wk-old Sert-Cre;orexin-ataxin3 mice which were injected in the DR with some AAV vector. We also measured the serotonin release in slices by using HPLC. All results are expressed as the mean ± SEM. Comparisons between individuals were analyzed by two-tailed Student's t test, whereas those within the individuals were analyzed by two-tailed Student's paired t test. Welch's t test was used when the variances of two group means were different.

Results: We identified the downstream target that mediates the anti-cataplectic effects of serotonin neurons in the DR that also send widespread projections throughout the brain. Furthermore, we found that the target area is involved in inducing cataplexy. Acute optogenetic activation of the target neurons induced cataplexy. Currently, we are searching the terminals that induce cataplexy upon their optogenetic activation.

Conclusions: Our study provides additional support for our previous observations that DR serotonin neurons mediate the anticataplectic function of orexin neurons (Hasegawa E, et al. 2014). Both studies propose the orexin neuron-DR serotonin neuron-amygdala pathway as a critical circuit to prevent cataplexy (Hasegawa E, et al. 2017). Furthermore, we are identifying the pathway inducing cataplexy.

NOCTURNAL SOREMPS AS A PREDICTOR OF THE SEVERITY OF NARCOLEPSY IN KOREA

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Introduction: The aim of this study is to investigate the severity of narcolepsy based on the presence of nocturnal sleep onset rapid eye movement sleep period (nSOREMP).
Materials and methods: Subjects included 167 narcolepsy patients diagnosed at the St. Vincent Hospital, the Catholic University of Korea. They underwent polysomnography (PSG) and Multiple Sleep Latency Test (MSLT). The standardized face to face interview and Epworth Sleepiness Scale were used to inquire about daytime sleepiness of the patients. Overall retrospective chart review was performed on their sleep health data.
Results: The presence of nSOREMP was highly correlated with short mean sleep latency and high number of SOREMPs in MSLT. Subjects with nSOREMP also demonstrated higher percentage of N1 sleep, lower percentage of N2 sleep, and more frequent arousals in PSG. Also, they showed higher prevalence of cataplexy and HLA DQB1*0602 positivity.
Conclusions: The subjects with nSOREMP showed more excessive daytime sleepiness and lower quality of sleep compared to the subjects without nSOREMP. Our study thereby suggests that nSOREMP possibly be the severity marker of narcolepsy.
Acknowledgements: Absence

CLINICAL PROFILE OF A TYPE 1 NARCOLEPTIC POPULATION FROM A BRAZILIAN TERTIARY OUTPATIENT CLINIC

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Introduction: Narcolepsy type 1 is a rare pleomorphic disease with often difficult and late diagnosis, especially in emerging countries. We present a clinical profile of type 1 narcoleptic patients from a large Brazilian center and its characteristics.

Materials and methods: Phisical examination and evaluation of the medical records of 51 patients with a diagnosis of type 1 narcolepsy, and assessment of sleepiness (Epworth Sleepiness Scale - ESS), sleep quality (Pittsburgh Sleep Quality Index -PSQI) and severity of narcolespy symptoms (Narcolepsy Severity Scale - NSS).

Results: The majority (58,8%) of the patients was female. The mean age at the time of the evaluation was 36.74 ± 12.48, and at the beginning of follow-up in our service was 32.87 ± 12.45. Mean ESS was 15.7 ± 5.4, PSQI was 11.76 ± 4.17 and NSS was 33.92 ± 11.32, meaning excessive daytime sleepiness, bad sleep quality, and severe narcolepsy symptoms. Related to a social unfavorable profile, with no gratuity medication options, no governamental refound and individual economic difficult to assess some medications, we found that only 56,9% was using stimulant drugs and only one third was using both stimulant and anti-catapletic antidepressant. Beside there was a weak and inverse correlation between the use of stimulant drugs with subjective somnolence defined by ESS score >9 (r=-0.299), and we found no correlation between the treatment prescribed and sleep quality or the severity of narcolepsy (PSQI and NSS, respectively). Our sample was majority composed of overweight (26.7%) and obese (57.8%) patients, with the mean body mass index (BMI) of 31.25 ± 6.11 m^2/Kg and mean abdominal circumference (AC) of 98.23 ± 18.67cm. There was a direct correlation between sleep quality (PSQI) and BMI and AC (PSQI, r=0.384), but no correlation between these measures with somnolence and severity of narcolepsy. Bad dreams or nightmares were experienced more than once a week by more than a half (56.9%) of our patients.

Conclusions: Our observed narcolepsy population presented clinical severity higher than that found in the literature, but not directly related to the therapeutic regimen in use. We observed a high rate of overweight and obesity correlated with bad sleep quality. Oniric symptoms were more frequent in our narcolepitc patients than known general population prevalence.

REAL-WORLD TREATMENT UTILISATION OF SODIUM OXYBATE IN ADULT PATIENTS WITH NARCOLEPSY: AN ANALYSIS OF CLAIMS DATA

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Introduction: In narcolepsy clinical trials, sodium oxybate (SXB) compliance rates were generally high; however, real-world SXB utilisation has not been well studied. This study examined SXB adherence, persistence, and overall treatment utilisation patterns in real-world settings.

Materials and Methods: This retrospective cohort analysis of Truven MarketScan® Commercial Claims and Encounters data (2012-2017) was comprised of US patients aged ≥18 years diagnosed with narcolepsy. Data were included only for patients treated with SXB with ≥1 nondiagnostic claim for narcolepsy; or ≥2 claims for narcolepsy with 1 being nondiagnostic; or ≥1 nondiagnostic claim for narcolepsy following a maintenance of sleep latency test (MSLT). Nondiagnostic claims were defined as claims without MSLT/polysomnography or other diagnostic testing. Patients were categorised as continuing or new users based on the presence or absence of SXB claims during the 1-year washout period prior to index. Adherence was assessed as mean proportion of days covered (PDC) and proportion of patients with PDC ≥80%. Persistence was evaluated by time to SXB discontinuation. Overall treatment patterns were examined using GRAPHx. Descriptive statistics were reported, and chi-square or *t* tests were performed to compare between-group treatment patterns. Kaplan-Meier curves were produced, and log-rank tests were performed to compare continuous time on treatment. *P* values were not controlled for multiplicity, hence, are nominal.

Results: Among 1,280 continuously enrolled SXB users (mean [±SD] age, 39.3 [±13.6] years; 67.6% female), 647 were continuing SXB users and 633 were new users. Among new users, 41.2% received monotherapy and 58.8% received combination therapy. Of new users receiving combination therapy, 30.9% received SXB plus a wake-promoting agent (WPA) and 25.5% received SXB plus an antidepressant. Adherence remained relatively high and constant for continuing users and decreased over time for new users. Mean PDC for continuing versus new users was 0.81 versus 0.64 at 6 months and 0.78 versus 0.56 at 12 months (both *P* < 0.001); the proportion with PDC ≥80% was 67.9% versus 47.1% at 6 months and 62.4% versus 40.6% at 12 months (both *P* < 0.001). Median (95% confidence interval [CI]) number of days to SXB discontinuation was 390 (350-420) for continuing users and 147 (120-180) for new users. Overall, continuing users had greater adherence and persistence than new users. GRAPHx analysis showed that most patients stayed on index treatment in the first year (versus switching), regardless of treatment type. Most treatment-naïve patients started a WPA before SXB. Many patients who used SXB at index were on treatment for several months or even 1 year after gaps.

Conclusions: In adults with narcolepsy, both new and continuing SXB users had high rates of adherence and persistence relative to other treatments, as reported in the literature. Adherence and persistence rates were higher for continuing versus new users. These findings are consistent with data from clinical trials showing that titrating to an optimal dose of SXB takes time and may involve multiple steps, but, once optimal dosing is established, patients can achieve and maintain long-term treatment benefits.

REAL-WORLD TREATMENT UTILISATION OF SODIUM OXYBATE IN PAEDIATRIC PATIENTS WITH NARCOLEPSY: AN ANALYSIS OF CLAIMS DATA

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Introduction: In narcolepsy clinical trials, sodium oxybate (SXB) compliance rates were generally very high (≥80%); however, real-world SXB utilisation in paediatric patients has not been well studied. This study examined SXB adherence, persistence, and overall treatment utilisation patterns in real-world settings.

Materials and Methods: This retrospective cohort analysis of Truven MarketScan® Commercial Claims and Encounters data (2012-2017) included US patients aged < 18 years diagnosed with narcolepsy. Data were included only for patients treated with SXB with ≥1 nondiagnostic claim for narcolepsy; or ≥2 claims for narcolepsy with 1 being nondiagnostic; or ≥1 nondiagnostic claim for narcolepsy following a maintenance of sleep latency test (MSLT). Nondiagnostic claims were defined as claims without MSLT/polysomnography or other diagnostic testing. Patients were categorised as continuing or new users based on the presence or absence of SXB claims during the 1-year washout period prior to index. Adherence was assessed as mean proportion of days covered (PDC) and proportion of patients with PDC ≥80%. Persistence was evaluated by time to SXB discontinuation. Overall treatment patterns were examined using GRAPHx. Descriptive statistics were reported, and chi-square or t tests were performed to compare between-group treatment patterns. Kaplan-Meier curves were produced, and log-rank tests were performed to compare continuous time on treatment. P values were not controlled for multiplicity, hence, are nominal.

Results: Among 61 continuously enrolled paediatric SXB users (mean [±SD] age=14.6 [±2.4] years; 50.8% were female), 23 were continuing and 38 were new users. Among 38 new users, 42.1% received monotherapy and 57.9% received combination therapy. Of new users receiving combination therapy, 31.8% received SXB plus a wake-promoting agent (WPA) and 13.6% received SXB plus an antidepressant. Adherence remained relatively high and constant for continuing users and decreased over time for new users. Mean PDC for continuing versus new users was 0.88 versus 0.76 at 6 months (P=0.071) and 0.86 versus 0.71 at 12 months (P=0.056); the proportion with PDC ≥80% was 82.6% versus 60.5% at 6 months (P=0.071) and 82.6% versus 57.9% at 12 months (P=0.046). The 25th percentile (95% confidence interval [CI]) for number of days to SXB discontinuation was 340 (30-600) and 111 (48-180) for continuing versus new users. Overall, continuing users had greater adherence and persistence than new users. GRAPHx analysis showed that most patients stayed on index treatment in the first year (versus switching), regardless of treatment type. Most treatment-naïve patients started a WPA before SXB. Many patients who used SXB at index were on treatment for several months or even 1 year after gaps.

Conclusions: In paediatric patients with narcolepsy, new and continuing SXB users had high rates of adherence and persistence relative to other treatments, as reported in the literature. Adherence was higher and persistence was similar for continuing versus new users. These findings are consistent with data from clinical trials showing that titrating to an optimal SXB dose takes time and may involve multiple steps, but, once optimal dosing is established, patients can achieve and maintain long-term treatment benefits.

Narcolepsy
Board #170 : Poster session 2
EFFECTS OF PITOLISANT ON NIGHTTIME SLEEP

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Introduction: Disrupted nighttime sleep is common in people with narcolepsy (30%-80%) and is mainly characterized by frequent awakenings and poor sleep quality. Overnight polysomnography (PSG) is routinely employed as part of the diagnostic work-up for narcolepsy. Repeat PSG, to assess the effects of treatment on nighttime sleep, is much less common in clinical practice. Pitolisant, a histamine 3 (H_3)-receptor antagonist/inverse agonist, reduces excessive daytime sleepiness (EDS) and attacks of cataplexy in patients with narcolepsy. Potential side effects of pitolisant treatment include insomnia. This analysis evaluates effects of pitolisant on nighttime sleep in patients with narcolepsy using real-world data from a sleep center database.

Materials and methods: Data collected at a clinical sleep medicine center included both objective (overnight PSG) and subjective (Pittsburgh Sleep Quality Index [PSQI]) measures of nighttime sleep. Overnight PSG was conducted in accordance with clinical practice guidelines. The PSQI includes 7 components (scored from 0 to 3) yielding a global score that ranges from 0 to 21; lower scores indicate better sleep quality (global score ≥5 indicates poor sleep quality).

Results: The sleep center database included 15 patients with narcolepsy who were treated with pitolisant as monotherapy and underwent both baseline and on-treatment PSG. For follow-up PSG, patients were on a stable dosage for at least 3 months. This sample of patients was 60.0% female and had a mean age of 33.9 years; 60.0% of patients were diagnosed with narcolepsy type 1. Patients received pitolisant 35.6 mg/day (60.0%), 26.7 mg/d (13.3%), or 17.8 mg/d (26.7%) for 6 to 12 months. The mean duration of treatment was 10.5 months. The on-treatment means were similar to baseline means for PSG-recorded total sleep time (361.5 minutes and 362.5 minutes), sleep efficiency (78.8% and 79.7%), and arousal index (18.7 and 17.7). There were no significant differences between baseline and on-treatment PSG assessments in the amount of slow wave sleep (17% vs 15%) or REM sleep (19% vs 18.5%). On the PSQI, there was generally no change (global score mean: baseline, 8.9; on-treatment, 9.1) except for the sleep efficiency component (mean score: baseline, 1.2; on-treatment, 1.6; $P< 0.05$). Study limitations include small sample size.

Conclusions: This analysis of real-world clinical data suggests that there were no meaningful changes in sleep architecture or sleep quality in patients treated with pitolisant. Additional research is needed to confirm these findings.

CHRONIC OREXIN RECEPTOR BLOCKAGE INDUCES NARCOLEPTIC BEHAVIOR BY REDUCING OREXIN PEPTIDE SYNTHESIS IN MICE

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Orexins/hypocretins are key neuropeptides which regulate central arousal and reward circuits. Two receptors respond to orexin signaling, orexin-1 receptor (Ox1R) and orexin-2 receptor (Ox2R) with partially overlapping nervous system distributions. Suvorexant (MK-4305), a potent, selective, and orally bioavailable antagonist of Ox1R and Ox2R induces sleep by blocking both types of orexin receptors. The disruption of orexin signaling, via loss of orexin and/or its receptors, results in narcolepsy in mice, dogs, and humans. Hence, we hypothesize that chronic antagonism of orexin receptor can lead to down-regulation of orexin signaling and may mimic the partial or complete orexin-KO condition. Chronic high-dose suvorexant administration in normal mice followed by 1-week washout and a re-challenge with a similar dose induced cataplexy. Similar to the narcoleptic models, positive emotions (chocolate) further intensified the cataplexy in these animals. As expected, NREM and REM sleep were acutely increased. However, there was a desensitization effect during chronic administration. Orexin peptide synthesis decreased and Ox2R expression increased by chronic suvorexant administration. Heterozygous orexin-knockout (Ox-KO+/-) mice showed lower brain orexin content which mimics the pre-narcoleptic humans, whereby orexin levels are not sufficiently low to unmask the cataplexy. We observed that even a single lower dose of orexin antagonist, in the presence of chocolate can induce cataplexy in Ox-KO+/- mice. Putting these data together, we concluded that chronic orexin receptor blockage reduces orexin peptide synthesis which results in narcoleptic behavior in mice.

REM SLEEP BEHAVIOR DISORDER IN A PATIENT WITH NARCOLEPSY

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Introduction: REM sleep behavior disorder (RBD) in a parasomnia characterized by repeated episodes of dream enactment behavior with the synucleinopathies in middle-aged patients. RBD may be idiopathic or symptomatic and both forms are strongly associated with neurodegenerative diseases. We report the rare case of a patient with narcolepsy presenting with abnormal behavior during the sleep compatible with RBD.

Materials and methods: A 19-year-old female was referred complaining of repeated nocturnal episodes of violent behaviors reflecting dream enactment with frequent dream recall and excessive daytime sleepiness. In addition, she reported infrequent episodes of weakness of the lower limbs elicited by emotions when falling asleep and tendency to fall asleep easily during the day. Neurological examination was normal and no extrapyramidal signs were detected. She had a score of 18 on the Epworth sleepiness scale. Nocturnal polysomnography (PSG) disclosed a sleep latency of 5.5 min, REM latency of 26.5 min, sleep efficiency of 85%, and a normal representation of the different sleep stages. During REM sleep intense phasic and tonic muscle activity (chin and posterior tibialis) was evident with limb movements. A multiple sleep latency tests (MSLT) was consistent with narcolepsy (mean sleep latency = 4.1 min and 2 out of 5 sleep-onset REM periods). She was treated with clonazepma 0.5mg at night, and modafinil 400mg in the day. Her nocturnal behavior disorder and daytime sleepiness were significantly improved.

Conclusions: Narcolepsy is a neurological syndrome closely associated with hypothalamic dysfunction and abnormality of the hypocretine system. It appears that the association of RBD and narcolepsy may be due to orexin deficiency. Orexin acts by modulating the secretion of other neurotransmitters with inhibitory or excitatory influences producing stability between motor and arousal regulatory systems. In conclusion, if RBD symptoms occur with companied by the combination of excessive daytime sleepiness and cataplexy, a nocturnal PSG followed by MSLT is recommended.

THE DIAGNOSTIC CONUNDRUM POSED BY ANTIDEPRESSANT MEDICATIONS WHILE CONDUCTING THE PEDIATRIC MSLT

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Introduction: Research examining the influence of antidepressants on multiple sleep latency testing (MSLT) parameters in pediatric populations is limited. We examined the impact of REM-suppressant antidepressant medications and other clinical, actigraphy and polysomnography (PSG) characteristics on mean sleep latency (MSL) and sleep-onset REM episodes (SOREMs) on MSLT in a large pediatric clinical sample.

Methods: This was a retrospective chart review at a tertiary level center. We identified 164 MSLTs performed in patients aged < 18 years between 2014-2017. All data were manually abstracted. Correlations between clinical, actigraphy and PSG characteristics and MSL as well as SOREMs were examined using univariate and regression analyses.

Results: Mean age of the sample was 11.9 years (SD 4.19), 62% were female, 28 (17%) were on REM-suppressant antidepressants (48% were able to discontinue these prior to MSLT) and mean Pediatric Daytime Sleepiness Score was 21.7 (SD 6.1). MSL was 11.27 min (SD=5.77) and mean number of SOREMs was 0.55 (SD 1.04). Twelve patients met criteria for narcolepsy; 40 for idiopathic hypersomnia.

In the overall sample, MSL positively correlated with average time in bed (TIB) on actigraphy, sleep-onset latency and REM latency on PSG, and negatively correlated with age, BMI and number of SOREMs (all $p < 0.05$).

The number of SOREMs positively correlated with REM latency on PSG, self-reported symptoms of cataplexy, hypnagogic and hypnopompic hallucinations, and clinical diagnosis of REM sleep behavior disorder and insomnia (all $p < 0.05$).

In regression analyses accounting for factors significant in univariate analyses and sex, MSL continued to be associated with age and actigraphy determined TIB. REM suppressant antidepressants were associated with reduced number of SOREMs (all $p < 0.05$).

Conclusions: Clinicians should attempt to taper REM-suppressant antidepressant medication when possible and account for their presence when interpreting the results of pediatric MSLT. Actigraphy should be considered to assess adequate time in bed before MSLT.

THE FEATURE OF SLEEP STAGE SEQUENCE OF NOCTURNAL REM PERIODS REFLECTS THE PATHOPHYSIOLOGY OF NARCOLEPSY

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Introduction: Multiple SOREMPs on the MSLT is one of the diagnostic criteria of narcolepsy but sensitive to sleep deprivation and circadian effect. Sleep stage sequence (SSS) analysis preceding SOREMPs on the nocturnal polysomnography (nPSG) and MSLT has been proposed as a novel biomarker that may reflect the pathophysiology of narcolepsy. However, little is known about the SSS related to REM periods over night on the nPSG. The aim of this study was to characterize the SSS before and after REM periods except for SOREMPs in narcoleptic patients.

Materials and methods: Retrospective analysis was done in 163 patients (age: 24.6 ± 6.5 [mean ± SD] years, female: 82, 50.3%) who underwent a nPSG/MSLT from 2008 to 2018. They were diagnosed as narcolepsy type 1 (NT1; n=39), narcolepsy type 2 (NT2; n=64), and idiopathic hypersomnia (IH; n=60) according to the ICSD-3 criteria. The nPSG data of fifty-one healthy volunteers (age: 24.6 ± 4.9 [mean ± SD] years, female: 28, 54.9%) were used as control. The sleep stages and other sleep variables were scored based on the criteria of Rechtschaffen and Kales. Based on the data on nPSG, SSS was defined as the epoch immediately preceding and following each REM period except for SOREMPs. For the data on MSLT, the SSS was defined as the epoch immediately preceding SOREMPs. Pooled data were compared between the groups using Chi-square or Fisher's exact test with the Bonferroni corrections for multiple comparisons.

Results: On the nPSG, REM periods were preceded by Wake/NREM1 more frequently in NT1 than in other hypersomnia and normal controls (p< .0001), and in NT2 than in normal controls (p=.0018) (NT1: 31.4%, NT2: 13.8%, IH: 11.2%, normal controls: 5.5%). REM periods were more frequently followed by Wake/NREM1 in NT1 than in normal controls (NT1: 78.1%, NT2: 66.4%, IH: 70.5%, normal controls: 58.0%) (p< .0001). On the MSLT, SOREMPs were more frequently preceded by Wake/NREM1 in NT1 than in other hypersomnia (NT1: 87.4%, NT2: 55.5%, IH: 28.6%) (p< .0001).

Conclusions: This is the first study evaluating SSS of REM periods on the nPSG except for SOREMPs. The SSS of Wake/NREM1 preceding or following REM periods was more pronounced in narcolepsy especially type 1 in comparison to other groups. This result suggests that SSS on the nPSG may become a marker to reflect the pathophysiology of narcolepsy.

EFFECTS OF SODIUM OXYBATE TREATMENT ON SLEEP ARCHITECTURE IN PAEDIATRIC PATIENTS WITH NARCOLEPSY

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Introduction: The effectiveness of sodium oxybate (SXB) in the treatment of cataplexy and excessive daytime sleepiness in paediatric patients aged ≥7 years was established in a double-blind, placebo-controlled, randomised withdrawal study. Efficacy and safety were maintained up to 1 year (Part 1). An open-label (OL) safety study (Part 2) was added to allow participants continued access to SXB for up to 2 additional years. This analysis evaluates SXB's effects on sleep architecture in Part 1. Interim data were previously presented. Final data are presented here.

Materials and methods: Participants with narcolepsy with cataplexy (7−16 years) who were on SXB or were SXB-naive were eligible. After screening in Part 1, SXB-naive participants were titrated on SXB to an optimal dose and then entered a stable dose period (SD) for 2 weeks. Participants already on SXB treatment at screening entered SD at their usual dose. The SD was followed by a 2-week double-blind, placebo-controlled, randomised withdrawal period (DB), with participants randomised to placebo or continued SXB. Following the DB, participants entered an OL safety period for up to 48 weeks. For SXB-naive participants, nocturnal polysomnography (PSG) was performed during screening (prior to initiating SXB), at the end of SD (on their optimal SXB dose) and at the end of Part 1 (on their usual dose). Participants on SXB treatment at study entry had PSG performed at screening and at the end of Part 1, both on SXB. Safety evaluation included assessment of treatment-emergent adverse events (TEAEs).

Results: A total of 106 participants were enrolled; 85 completed 1 year (Part 1). In SXB-naive participants, PSG changes with SXB administration from screening (no drug) to the end of SD (optimal SXB dose) included decreased total arousals per night (median [Q1, Q3] change, −43.0 [−58.0, −17.0]), decreased N1% (−4.6% [−7.5, −0.6]), and REM% (−6.0% [−12.3, −0.8]) and increased N3% (12.6% [7.1, 20.9]). Further decreases in number of arousals were seen from the end of SD to the end of Part 1 (−4.0 [−14.0, 8.0]) in SXB-naive participants. In participants on SXB at study entry, sleep architecture generally did not change from screening to the end of Part 1 (both on SXB). The most common TEAEs (>10%) during Part 1 were enuresis, nausea, vomiting, headache and decreased weight. The most common TEAEs (>10%) during Part 2 were upper respiratory tract infection, nasopharyngitis, headache, somnambulism and vomiting. There were 2 treatment-related serious AEs in Part 1 and 2 unrelated serious AEs in Part 2. Mean vital signs generally remained within normal range throughout the study; increased mean blood pressure was observed in Part 2, with no apparent relationship to SXB.

Conclusions: SXB treatment-related changes in sleep architecture (reduced arousals, REM and N1; increased N3) in paediatric patients with narcolepsy were similar to those reported in adults, and demonstrate improvement in disrupted nighttime sleep. The overall safety profile was similar to that seen in adult clinical trials.

Narcolepsy
Board #209 : Poster session 3
CATAPLEXY-FREE DAYS FOLLOWING SODIUM OXYBATE TREATMENT IN CHILDREN/ADOLESCENTS WITH NARCOLEPSY WITH CATAPLEXY

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Introduction: Cataplexy resolves in some patients with narcolepsy when treated with sodium oxybate (SXB). A post hoc analysis was conducted to determine the number of cataplexy-free days/week experienced by participants in a placebo-controlled, randomised withdrawal study evaluating SXB treatment in children/adolescents with narcolepsy with cataplexy.

Materials and methods: SXB-naive participants were titrated to an optimal dose of SXB and then entered a stable-dose period (SD) for 2 weeks; participants already on SXB entered the SD on their usual dose of SXB for 3 weeks. After a 2-week double-blind, placebo-controlled randomised withdrawal period (DB), participants entered an open-label safety period (OL) for a total duration of ≤1 year. Cataplexy-free days/week were calculated from daily cataplexy diaries completed by participants during each study period. Safety was also assessed.

Results: Of 106 participants, 74 (69.8%) were SXB naive and 32 (30.2%) were on SXB at enrolment. In SXB-naive participants, the number (median [Q1, Q3]) of cataplexy-free days/week increased over the titration period: week 1 (0.0 [0.0, 2.0]), week 2 (1.0 [0.0, 3.0]), and last 7 days (4.0 [1.0, 6.0]); n=71. Sixty-seven participants who were SXB naive entered the SD. During the last 14 days of the SD, the number of cataplexy-free days/week remained stable and was similar in participants who were SXB naive or on SXB at study entry: 4.3 (1.0, 5.8), n=66, and 4.8 (0.8, 6.5), n=32, respectively. During the last week of the DB, the number of cataplexy-free days/week decreased to 0.0 (0.0, 2.7) in participants randomised to placebo (n=32) but remained stable at 4.0 (1.0, 6.0) in participants continuing SXB (n=31). The number of cataplexy-free days then remained stable throughout the OL (participants who were SXB naive: weekly median, 2.3-7.0; participants who were on SXB at study entry: weekly median, 2.3-6.0). Common adverse events (>10%) in the safety population (n=104) were enuresis, nausea, vomiting, headache, and decrease in weight.

Conclusions: SXB treatment increased the number of cataplexy-free days/week in children/adolescents with narcolepsy with cataplexy. The safety profile of SXB in this study was consistent with previous studies in adult and paediatric narcolepsy.

THE 15-YEARS-OLD GIRL WHO WAS DIAGNOSED AS NARCOLEPSY WITH PROGRESSING INTELLECTUAL DISABILITY AND SYMPTOMS LIKE AUSTIC CHILDREN

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Introduction: We experienced a 15-years-old girl diagnosed as narcolepsy type 1 with progressing intellectual disability and symptom like autistic children. We could not establish the diagnosis because the results of screening for Nieman pick disease type C and anti-N-methyl D-aspartate (NMDA) receptor encephalitis were negative.
Patient: She had no family history of developmental, neurological or psychiatric disorders, including narcolepsy. She was mildly retarded in speech development, and she uttered words at 2 years, whereas she showed normal motor development. She was diagnosed as intellectual disability at 6 years, when her developmental quotient (DQ) was 70. At the age of seven, she [MH1] visited hospital because of daytime sleepiness and cataplexy. Low [MH2] level of orexin in the cerebrospinal fluid (CSF) and sleep onset REM in multiple sleep latency tests indicated the existence of comorbid narcolepsy type 1. She was treated with modafinil, methylphenidate, clomipramine and nitrazepam. Treatment with intravenous immunoglobulin (IVIG) alleviated daytime sleepiness and cataplexy, and she went to school with regular daily schedule, although she fell asleep occasionally. One year after the first IVIG treatment, her symptoms were aggravated; with sleep prolongation about 15-16 hours and more frequent cataplexy. The second IVIG treatment had no effects. Her symptoms changed and looked similar to forced laughing and monologue characteristic of children with autism spectrum disorder. Video-EEG/PSG recordings revealed her symptoms occurred during REM sleep without atonia, indicating the symptoms were caused by REM-related parasomnias. She started to walk around a room during the nighttime. Cataplexy in the upper limbs and neck appeared during the walk. Her mother told that she slept only for few hours, though the orexin level in CSF remained low. At the age of 9 years, her intelligence quotient was 78 by WISC-IV. She only speaks a few words abruptly or phrases occasionally. Her intellectual disabilities progressed so that she could not follow directions nor make a conversation at the age of 14. Brain MRI failed to demonstrate abnormalities. Genetic test and pathological test for Niemann-Pick disease type C was negative. Autoantibodies including anti-NMDA receptor body in the CSF were negative[MH3] .
Discussions and conclusions: We consider her abnormal stereotypic movements as the symptoms relating to the REM sleep. Walking during nighttime might be the stage of REM sleep. Modafinil made her excited. Clomipramine did not effective for cataplexy and made her excited. Sulpiride seems to be good for cataplexy, which could modulate noradrenalin system. Her progressive intellectual disability and strange sleep phenotypes (REM-related parasomnia with frequent cataplexy like episodes) might be caused by a common unknown causes. Any comments to understand and improve this case are welcome.

SAFETY AND TOLERABILITY OF PITOLISANT IN THE TREATMENT OF ADULTS WITH NARCOLEPSY: INTEGRATED DATA FROM CLINICAL STUDIES

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Introduction: Pitolisant, a potent, highly selective histamine 3 (H_3)-receptor antagonist/inverse agonist, has been investigated for the treatment of excessive daytime sleepiness (EDS) and for cataplexy in adult patients with narcolepsy. This analysis evaluates the integrated safety data from studies of pitolisant in adult patients with narcolepsy.

Materials and methods: Data were pooled across 4 randomized, double-blind, placebo-controlled, 7- to 8-week studies. Pitolisant was flexibly dosed to a maximum of 35.6 mg (3 studies) or 17.8 mg (1 study) once daily, based on efficacy and tolerability. Safety assessments included adverse events (AEs), vital signs, laboratory assessments, and electrocardiogram (ECG) measurements.

Results: The analysis population consisted of 172 patients who received pitolisant and 131 patients who received placebo. Overall, 54.5% of patients were male; mean age was 39.2 years; and mean duration of narcolepsy was 11.3 years. The study completion rate was similar for pitolisant (94.2%) and placebo (94.7%). Across all 4 studies, the maintenance dose of pitolisant was 35.6 mg in 39.5% of patients and ≤17.8 mg in 60.5%; in studies that included 35.6 mg, 68.5% of patients were titrated to that dose. The overall incidence of AEs was 49.4% with pitolisant and 41.2% with placebo. The most common AEs (>3% of pitolisant-treated patients) for pitolisant versus placebo were headache (18.0% vs 13.7%), nausea (5.2% vs 3.1%), insomnia (4.1% vs 2.3 %), upper respiratory tract infection (4.1% vs 0.8%), back pain (3.5% vs 0.8%), and dizziness (3.5% vs 2.3%). Serious AEs were reported in 2 (1.2%) pitolisant-treated patients (hemorrhoids, pyelonephritis) and 1 (0.8%) placebo-treated patient (biliary colic). AEs resulted in treatment discontinuation for 3.5% and 3.8% of patients in the pitolisant and placebo groups, respectively. No clinically relevant effects were observed in vital signs, laboratory findings, or ECG parameters.

Conclusions: Integrated safety data from the clinical development program in adult patients with narcolepsy demonstrated that pitolisant was generally well tolerated. Considered together with the previously published efficacy findings (Dauvilliers Y, et al. *Lancet Neurol*. 2013;12[11]:1068-1075; Szakacs Z, et al. *Lancet Neurol*. 2017;16[3]:200-207), pitolisant offers a favorable risk/benefit profile and represents a potential advancement in the treatment of EDS and cataplexy in adult patients with narcolepsy.

Narcolepsy
Board #184 : Poster session 3

SAFETY, TOLERABILITY AND PHARMACOKINETICS OF A POTENT AND SELECTIVE HISTAMINE H3 RECEPTOR INVERSE AGONIST, SUVN-G3031 FOLLOWING SINGLE AND MULTIPLE ASCENDING DOSES IN HEALTHY SUBJECTS

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Introduction: SUVN-G3031, a potent, selective histamine H3 receptor inverse agonist is being developed for the treatment of narcolepsy and other sleep related disorders. SUVN-G3031 modulates neurotransmitters involved in the maintenance of wakefulness and treatment of cataplexy. SUVN-G3031 demonstrated robust wake promoting effects in rodents when evaluated in electroencephalography. Preclinical results provide a strong support for the potential therapeutic utility of SUVN-G3031 in sleep related disorders.

Materials and methods: SUVN-G3031 was studied in a single-center, multifaceted phase 1 clinical studies (US IND) to evaluate its safety, tolerability, and pharmacokinetics after single and multiple ascending doses in healthy subjects. For single ascending dose evaluation, healthy subjects were dosed with 0.1, 1, 6, 12, and 20 mg of SUVN-G3031. In multiple dose evaluation, once daily dose of 1, 3, and 6 mg were administered for 14 days in healthy adult male subjects. Effect of food, gender and age on pharmacokinetics was evaluated in healthy subjects at the dose of 6 mg. SUVN-G3031 was quantified in plasma using a validated LC-MS/MS method. Safety and tolerability was evaluated based on assessments of adverse events, physical examinations, laboratory tests, vital signs, 12-lead ECGs and continuous telemetry.

Results: Absorption of SUVN-G3031 was rapid and exposures were dose proportional at tested doses between 0.1 to 20 mg. SUVN-G3031 achieved the projected efficacy concentrations and attained steady state on day five in tested population on multiple administration. Food, gender and age had no effect on the pharmacokinetics of SUVN-G3031. SUVN-G3031 was well tolerated up to the highest tested dose of 20 mg/day single dose or 6 mg repeated dose in healthy subjects.

Conclusions: SUVN-G3031 has favorable safety and pharmacokinetic profile in healthy subjects. SUVN-G3031 is well tolerated in humans with adequate plasma exposure for efficacy and favorable pharmacokinetics suitable for once a day oral administration. Phase 2 POC study for the treatment of narcolepsy is being planned in USA.

Acknowledgements: None

PREDICTING THE RISK FOR NARCOLEPSY BASED ON GENETIC RISK SCORES OF CANDIDATE LOCI

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Introduction: Genome-wide association studies (GWASs) have identified a large number of single-nucleotide polymorphisms (SNPs) associated with narcolepsy. However, the sum impact of these SNPs on defining the genomic risk of narcolepsy remains unknown. In the present study, we investigated associations between genetic risk scores (GRSs) and narcolepsy and their predictive power.

Materials and methods: A case-control study consisting of 903 narcolepsy patients and 1,981 healthy control subjects was performed. 32 SNPs previously reported to confer susceptibility to narcolepsy were assessed for association with narcolepsy risk. Subsequently, we constructed four GRS groups comprising reported narcolepsy susceptibility SNPs located in different genomic regions, and tested their association with narcolepsy risk using a regression model. Receiver Operating Characteristic (ROC) curves were used to examine the discriminatory power of the GRSs for predicting narcolepsy.

Results: Nine individual SNPs were significantly associated with narcolepsy after Bonferroni correction. All four GRSs were strongly associated with narcolepsy risk even when GRSs were constructed using SNPs located outside the previously implicated HLA region on chromosome 6. The Odds Ratio (OR) for narcolepsy risk increased with the number of genetic loci implicated, ranging from an OR of 2.016 (95%CI, 1.657-2.456) to an OR of 4.298 (95% CI, 3.378-5.481). GRS4, constructed using the narcolepsy-associated SNPs identified in the Chinese population, performed best for predicting narcolepsy risk.

Conclusions: The results suggest that the GRS method for combining common genetic variations is useful in narcolepsy risk prediction and may facilitate narcolepsy risk stratification for prevention trials, both for HLA-DQB1*06:02 positive and negative individuals

TRANSPLANTING IMMORTAL OREXIN CELLS IN NARCOLEPSY

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Introduction: Narcolepsy is a sleep disorder caused by loss of orexin neurons in the lateral hypothalamus. This results in symptoms such as excessive daytime sleepiness and cataplexy, a sudden and involuntary loss of muscle tone during wake. By the nature of this disorder it could be reasoned that reinstating orexin transmission in the central nervous system (CNS) will lead to a recovery of behaviour. However, mature neurons lack the ability to regenerate, thus limiting the capacity of the CNS for recovery after neuronal loss. The primary objective of cell transplantation is to treat disease by reinstating lost transmission, but is dependent on the availability of cells with phenotype of those lost. The aim of this study is to investigate a novel orexin cell line and to determine the outcome on behaviour by transplanting these cells in a mouse model of narcolepsy.

Materials and methods: To do this, we used an immortal cell line isolated from transgenic mice (m) expressing green fluorescent protein (GFP) in orexin (ORX) neurons, isolated from the adult (A) hypothalamus (Hypo), the mHypoA-ORX/GFP4 cell line. First, we performed immunocytochemistry against GFP and orexin to confirm the phenotype of these cells. Next, we performed a live cell secretion assay, coupled with enzyme immunoassay, to confirm the ability of these cells to secrete orexin. A glucose-sensing paradigm was designed with high (5.0mM glucose media) and low glucose (0.2mM glucose media) challenges. Next, we transplanted cells to the lateral hypothalamus (1.65/±1.0/4.5) in a mouse model of narcolepsy, the *orexin*-knockout mouse. Transplant recipients were observed for changes in behaviour, specifically periods of behavioural arrest. Chemogenetics is a useful technique to remotely control the activity of cells. Cultured mHypoA-ORX/GFP4 cells were transfected with hM3D to test the activation of cultured cells by this chemogenetic system. Cultured cells were treated with clozapine N-oxide (CNO) and stained for cFos using immunocytochemistry to denote neuronal activation.

Results: The phenotype of mHypoA/ORX-GFP4 (#cells=379; n=3) was validated, as cells co-expressed orexin and GFP. Using a live cell secretion assay we detected orexin secretion under baseline conditions (high glucose; 0.276±0.030ng/ml; n=3) with a significant increase in orexin release in cultured cells when challenged with hypoglycemia (0.337±0.031ng/ml; n=3; unpaired t-test; **p=0.0097). We found no difference in number of behavioural arrest episodes in cell transplant recipients (8±1; n=6) when compared to sham controls (13±2; n=4; unpaired t-test; p=0.3001). There was a trend for decreased episode duration in transplant recipients (39±4s; n=6) when compared to sham controls (46±6s; n=4; unpaired t-test; p=0.0539). When hM3D-transfected mHypoA-ORX/GFP4 cells were exposed to CNO (500nM) we found a significant increase in cFos expression (%-cFos; 66±13%; n=4) when compared to hM3D-transfected cells exposed to media-only (33±5%; n=4; unpaired t-test; *p=0.0159).

Conclusions: This experiment highlights the potential of cell transplantation as a novel therapeutic strategy for narcolepsy.

DYSREGULATION OF BETA-AMYLOID METABOLISM IN NARCOLEPSY

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Introduction: Narcolepsy is characterized by a lack of hypocretin due to the loss of hypothalamic orexergic neurons. In recent years, several studies showed the relationships between the orexinergic system and the metabolism of beta-amyloid protein which is also modulated by sleep. It is also known that the metabolism of beta amyloid protein can be influenced by inflammatory factors.

Materials and methods: In order to test the autoimmune/inflammatory hypothesis, we analyzed the cerebrospinal fluid (CSF) levels of beta-amyloid 1-42, t-tau and p-tau proteins in a sample of 39 narcoleptic patients (mean age 36.5 ± 12.9), compared to 17 healthy controls (mean age 33.3 ± 8.4). In particular, based on the ICSD-3 diagnostic criteria, 24 patients (mean age 35.6 ± 12,3) were suffering from type 1 narcolepsy (NT1) and 15 patients (mean age 37.8 ± 14) from type 2 narcolepsy (NT2)

Results: The CSF levels of beta-amyloid 1-42 were significantly lower in both patients with narcolepsy compared to controls (685 ± 283 vs 1039 ± 105), and in NT1 patients compared to NT2 patients (575 ± 252 vs 860 ± 274), while the p-tau values were higher in patients with NT2 with respect to NT2 (35.9 ± 10.9 vs 25.4 ± 8.4).

Conclusions: These data suggest the presence of a dysfunction of the beta amyloid protein metabolism in patients affected by narcolepsy, which seems further support the hypothesis of the involvement of inflammatory pathogenetic mechanisms in narcolepsy. Furthermore, we hypothesize that the differences in CSF concentration of neurodegeneration markers found in the two patient subgroups may underlie different pathogenic mechanisms present in NT1 compared to NT1.

SODIUM OXYBATE PRESCRIBING ADJUSTMENTS BY PHYSICIANS IN A REAL WORLD CLINICAL SETTING

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Introduction: A prior cross-sectional study presented real-world evidence on physician prescribing practices and guidance provided to patients with narcolepsy treated with sodium oxybate (SXB) regarding adjustments to SXB dose and regimen (Roy, 2019). Recommended SXB dosing is twice nightly, equally divided. This prospective, longitudinal real-world study examined physician prescribing practices for usual SXB dosing regimens and dosing adjustment guidance provided to patients.

Materials and methods: This IRB-approved study enrolled board-certified sleep medicine physicians with ≥12 months experience treating patients with narcolepsy with SXB, who reported currently treating ≥10 patients taking SXB and interacting with ≥5 patients taking SXB within a 60-day period. Physicians were recruited from existing panels. At baseline, physicians completed a web-based survey about usual SXB dosing regimens prescribed, frequency of SXB dosing discussions, and perceived importance of adjustments to SXB dose and/or regimen. Each day for 60 days, physicians received a text message asking if they interacted with a patient with narcolepsy taking SXB, and if they discussed SXB dosing or provided guidance regarding adjustments to SXB dose and/or regimen. Each day an SXB dosing discussion occurred, physicians answered questions via an automated voice-response system regarding patients' circumstances that prompted dosing discussions, SXB dosing guidance provided, patient factors taken into consideration, and confidence in providing SXB dosing guidance. At study conclusion, physicians completed a follow-up survey. This abstract presents baseline survey findings. Descriptive statistics summarize responses.

Results: At study start, 25 participating physicians reported currently treating between 10 to 250 (mean=49) patients with narcolepsy with SXB. On average, physicians reported prescribing a twice-nightly usual dosing regimen for most patients (83%), with 14% once-nightly, and 4% thrice-nightly. Physicians reported equally divided total nightly doses in 87% of current patients, and unequally divided doses in 13% of current patients. All physicians (100%) reported providing SXB dosing guidance regarding adjustments in dose and/or regimen to accommodate occasional changes in patient typical routine; 16% reported providing this guidance during dose titration, 48% after titration during scheduled visits, and 36% after titration as needed. When providing guidance regarding adjustments to SXB dose and/or regimen to accommodate a specific circumstance, 72% of physicians recommended taking some SXB over skipping SXB entirely; 20% recommended skipping SXB entirely, while 8% did not recommend adjusting or skipping SXB doses. Most (60%) physicians reported it was 'important' or 'very important' that patients take some SXB, over skipping SXB entirely in situations requiring dose adjustments. Most physicians indicated that the ability to adjust SXB dosing was 'important' (80%) and had a positive impact on ability to provide care (84%).

Conclusions: Consistent with previous research, this study showed that physicians regularly discuss SXB dosing with patients and perceive the ability to adjust SXB dose and/or regimen to be important in providing care. Further analyses from this study will examine circumstances that prompted dosing discussions, guidance provided regarding adjustments to SXB dose and/or regimen, patient situations considered, and prescriber confidence in providing SXB dosing guidance.

Narcolepsy
Board #176 : Poster session 2
BURDEN OF NARCOLEPSY: A SURVEY OF PATIENTS AND PHYSICIANS

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Introduction: Narcolepsy is a chronic neurologic disorder associated with substantial personal and socioeconomic burden on affected patients. Surveys of patients and healthcare providers (HCPs) can identify unmet needs in medical diagnosis and treatment and highlight areas for improvement.

Materials and methods: Separate, but coordinated, online surveys were conducted of patients with narcolepsy and physicians who have treated patients with narcolepsy within the previous 2 years.

Results: Survey respondents included 200 patients with narcolepsy (69.0% female; 79.4% white; mean age, 46.5 years) and 251 physicians (45.0% board-certified sleep specialists). Although patients reported a range of negative impacts of narcolepsy on work/school performance, interpersonal relationships, social activities, and emotional well-being, many patients were not discussing with HCPs how narcolepsy affects their daily lives (39.9%). Most patients (87.5%) and physicians (92.0%) identified excessive daytime sleepiness as one of the most disruptive narcolepsy symptoms; however, only 12.5% of all patients (narcolepsy type 1 and narcolepsy type 2) identified cataplexy as a disruptive symptom, compared with 70.5% of physicians. Notably, although only 25.5% of patients reported cataplexy as a symptom, an additional 32.5% reported brief/mild muscular weakness triggered by emotions. More than half of patients (53.5%) reported knowing little or nothing about cataplexy. The vast majority of physicians (93.6%) noted that people with narcolepsy unknowingly alter their lives to accommodate their symptoms; a much smaller percentage of patients (40.0%) reported avoiding social situations, and 20.0% reported avoiding strong emotions. Physicians reported that symptoms were completely or mostly under control in 27.5% of patients on average, whereas only 12.0% of patients reported this level of symptom control. Patients (94.0%) and physicians (94.0%) agreed that there is a need for better treatment options.

Conclusions: Narcolepsy imposes substantial burden on many aspects of life, including school, work, social activities, and relationships. Physicians may overestimate the degree to which patients' symptoms are controlled; however, both patients and physicians agreed that there is a need for new, effective treatment options for the management of narcolepsy. The relatively low prevalence of cataplexy reported in this survey indicates a need for increased patient education and improved HCP-patient communication about this important symptom.

Acknowledgements: Harmony Biosciences, LLC.

LONG-TERM SAFETY OF SODIUM OXYBATE IN PAEDIATRIC NARCOLEPSY WITH CATAPLEXY: OPEN-LABEL CONTINUATION AFTER 1 YEAR OF TREATMENT

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Introduction: In a placebo-controlled, randomised withdrawal study with subsequent open-label investigation for up to 1 year, sodium oxybate (SXB) demonstrated efficacy and safety in the treatment of paediatric narcolepsy with cataplexy. In a further continuation period for up to 2 years, safety of SXB and effects on growth were assessed.

Materials and methods: Participants who completed Part 1 (up to 52 weeks on study) could transition or re-enrol into the open-label continuation (Part 2) for up to an additional 2 years. Part 2 evaluations included body mass index (BMI), weight, height, treatment-emergent adverse events (TEAEs), and vital signs. Age- and sex-based percentiles for height, weight, and BMI at each assessment were determined using standardised growth charts (Centers for Disease Control, 2000).

Results: Of participants in Part 2 (n=44), 35 completed and 9 discontinued (4 withdrew consent, 2 lost to follow-up, 3 due to AEs). Mean (SD) age at first SXB dose in Part 2 was 13.1 (2.2) years; 29.5% were 7-11 years, 70.5% were 12-17 years; 68.2% were male; and 65.9%, 27.3%, 2.3%, and 4.5% were white, black or African American, Asian, and other race, respectively. In Part 1, mean baseline BMI percentile was elevated relative to age-matched population means. In Part 1, there were initial decreases from baseline in median BMI percentile values (median change from Part 1 baseline to end of Part 1: BMI percentile, −7.8; weight percentile, −5.9; height percentile, −1.8), which stabilised in Part 2 (median change from Part 2 baseline to Part 2, month 12: BMI percentile, +0.6; weight percentile, +0.2; height percentile, −3.75; median change in absolute height, +3.1 cm). TEAEs with onset in Part 2 were reported in 21/44 (47.7%) participants; the most frequent were upper respiratory tract infection (9.1%), nasopharyngitis (6.8%), headache (4.5%), somnambulism (4.5%), and vomiting (4.5%). There were 2 serious TEAEs in Part 2 (colon cancer [n=1] and hallucination [n=1]), neither related to treatment. Three participants discontinued due to AEs in Part 2: one due to anger, anxiety, and depression (treatment related), one due to colon cancer (not treatment related), and one due to asthma (not treatment related). Mean vital signs generally remained within normal range throughout the study, with increases in mean blood pressure observed in Part 2.

Conclusions: Although the population changed over time, median growth parameters were relatively unchanged throughout the ≤2-year continuation period. Overall safety findings were consistent with those previously reported.

PSYCHIATRIC SYMPTOMS IN ADOLESCENTS WITH NARCOLEPSY

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Objective: The presence of psychiatric illness in narcolepsy patients is common. The timeline for development of psychiatric symptoms is poorly define. The influencing factors include age of onset, gender, and duration of illness. There is suggestion that the behavioral phenotype of narcolepsy encompasses various traits of psychiatric disease. We reviewed narcolepsy comorbidity schizophrenia and clinical features.

Methods: A retrospective review of 70 patients with narcolepsy who were under the age of 25 years from the sleep center of Xuanwu Hospital during 2017~2019. Neuropsychiatric assessment of ESS, HAMA, HAMD, ADHD, RBD questionnaire, and polysomnography were performed. Multiple sleep latency test studies were also performed.

Results: A total of 70 patients were enrolled to meet the diagnostic criteria for ICSD-3 of Narcolepsy I (N1)/ Narcolepsy II (N2), including 46 males and 24 females, with an onset age of 7 to 25 years, and mean age 13.27 (±2.43) years. Clinical manifestations: EDS 70/70, Sleep paralysis 17/70, Cataplexy 46/70, increased limb movement during sleep 45/70, and RBD 16/70, and main complaints of nighttime sleep continuity disorder 51/70. The main psychiatric manifestations: depression 43/70, anxiety 37/70, ADHD 21/70, 16 cases of psychotic symptoms out of total 70 patients, including hallucinations, delusions, manic episodes, behavioral abnormalities, proverbs. Regarding to the cognitive assessment, there were 14 patients with cognitive decline out of these 70 patients. We also noticed multiple sleep latency test (ML) 3.12±0.26, number of REM (R) 3.31±0.15, TST 442.92±10.11, SE 78.35±1.77, WT 114.33±9.78, and SWS 74.89±5.93. A total of 7 patients were subjected to cerebrospinal fluid orexin level measurements and the orexin levels were reduced significantly.

Discussion: Narcolepsy is a rare chronic disabling neurological sleep disorder that occurs mostly in children and adolescents. Psychiatric symptoms are common in patients with narcolepsy, especially in adolescents; however, it is often misdiagnosed and delayed. Although the exact timeline for the onset of psychotic symptoms of narcolepsy is uncertain, most patients have psychiatric symptoms that occur after 2 to 4 years showing typical symptoms such as drowsiness and tripping. The psychotic symptoms have been thought to be caused by the use of awakening agents. Our retrospective analysis suggests that this is not sufficient reason to explain the observed psychotic symptoms of narcolepsy. 16 patients have typical psychotic symptoms. Only 2 patients had short-term use of methylphenidate, and 4 had a manic episode due to the use of SNRI. Excessive sleepiness associated with narcolepsy, ADHD, and psychotic symptoms severely affected the patient´s social function. Anti-stumping and awakening agents can aggravate psychotic symptoms and manic symptoms. Antipsychotic treatment exacerbates drowsiness and weight gain. The mechanism of the development of psychotic symptoms of narcolepsy is unclear. It is unresolved why mental illness occurs in adolescence. Whether narcolepsy itself is a part of mental illnesses needs to be studied. Whether the persistence of low orexin level is the main cause of comorbid psychosis symptoms is to be defined. This dilemma also generally results in challenge for patient treatment. Further large sample clinical cohort studies are needed to resolved the involved questions.

BDNF GENOTYPE MODERATES THE IMPACT OF SLEEP CHARACTERISTICS ON OVERNIGHT VISUAL LEARNING

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Introduction: A common single nucleotide polymorphism (SNP) of the brain-derived neurotrophic factor (*BDNF*) gene, Val66Met, reportedly impairs BDNF secretion and affects memory function. However, considering the impact of sleep on memory consolidation, relatively few studies have investigated the interaction of *BDNF* genotype and sleep characteristics, such as different sleep stages and sleep spindles. In this study we compared overnight visual memory between the carriers of *BDNF* Met and non-carriers (Val homozygotes), and examined how sleep characteristics associated with memory performance.

Materials and methods: The sample constituted of 151 adolescents (mean age 16.9 years; 69% Val homozygotes, 31% Met carriers). The learning task contained high and low arousal pictures from Interactive Affective Picture System. The pictures were encoded in the evening and recognition accuracy was assessed in the morning. The learning task and all-night polysomnography were conducted at the homes of the adolescents who followed their normal sleeping schedules. Examined sleep characteristics included the durations of Rapid-Eye-Movement (REM) sleep and non-REM sleep, the density of slow and fast sleep spindles and the ratio of time spent asleep or awake between the picture encoding and recognition (SWR).

Results: Met carriers and Val homozygotes did not differ in the learning task scores nor in the sleep characteristics. However, the genotypes differed in how sleep characteristics related with learning task scores, indicated by significant interactions. Only in Val homozygotes the recognition of high and low arousal pictures associated positively with frontal fast sleep spindle density and SWR, respectively. Sleep characteristics did not associate with learning task scores in Met carriers.

Conclusions: In sum, the benefit of sleep in visual learning is not equal across individuals but is moderated by a common gene variant. While this novel finding necessitates further research to specify the underlying mechanics, the results suggest that the difference may be attributed to events promoting long-term potentiation, i.e. sleep spindles, as well as to the protective role of sleep in preventing memory decay and contamination.

THE EFFECT OF HYPER-BUOYANCY FLOATATION (HBF), A MODEL OF SIMULATED MICROGRAVITY, ON SLEEP AND COGNITIVE FUNCTION IN HUMANS

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Introduction: Microgravity is known to alter various physiological variables in humans. However, changes in neuroanatomy, cognition, and sleep have not been significantly studied in the literature. The aim of the present study was to determine the effect of seven-days of supine unloading on a supersaturated saline-filled water bed (hyper-buoyancy floatation, HBF), a novel Earth-based microgravity analogue, on cognition and sleep.
Materials and methods: Twelve healthy male subjects were subject to seven continuous days of HBF, during which subjects' (floatonauts') major cognitive domains (psychomotor speed, attention, memory, executive function, and social cognition) and sleep were monitored by CANTAB testing batteries and 64-lead EEG respectively. Ten control subjects underwent identical cognitive testing regime protocol for comparison.
Results: The unloading period of seven days resulted in a significant ($p < 0.05$) impairment in psychomotor speed and spatial working memory. However, a significant improvement was recorded in several domains of verbal memory. Various physiological changes, including the altered sleep architecture were recorded in floatonauts. Seven days of exposure lead to overall decreased sleep time, decreased non-rapid eye movement 2 sleep stage (N2) duration and decrease in overall NREM duration. Conversely, an increase in mean REM duration, sleep latency, along with increases in height and spine length were demonstrated. Postural changes appeared negatively related to changes in NREM duration, and verbal memory performance.
Conclusions: Overall, the results suggest several cognitive and physiological changes induced by an intervention period of only seven days of HBF. These are hypothesized to occur due to the changes in neuroanatomical homeostasis, cephalic body fluid shift, physical activity, and sleep architecture. Further studies are required to investigate potential mechanisms underlying the observed multiple domain cognitive changes and their possible reversal.

SLEEP QUALITY AND GLYCAEMIC CONTROL AMONG ASIAN POPULATION WITH TYPE 2 DIABETES MELLITUS: A META-ANALYSIS

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Introduction: Worldwide sleep disturbances and deprivation has become more prevalent over the recent years and associated with the significant burden of type 2 diabetes mellitus (T2DM) and obesity. Excessive and insufficient sleep disrupts glycaemic control and health related quality of life in patients with T2DM. However, there is lack of published evidence on the association between sleep duration, sleep quality and glycaemic control in Asian population with T2DM. We aimed to perform a systematic literature review and meta-analysis of sleep duration and sleep quality on glycaemic control in Asian population with type 2 diabetes mellitus.

Materials and methods: A systematic literature search was performed on Medline and Embase from inception through April 2019 with relevant keywords to identify relevant published studies that assess the relationship between sleep duration, sleep quality and glycemic control in Asian population with T2DM. We estimated the pooled mean difference (MD) and 95% confidence intervals (CIs) using the using a weighted random-effect model through RevMan (Version 5.3) software. To assessed the quality of the methodology for each observational studies by using the Downs and Black assessment tool.

Results: A total of seven observational studies qualified for meta-analysis. The results from meta-analysis, suggesting short sleep was associated with significantly higher HbA1c levels compared to normal sleep (MD: 0.11; 95% CI: 0.06-0.17). While long sleep duration was associated with significantly higher fasting plasma glucose levels (FPG) (MD: 5.30; 95% CI: 3.27-7.34) compared to normal sleep duration. Good sleep quality was significantly reduced the FPG levels (MD: 11.28; 95% CI: 5.13-17.42) compared to poor sleep quality. There is no any significant difference found on HbA1c levels, compared between good sleep quality and poor sleep quality (MD: 0.35; 95% CI: -0.40-1.10). Downs and Black assessment tool scored from 10 to 20 (out of 31) on the risk of bias assessment tool. Majority of the studies scored (15-20) suggesting the high quality. Considering reporting and selection of bias, all the studies scored an average or above average.

Conclusions: Findings from our study suggested that sleep duration, as well as the quality of sleep, is thought to be an important factor in the metabolic function of type 2 diabetes patients. However, Further studies warrant to confirm the present findings and to establish the potential causal relationship between sleep and glycaemic control.

Neurological Sleep Disorders Affecting Sleep
Board #179 : Poster session 2

POLYSOMNOGRAPHIC CHARACTERISTICS IN A SERIES OF CHILEAN PATIENTS WITH MYOTONIC DYSTROPHY TYPE 1

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Introduction: : Myotonic dystrophy type I (DM1) is a hereditary multi-system disorder caused by the expansion of a CTG repeat in the DMPK gene on chromosome 19q13.3. It is characterized by myopathic facies, distal muscle wasting, myotonia and multiorgan involvement. Because of the oropharyngeal and respiratory muscles weakness and abnormal Central Nervous System sleep regulatory circuits, these patients develop sleep-related breathing problems such as hypersomnia and sleep apnea. The objective of this study is to describe polysomnographic characteristics in a series of Chilean patients with Myotonic Dystrophy type 1.

Materials and methods: Retrospective-descriptive study. Review of polysomnographic studies of patients diagnosed with DM1 who have been evaluated at the Neuropsychiatry Service of Hospital San Borja Arriaran between 2016 and 2019.

Results: Twenty-six patients with confirmed diagnose of DM1 were included in the study. Eleven adults; 6 male and 5 female, and 15 children; 5 male and 10 female. Seven patients had sleep noninvasive ventilation; 4 adults and 3 children. In the adult group, almost all the patients (10/11) evidenced reduced sleep efficiency (mean: 64%) and 8/11 demonstrated altered sleep stages distribution (reduced REM stage and increased N1 stage). Four adult patients presented increased arousals events. Almost half of the adult patients (5/11) revealed increased respiratory events (mainly hypopneas and obstructive apneas) with normal mean arterial saturation and 5 patients had reduced minimal saturation (being the minimum 79%). Only 1 patient had periodic breathing. Three patients presented snoring, and none had periodic limb movements. In the children group, half of the patients (8/15) presented reduced sleep efficiency (mean: 80%), and 4/15 had altered sleep stages distribution (reduced REM stage). Five children demonstrated increased arousals events. More than a third of the children (6/15) presented increased respiratory events (mainly hypopneas) with normal mean arterial saturation, and 7 patients had reduced minimal saturation (being the minimum 68%). Only 1 patient evidenced periodic breathing. Two patients presented snoring, and none had periodic limb movements.

Conclusions: In our series of adult and children patients with DM1, both groups had diminished sleep efficiency and abnormal sleep architecture. Half of the patients had increased respiratory events, being more frequent in the adult group. Both groups presented hypopneas, but obstructive apneas were more prevalent in the adult group than in the children group. Almost half of the patients evidenced reduced minimal saturation. In this group of patients, sleep architecture and sleep-related breathing problems are the predominant findings in the polysomnographic studies, and these are present from an early-stage disease.

Neurological Sleep Disorders Affecting Sleep
Board #180 : Poster session 2

FEASIBILITY OF A HOME SLEEP APNEA TEST IN A COGNITIVELY IMPAIRED POPULATION

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Introduction: Obstructive sleep apnea (OSA), which causes abnormal pauses in breathing during sleep, increases the risk of developing cognitive impairment. Although in-laboratory polysomnography (PSG) is the gold standard tool to diagnose OSA, it is often underutilized due to long wait times, high costs and patient reluctance to spend a night in a sleep laboratory. Home sleep apnea testing (HSAT) may be a more accessible alternative, as it is simple to use, conveniently administered in a patient's own home and validated against PSG.
Objective: To assess if HSAT is a clinically feasible approach to screen for OSA in a cognitively impaired patient population.
Methods: Patients with cognitive impairment due to neurodegenerative and/or vascular etiologies were enrolled and completed various cognitive, sleep, and mood assessments and questionnaires. Patients also completed OSA screening using a HSAT. HSAT was considered a feasible technique if ≥80% of the study population obtained ≥4 hours of analyzable data. HSAT was considered a practical technique if ≥50% of the patients approached obtained ≥4 hours of analyzable data.
Results: One hundred and seventeen eligible patients were approached for participation, eighty-one completed the baseline assessment and seventy-six patients completed baseline testing and attempted HSAT. Patients who attempted HSAT had a mean age (±SD) of 72.0 (±11.2) years, 44.7% identified as male and the median Montreal Cognitive Assessment score was 22. Ninety-two percent (70/76) of patients obtained ≥4 hours of analyzable data using the HSAT and 59.8% (70/117) of eligible patients approached obtained ≥4 hours of analyzable data.
Conclusion: Our study demonstrated that HSAT was a feasible and practical technique for screening for OSA in a cognitively impaired tertiary care clinic population. As OSA is a modifiable risk factor for patients with cognitive impairment, HSAT has the potential to lead to expedited treatment for OSA, which may potentially improve health related outcomes such as cognition.

Neurological Sleep Disorders Affecting Sleep
Board #157 : Poster session 1

THE RHYTHMS OF AMBES (AROUSAL RELATED MOTOR BEHAVIORAL EPISODES) IN AGRYPNIA EXCITATA: A VIDEO MOTOR ANALYSIS

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Introduction: "Agrypnia Excitata" (AE) is a term coined originally by Lugaresi and Provini to describe a syndrome caused by a dysfunction in thalamo-limbic circuits producing severe insomnia, mental confusion, dream enactment, motor and autonomic activation. This syndrome is observed in fatal familial insomnia (FFI), l autoinmune encephalopathy and delirium tremens (Lugaresi E. and Provini F., Sleep Med. Rev. 2001). In patients with AE, oscillatory EEG rhythms have been observed during "pseudosleep", but also in REM sleep in patients with Agrypnia Excitata-Fatal Familial Insomnia (AE-FFI) (Garay A., Neurology 1994). Episodes of AMBEs with and without behavioral correlates constitute an intriguing finding in patients with AE (Antelmi E. et al., Sleep Med. Rev. 2016). Now, we attempt to characterize this oscillatory behavior observed in a proven case of FFI (Garay A., Neurology 1994; Reder A. et al, Neurology 1995) using motor video analysis techniques (VMA).

Materials and methods: We analized raw data of polysomnograms (n=5) and in particular, a nocturnal video polysomnogram of a case of FFI (Garay A. et al. Neurology 1994, Reder A. et al. Neurology 1995). The video analysis of 8 hours of S-VHS tape recorded was done by computer programs using Python 2.7 scripting OpenCV 3.2.0, Numpy 1.13.1, Scipy 1.1.0 and Matplotlib 2.2.2 libraries. These programs were employed to register and analyze the movements of the head and legs as a function of time during four hours considered for analysis. Frame analysis (30fps) detect changes of integrated monochromatic intensity of a selected region of interest (ROI) normalized with the integrated intensity of a quiescent ROI as background. The fundamental frequencies were obtained by Fast Fourier Transform (FFT). Statistical analysis used the covariance matrix of data and a probability less than 0.05 was considered significant.

Results: AE-FFI was characterized, according to standar polysomnograms, during AMBEs, with an intra atypical REM sleep fragmentation/"pseudosleep" cycling behavior with an increase of near one-minute centered bursts ($p< 0.05$). Segmental analysis using VMA obtained during AMBES showed significant peaks for head (H) and right or left legs (Lr /Ll) movements, cycling in a range of 1.5 to 20 minutes with a low correlation between H and Lr /Ll (r covariance H/ Ll : 0.04; H/ Lr /Ll : 0.08).

Conclusions: This case of AE-FFI demonstrates, a) a disconnection between cortical and sleep postural behavior, b) a disconnection of a central motor pattern generator (CMPG) that mediates the dream enacting behavior and c) a loss of rhythmicity of a central pattern motor generator. These functional correlates suggest a state of thalamo-limbic-brainstem disconnection which may have implication in this and other clinical settings.

THE ANTIDIABETIC DRUG PIOGLITAZONE RESCUES SLEEP ABNORMALITIES IN THE GBA DEFICIENCY FLY MODEL OF GAUCHER'S DISEASE/PARKINSON'S DISEASE

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Introduction: Sleep disturbances are common in neurodegenerative diseases and may represent clinical-risk factors in disease etiology. Gaucher's disease (GD) is a rare lysosomal storage disease caused by mutations in the gene encoding for the enzyme β-glucocerebrosidase, also known as acid β-glucosidase 1 (GBA1) and is the most common genetic risk factor for Parkinson's disease (PD). GBA1 mutations are also associated with Lewy body dementia and rapid eye movements (REM) sleep behavior disorders, a prodromal symptom of PD. While current therapeutic approaches treat systemic GD symptoms, they fail to address neurological GD symptoms. Therefore, identifying therapeutic strategies to treat sleep disturbances in GD/PD models may provide an opportunity for developing novel drug targets in treating neurological manifestations of GD/PD. Deletions in the *Drosophila GBA1* homolog, *dGBA1b*, a fly GD model, is associated with shortened lifespan, locomotor and memory deficits, aggregate protein accumulation, and neurodegeneration. Whether sleep behavior is disrupted in this GD fly model remains unknown. Pioglitazone (PGZ) is a peroxisome-proliferator activated receptor γ (PPARγ) agonist developed for the treatment of type 2 diabetes but has also shown promise for treatment of neurodegenerative disease. Here we observe sleep abnormalities in this GD mutant fly model, and PGZ treatment rescues the GD-associated daytime sleep phenotype.

Materials and methods: GBA1$^{ΔTT/ΔTT}$ flies with a homozygous deletion *dGBA1b* or *dGBA1b* (GBA1$^{+/+}$) control flies were exposed to media containing Dimethyl sulfoxide (DMSO; Sigma), or an equal volume of [500nM] or [1mM] pioglitazone (PGZ; Cayman Chemical) in DMSO and allowed to lay eggs for 3 days. Larvae were reared on PGZ or DMSO food until adulthood, then 1-3 day post-eclosion males were individually collected under CO_2 anesthesia and transferred into 5mmx65mm polycarbonate tubes containing normal media for recording sleep using the Drosophila-Activity-Monitoring-System (DAMS;Trikinetics).

Results: We observed significantly decreased total sleep time in GBA1$^{ΔTT/ΔTT}$ flies compared to control GBA$^{+/+}$ flies, including daytime (Zeitgeber time, ZT1-12), and nighttime (ZT13-24) sleep ($p < 0.0001$ one-way ANOVA, $p < 0.05$ Tukey post-hoc). PGZ at [1mM] was able to rescue daytime sleep deficits in GBA1$^{ΔTT/ΔTT}$ flies compared to control GBA$^{+/+}$ flies, but not nighttime sleep deficits. PGZ at [500nM] was unable to rescue daytime or nighttime sleep in GBA1$^{ΔTT/ΔTT}$ flies compared to control GBA$^{+/+}$ flies. PGZ at either [500nM] or [1mM] had no effect on daytime or nighttime sleep compared to DMSO treated control GBA$^{+/+}$ flies.

Conclusion: PGZ dose-dependently rescued daytime sleep deficits observed in a GD/PD fly model. This suggests PGZ may represent a potential compound for treating GD/PD. Whether PGZ can rescue other phenotypes associated with this model (shortened lifespan, locomotor and memory deficits, aggregate protein accumulation, and neurodegeneration), or nighttime sleep rescue at higher doses, remains to be determined. Future studies testing this and other related drugs on sleep deficits using this model may prove beneficial for screening therapeutic targets of GD/PD.

SLEEP DISORDERS AND POOR SLEEP ARE COMMON IN MULTIPLE SCLEROSIS (MS) AND ARE ASSOCIATED WITH FATIGUE AND DEPRESSION: A CROSS-SECTIONAL INVESTIGATION IN AN UNSELECTED COHORT OF PEOPLE WITH MILD TO MODERATELY SEVERE MS

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Introduction: Knowledge on the importance of sleep disorders and sleep problems in people with multiple sclerosis (MS) is increasing. This is because they are very common, have debilitating effects on well-being and likely contribute to other major disease comorbidities (e.g. fatigue). However, previous investigations into sleep in people with MS have had major methodological limitations. Therefore, it is important to conduct an appropriately designed study to determine the rates of sleep disorders/poor sleep quality in MS, elucidate the potential relationships between sleep disorders/poor sleep quality and disease comorbidity, identify the potential causes of poor sleep quality, and evaluate screening methods to identify sleep disorders and sleep problems that can be effectively treated in people with MS. Thus, the primary aim of the current study was to define rates of sleep disorders/poor sleep quality in a consecutively recruited cohort of people with mild to moderately severe MS. Secondary aims were to investigate: 1) potential relationships between sleep disorders/poor sleep quality with fatigue, depression and sleepiness, 2) potential causes of poor sleep quality, and 3) performance characteristics of three standard obstructive sleep apnea (OSA) screening questionnaires.
Materials and methods: 111 adults (85 females) with MS and an expanded disability status scale score between 2-6 were consecutively recruited to take part in this sleep sub-study as part of a larger randomized controlled trial (ACTRN12616001053415). Validated sleep and health-related questionnaires, a home sleep study and 1-week of daily-life actigraphy were performed.
Results: More than half of the participants had one or more sleep disorders; sleep apnea (31%), insomnia (29%), restless legs (26%) and 66% reported poor sleep. Poor sleep was an independent predictor of fatigue (OR:2.63 [1.02-6.77] p=0.046) and insomnia was an independent predictor of depression (OR:5.62 [1.77-17.84] p=0.003). Over a 24h period, participants spent 10.7±1.9 hours lying down and increased time lying was associated with poorer subjective sleep quality (r=0.36 p< 0.01). The STOPBANG (AUC:0.68) and Berlin (AUC:0.74) questionnaires preformed best in screening for mild and moderate OSA respectively.
Conclusions: Sleep disorders and poor sleep are common in people with MS and are associated with major comorbidity including fatigue and depression. Sleep should be routinely assessed as strategies to improve sleep may help reduce comorbidity burden. However, simple recommendations to increase sleep opportunity are unlikely to be helpful as more time lying down may further worsen sleep quality. Common OSA screening questionnaires have comparable performance characteristics compared to non-MS populations and may be useful to help guide referral decisions for polysomnography in this group that is often fatigued and does not necessarily has the typical sleep apnoea risk factors (i.e. predominantly non-obese women).

NOCTURNAL HEART RATE VARIABILITY AS A BIOMARKER FOR AUTONOMIC NERVOUS SYSTEM DYSFUNCTION IN FATAL FAMILIAL INSOMNIA

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Introduction: Fatal familial insomnia (FFI) is a serious and rare prion disease, which caused by a mutation at codon 178 of the prion-protein gene (PRNP). FFI is mainly characterized by autonomic hyperactivation, sleep disturbances with insomnia, and motor abnormalities. Heart rate variability (HRV) has been proved to be a valuable, noninvasive clinical evidence for evaluating the function of the autonomic nervous system. The purpose of this study was to investigate the autonomic dysfunction in patients with FFI using linear and nonlinear indices.

Materials and methods:
Nine patients with FFI and nine healthy controls matched for sex, age, and body mass index completed standard overnight polysomnography. Linear and nonlinear indices of HRV were derived from 5-min electrocardiogram segments during stage 2 (S2), stage 3 (S3), rapid eye movement (REM) sleep and the wake period.

Results: In patients with FFI, RMSSD were significantly lower than in healthy controls during stage 2, stage 3, REM sleep and the wake period. LF/HF (low-frequency/ high-frequency) ratios in patients with FFI were significantly higher than in healthy controls during stage 2 and stage 3 sleep, but not during REM sleep and wake period. Values of correlation dimension (D2) and Poincaré plot indices SD1 in patients with FFI were significantly lower than in healthy controls during stage 2, stage 3, REM sleep and wake period.

Conclusions: This study found that patients with FFI showed reduced heart rate variability during sleep and wake period, and increased LF/HF ratios during stage 2 and stage 3 sleep. We also found lower value of D2 and Poincaré plot indices SD1 in patients with FFI during sleep and wake period. Our findings suggested reduced complexity in heart rate and increased sympathovagal balance in patients with FFI. Therefore, HRV is a potential biomarker for autonomic nervous system dysfunction in fatal familial insomnia.

THE EFFECT OF THE LONG-TERM TREATMENT WITH VAGUS NERVE STIMULATION ON OBJECTIVE RESPIRATORY PATTERNS AND SUBJECTIVE SLEEP QUALITY AND DAYTIME SLEEPINESS IN KOREAN PATIENTS WITH DRUG-RESISTANT EPILEPSY

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Introduction: Our study aimed to investigate the effects of vagus nerve stimulation (VNS) on sleep breathing, subjective sleep quality and daytime sleepiness in patients with drug resistant epilepsy (DRE) and to analyze correlations between the effects of VNS and the patients' clinical findings.

Materials and methods: Thirteen patients with DRE were included to investigate the effects of VNS on seizure outcome, sleep breathing, subjective sleep quality and daytime sleepiness by performing polysomnography (PSG) and sleep scales before and after VNS treatment. The differences in sleep apnea-hypopnea, daytime sleepiness, insomnia, and sleep quality between before and after VNS treatment were analyzed by nonparametric statistical method. A univariate linear regression analysis was also performed to find any interactions among different clinical findings.

Results: Statistically significant differences between the other sleep variables after VNS treatment were found in the mean number of apneas (0.5→1.2, p=0.042), RDI in REM sleep (8.3→10.8, p=0.033), and the mean MAD (6.1→11.5, p=0.036). Three sleep questionnaires (mean ESS: 8.5±5.5→7.5±5.8, mean ISI: 9.2±5.4→6.8±5.0, and mean PSQI total: 7.2±3.0→6.8±3.9) at the follow-up evaluation showed no significant difference compared to those of the baseline evaluation, except the sleep latency component of PSQI (1.5±1.1→0.8±1.0, p=0.041). The number of seizures was remarkably reduced in aura (6.8→1.5, p=0.002) and focal seizure (22.1→8.4, p=0.001) after VNS treatment. Mean rates of seizure reduction in all seizure types (aura, focal seizure, and generalized seizure) were 81.7% (±81.4), 57.5% (±33.6), and 88.9% (±60.3), respectively. The seizure frequency of predominant seizure type (focal seizure) decreased by more than 50% in 9 patients (69.2%), by 30-40% in 3 patients (23.0%), and did not change in 1 patient (7.7%). Half of 10 patients with an aura reported a preventive effect of progression to seizures of a VNS magnet use.

VNS worsened sleep disordered breathing markers, such as apnea-hypopnea index (AHI), apnea, maximum apnea duration (MAD), and respiratory disturbance index (RDI), whereas VNS decreased daytime sleepiness and sleep latency. The reduction of Epworth Sleepiness Scale was correlated with higher seizure reduction rate and higher rate of seizure prevention by VNS magnet use. We found that the increases of AHI and hypopnea were positively correlated with the rates of seizure reduction in aura. Higher MAD was associated with thicker neck circumference and higher weight.

Conclusions: Our study confirmed that VNS improves not only seizure control in patients with DRE, but also daytime sleepiness, while it worsened sleep disordered breathing in some patients. Therefore, careful observation of sleep breathing is recommended in epilepsy patients who received VNS treatment.

Acknowledgements: none

COMPARISON OF SLEEP PROBLEMS AND CLINICAL FEATURES BETWEEN MEN AND POSTMENOPAUSAL WOMEN WITH BURNING MOUTH SYNDROME

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Introduction: Burning mouth syndrome (BMS) is known to occur predominantly in postmenopausal women. In some rare cases, however, it may also appear in men. There is little information about whether sleep problems affect symptoms of burning mouth syndrome, and whether gender differences exist.
Materials and Methods: A total of 18 male patients and 37 typical postmenopausal female patients (age: ≥ 50 years) with a BMS in the mouth without any visible signs of oral mucosal diseases were included. All individuals in the 2 groups were subjected to clinical evaluations including an interview, a comprehensive questionnaire, a psychological evaluation (Symptom Checklist90-Revision [SCL-90-R]), blood tests, and a measurement of salivary flow rate. The obtained data were analyzed by statistical methods.
Results: The male patients with BMS reported sleep problems less commonly (38.9%) than the postmenopausal group (73.0%, p-value = 0.016). Salivary flow rates were lower in female than male in both unstimulated and stimulated conditions, and the number of oral region where symptoms occurred was significantly smaller in male than in female. Among the 9 symptom dimensions of the SCL-90-R, the scores of interpersonal sensitivity, phobic ideation, and paranoid were significantly higher in male patients. The visual analog scale (VAS) score and the antidiuretic hormone (ADH) level showed a significant negative correlation in both sexes. When patients had sleep problems, salivary flow rates were significantly lower than those without sleep problems, and this tendency was seen in both sexes. In female patients, the mean VAS score was significantly greater when the patients had sleep problem, and the ADH and progesterone levels were significantly smaller than those without sleep problems.
Conclusions: The effects of sleep problem on the clinical features of BMS were different and complex to explain in men and postmenopausal women. Patients with BMS may experience dysregulated endocrinologic or psychoneuroendocrinologic interactions, which might affect oral BMS symptoms according to their sex. Therefore, clinicians and researchers should be considered patient´s sex, sleep problems, and ADH level, for appropriate treatment and management of BMS symptoms.

Neurological Sleep Disorders Affecting Sleep
Board #160 : Poster session 1

SLEEP IS NOT ASSOCIATED WITH NEUROFILAMENT LIGHT CHAIN (NFL) IN A POPULATION-BASED STUDY OF MIDDLE-AGED AND ELDERLY

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Introduction: Neuronal damage has been hypothesized to underlie the association between disturbed sleep and neurodegenerative disease. One indicator of structural neuronal damage is Neurofilament light chain (NfL), which is released into the extracellular fluid and can be reliably measured in blood. NfL in blood is used successfully in clinical populations, and could also be of use in large populations due to its low patient burden. Although NfL is clearly associated with neurodegenerative diseases, the association of NfL with sleep is still largely unclear, particularly in non-clinical populations. Therefore, we assessed the association of disturbed sleep with NfL in serum in a population-based cohort of middle-aged and elderly persons.

Materials and methods: Within the population-based Rotterdam Study, data on sleep and NfL was available in 4,690 participants (mean age 72 ±7 years, 57% women). During the research center visit blood was drawn to determine NfL in serum with a single-molecule array (Simoa). Sleep was assessed with the Pittsburgh Sleep Quality Index and a subgroup of 838 participants also wore an actigraph (Actiwatch AW4, Cambridge Technology, UK) for ≥4 days/nights periods. This allowed us to objectively estimate Total Sleep Time (TST), Sleep Onset Latency (SOL), Wake After Sleep Onset (WASO), Sleep Efficiency (SE), Interdaily Stability (IS, rhythm stability), and Intradaily Variability (IV, rhythm fragmentation). We also determined serum levels of beta-amyloid42 (Aβ42), Aβ40, and total tau to facilitate comparisons between known associations of sleep with these biomarkers and the association of sleep with NfL. To assess cross-sectional associations of sleep with NfL and other biomarkers we used linear regressions, adjusting for multiple relevant confounders and taking into account multiple testing. NfL and other serum biomarkers were standardized to facilitate interpretation. Participants with dementia were excluded from all analyses.

Results: Subjective sleep quality was not associated with NfL, nor were self-reported TST, SOL, awakenings and SE. This contrasts the findings for other markers of neurodegeneration; poor subjective sleep quality and SE were associated with higher levels of Aβ42 (Hazard Ratio (HR) 0.03, 95% Confidence Interval (CI): 0.00;0.06, and HR -0.04, 95%CI: -0.07;-0.01 respectively), and a lower total-tau/Aβ42 ratio (HR -0.04, 95%CI: -0.07;-0.01, and HR 0.03, 95%CI: 0.00;0.06 respectively). Actigraphy-derived sleep and 24-hour rhythms parameters were not associated with NfL or other neurodegeneration markers.

Conclusions: Sleep and 24-hour activity rhythms are not related to structural neuronal damage as indicated by NfL in middle-aged and elderly persons from the general population. Previously reported associations of sleep disturbances with neurodegenerative disease are likely driven by other factors than neuronal damage indicated by NfL.

SLEEP DISTURBANCES ASSOCIATED WITH RESTLESS LEGS SYNDROME IN THE STUDENTS LIVING IN GEORGIA

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Introduction: Restless Legs Syndrome (RLS) is one of the most recognizable sleep disorder as well as insomnia, sleep apnea, and narcolepsy. RLS is classified as a sleep disorder since the symptoms are triggered by resting and attempting to sleep, and as a movement disorder, since the individuals are forced to move their legs. The prevalence of RLS in general population is reported in most studies 10-12% (though the rate has increased up to 24% during recent years). RLS is more common in northern Europe compared with southern Europe and Asia. Although the reports on the distribution of RLS in a Georgian general population have been appeared in scientific arena recently, very little is known about the prevalence of RLS and its relation to sleep impairment among otherwise healthy young adults. This study was aimed to examine the association of RLS with sleep disturbances in a sample of students living in Georgia.

Materials and methods: All volunteer subjects of this study were students of two universities, Tbilisi, Georgia. 220 questionnaires which included personal data, 15 items about sleep-wake habits and schedule, and standard questionnaires such as Insomnia Severity Index (ISI), RLS and Epworth Sleepiness Scale (ESS), were delivered to the students. The final study sample consisted of 211 participants aged 19-21 years. 155(73.4%) of the respondents were females and 56(26.6%) males. RLS was assessed based on the criteria suggested by the international restless legs syndrome study group.

Results: In overall, 12.79% of respondents (27 out of 211) have had RLS according to the RLS estimated criteria. RLS was identified in these students for the first time. 15(55.5%) had a positive family history. The history of known iron deficiency was not declared. Because of unpleasant feelings in the legs, sleep onset difficulty was observed in 12(44.4%), 8 female and 4 male subjects. 59.3% (16 out of 27) had insomnia of different severity. In particular, subthreshold insomnia was detected in 6(22.2%), clinical insomnia of moderate severity - in 6(22.2%) and cinical insomnia (severe) - in 4(14.8%) that was more frequent in the males (2 out of 7; 28.5%) than females (2 out of 20; 10%). 18.5% (5 out of 27) have had excessive daytime sleepiness. Total Sleep Time was less than Time in Bed in all students having RLS symptoms.

Conclusions: Sleep complaints are common in the students with RLS. RLS makes it difficult to get comfortable enough to fall asleep, and leads to insomnia, lack of sound sleep and daytime sleepiness. RLS could have a serious impact on sleep quality. Sleep disturbances may result from the sensory symptoms of RLS. Therefore, the assessment, diagnosis, and implementation of appropriate strategies to improve students' sleep quality are required. It is suggested that subjective sleep disturbances can be improved by the standard treatment for primary RLS.

A META-ANALYTIC REVIEW OF THE EFFECTIVENESS OF INTERVENTIONS FOR TRAUMATIC BRAIN INJURY WITH SLEEP DISTURBANCE

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Introduction: Sleep disturbance among individuals with traumatic brain injury (TBI) is a leading cause of disability with millions of Americans affected each year. Sleep disturbance can impede the healing process of TBI patients, negatively affecting their cognition, mood, appetite, motivation, personality, and overall functioning. Understanding the neurological impact of traumatic brain injury and the effectiveness of various treatment options (exercise, medication, CBT-I) is important for clinicians since rates of TBI are expected to rise as the nation ages.
Materials and methods: Searches for articles were conducted using the MEDLINE, PsycINFO, PubMed, and PsycARTICLES databases. The following search terms were used: "traumatic brain injury," "concussion," "head injuries," "insomnia," "brain trauma," and "brain injury." Effect sizes from each of the articles were calculated using Cohen's *d*, then combined via weighted averaging to find an overall effect size for all interventions implemented.
Results: The total effect size for interventions implemented to treat insomnia associated with traumatic brain injury was 0.36, a small overall effect size for this meta-analysis. Cognitive Behavioral Therapy for Insomnia (CBT-I) was found to be the most effective form of treatment for individuals with TBI.
Conclusions: While there is no current gold standard of treatment for traumatic brain injury (TBI) with sleep disturbance, CBT-I is an evidence-based treatment methodology that has been found to be effective in this population. However, without more data and research, information and literature on sleep disturbance among individuals with TBI will remain limited and patients will continue to receive uninformed, mismanaged, and non-comprehensive care.

CONTROL OF COMPLEX PARCIAL SEIZURES IN A PATIENT WITH SLEEP APNEA TREATED WITH A MANDIBULAR ADVANCEMENT DEVICE

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The Complex Parcial Crisis is a clinical phenomenon affecting 0.8% of the population and is manifested by epileptic discharges most commonly located in the amygdalo-hippocampal complex, which can produce visual delusions and hallucinations, either olfactory, auditory or affective. The prevalence of obstructive sleep apnea syndrome (OSAS) in patients with epilepsy, range from 5% to 63%, depending on the selection criteria, increasing with age. An important relationship was found between OSAS studies and refractary epileptic seizures , as well as between OSAS improvement and refractary seizures improvement with continuous positive pressure in the airways. Although typically contraindicated in seizure disorder, the efficacy of MAD in the treatment of OSAS-associated epilepsy events was recently reported, suggesting that this option may be relevant in specific circumstances in the context of OSA-comorbidly epilepsy.
We therefore report a case of a patient with a diagnosis of complex partial epileptic seizures and moderate OSA which was successfully controlled for either OSAS and epileptic seizures. ABB was referred from the neurologist with a diagnosis of OSAS (AHI=15/h; ODI=2/h) and epilepsy with crisis starting at the age of 15 yo. After refusing positive airway pressure therapy, a MAD was installed and titrated. After 2 years follow up showed resolution of respiratory related events (AHI=3,4;ODI=1/h) and absence of seizures or other clinically relevant features which is maintained after 3 years, corroborating the previous belief on the therapeutic benefits of MAD in OSA epileptic patients. Furthermore it showed for the first time the achievement of a full rather stable therapeutic success with this therapeutic option.

SLEEP ARCHITECTURE IN 22Q11.2 MICRODELETION SYNDROME PATIENTS: POLYSOMNOGRAPHIC STUDY OF PRODROMAL SIGNS OF PARKINSON'S DISEASE AND OBSTRUCTIVE SLEEP APNEA

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Introduction: *.* The 22q11.2 deletion syndrome (22DS) is the most frequent chromosomal microdeletion syndrome, and exhibit an heterogeneous clinical presentation. Is the most common congenital cause of palatal anomalies and the second in congenital heart disease. Neurologic and neuropsychiatric illnesses are also frequent such as moderate to severe mental retardation, schizophrenia and epilepsy. 22DS has been recently recognized as a risk factor for early onset Parkinson's Disease (PD). REM sleep behaviour disorder (RBD), a prodromal sign of synucleinopathies such as PD was evaluated in a cohort of 22DS patients. Repiratory disturbances during sleep were also studied as most patients have been treated for palate anomalies

Materials and methods: Sleep quality and architecture of twenty young patients with genetic diagnosis of 22DS (M=9; F=11; age: 26.6±1.9 y) was studied by means of one-night domiciliary video-polysomnography (vPSG). Type II- polysomnography included EEG, EOG, EMG (*mentalis*, and bilateral *flexor digitorum superficialis*), nasal pressure transducer, respiratory thermistor, pulse oximetry, and thorax/abdomen respiratory effort. Hypnogram and AHI index were reported according to AASM recommendations. REM sleep motor events were reported according to SINBAR recommendations. Patients were clinically assessed with anamnesis, Pittsburgh Sleep Quality Index (PSQI), Hong-Kong self report of RBD (HK-RBD) and Mayo Clinic Questionnaire (MSQ, Informant). Envelope analysis of chin and forearm EMG was performed to further asses muscle activity.

Results: Self report (PSQI) on sleep quality refer moderate to severe complaints. Diurnal somnolence is described as common by parents and family, a fact may be related to medication (antiepileptic and antipsychotic drugs) and sleep habits. vPSG were successfully obtained with a mean 7.9 (±0.2) hours of total sleep time, an efficiency of 85 (±2.4)%, and 52.1(±11.3) minutes of WASO. Only one patient presented mild OSA (AHI index= 9.3). Six patients reported scores >17 in the HK-RBD (suspicion of RBD) whereas the informant report (MSQ) was always negative for RBD. Envelope analysis of chin and forearm EMG do not demonstrate anomalous muscle activity during REM sleep.vPSG discarded objective signs of RBD and REM without atonia in the whole cohort.

Conclusions: Only one older (39 y) male patient presented polysomnographic signs of OSA. Anamnesis and self report on sleep quality suggest inadequate sleep hygiene, may be related to cognitive disabilities and treatment of other comorbidities. Contradictory results were obtained when comparing self-report and the informant report on RBD. No objective evidences (vPSG and EMG envelope) for prodromal signs of synucleinopathies were obtained in the whole cohort.

PHASIC COHERENCE OF FOREARMS MUSCLE ACTIVITY: A SPECIFIC MEASURE OF REM SLEEP WITHOUT ATONIA EVALUATED BY MEANS OF ENVELOPE ANALYSIS OF THE ELECTROMYOGRAM

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Introduction: REM sleep without atonia (RWA), namely maintenance of muscle activity during REM sleep, is required for the diagnosis of REM sleep Behavior Disorder (RBD). Isolated RBD (iRBD) is an early manifestation of neurodegenerative alpha-synucleinopathies. Automated strategies have been proposed to assist in EMG scoring to maximize diagnostic accuracy. Here, we propose a novel envelope analysis method on EMG of video-polysomnographic (v-PSG) records as an accurate procedure in assisting RBD diagnosis.
Methods: V-PSG records of eight healthy volunteers were obtained in Chile by means of ambulatory v-PSG. V-PSG of 12 controls with mild obstructive sleep apnea and 22 patients with iRBD were obtained from the Sleep Disorders Clinic of the Department of Neurology, Innsbruck Medical University, Austria. Visual sleep stage scoring was performed for 30 second epochs according to AASM rules. Tonic and phasic muscle activity during REM sleep were evaluated according to SINBAR criteria in chin and bilaterally in flexor digitorum superficialis (forearm). EMG envelope analysis was performed on R language. The EMG envelope estimates the amplitude and variability of the signal within the 30 second epoch. The coefficient of variation of the envelope (CVE) provide qualitative information to identify three states of muscle activity: rhythmic, phasic and Gaussian noise. CVE values of 30-second EMG epochs were normalized to the Gaussian noise constant of the Rayleigh distribution (≈ 0.523). Phasic epochs were defined as those with a CVE which more than doubled Gaussian noise constant (CVE>2). Coherence between left and right forearms was defined as the rate of REM sleep epochs with coincident phasic muscle activity (CVE>2) over non-phasic epochs. Atonia corresponded to REM sleep epochs whose amplitude of the envelope (AE) was lower than the median of N3 of NREM sleep. Phasic coherence between forearms was defined as the rate of REM sleep epochs with coincident phasic muscle activity (CVE>2) occurring in left and right forearms over non-phasic epochs.
Results: Among non-RBD subjects AE-defined atonic epochs of chin amounted 69%, and CVE-defined phasic epochs of REM sleep amounted on average 17% in forearms and 15% in chin. RBD patients exhibit 27% of atonic epochs in chin, and 48% and 85% phasic epochs in chin and forearms respectively ($p < 0.05$ for no-RBD vs. RBD comparisons). Mean phasic coherence in forearms were 0.11 and 5.48 for non-RBD and RBD respectively ($p < 0.05$). The obtained area under the ROC curve for phasic forearm coherence exhibit an accuracy close to 1 (specificity and sensibility >98%).
Conclusions: Within envelope-defined environment analysis, RWA can be accurately identified by means of forearm coherence of phasic activity.

BLUE-ENRICHED WHITE LIGHT THERAPY REDUCES FATIGUE IN SURVIVORS OF SEVERE TRAUMATIC BRAIN INJURY: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Fatigue is one of the disabling sequelae of traumatic brain injury (TBI), with repercussions on quality of life, rehabilitation and professional reintegration. Research is needed on effective interventions. We evaluated efficacy of blue-enriched white light therapy on the fatigue of patients with severe TBI.
Setting: Physical Medicine and Rehabilitation and Physiology departments of University hospitals.
Participants: Adult patients with fatigue symptoms following severe TBI, Fatigue Severity Scale score (FSS) ≥ 4, were randomly assigned to one of two parallel groups: a blue-enriched white light therapy (BWL) group: 30-minute exposure to waking white light enriched with blue for 4 weeks, and a group without Light Therapy (N-BWL): no light.
Design: Randomized controlled trial. ClinicalTrials.gov number: NCT02420275.
Main Measures: The primary outcome measure was the response of the FSS to four weeks treatment. In addition, we also assessed latency change of the P300 component of event related potentials before and after therapy.
Results: Univariate analysis showed significant improvement of the FSS score ($p = 0.026$) and of the latency of the P300 event related potentials' component ($p = 0.04$) were found in the BWL group compared to the N-BWL group.
Conclusion: Blue-enriched white light phototherapy reduces fatigue of severe traumatic brain injury patients.
Keywords: Traumatic brain injury, head injury, fatigue, bright light therapy, cognitive functions, P300, Events related potential, clinical trial.

MICROGLIA ELIMINATION CAUSED PROLONGED INCREASES IN SLEEP FOLLOWING BOTH PERIPHERAL AND CENTRAL INFLAMMATORY CHALLENGES IN THE MOUSE

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Introduction: Inflammation modulates sleep and conversely sleep, or sleep loss, alters inflammatory responses. This includes the production of inflammatory cytokines that may have dual roles as sleep regulatory substances (e.g. interleukin (IL)-1β, IL-6, tumor necrosis factor (TNF)-α). A trigger, such as a traumatic brain injury (TBI), initiates an innate immune response that is accompanied by activation of microglia, the major cellular component of innate immunity in the central nervous system (CNS). Microglia activated by TBI can become dysregulated and produce high levels of inflammatory cytokines, which amplify and prolong the inflammatory response, hinder CNS repair, and can exacerbate neurological symptoms such as inflammation-induced sleep disturbances. Although the role of microglia in the immune response has been exhaustively studied, the mechanism of how microglia influence inflammation-induced sleep remains unknown. Our long-term objective is to identify mechanistic links between inflammation and sleep in order to refine intervention approaches that improve health. We hypothesized that microglia elimination with a CSF1R inhibitor (PLX5622) would attenuate cytokine levels and regulate sleep after peripheral-induced and TBI-induced inflammation.

Materials and methods: Adult male C57BL/6J mice (n=20) were acclimated to non-invasive piezoelectric sleep cages. Mice were administered a CSF1R inhibitor, PLX5622, or control diet for 21 days and baseline sleep was measured to investigate the role of microglia in physiological entrained sleep. At day 21 mice were randomly assigned to a treatment group and received lipopolysaccharide (LPS;1.2mg/kg i.p) or diffuse TBI (midline fluid percussion injury) and sleep was recorded for 3 days. Blood was collected to measure peripheral cytokine levels (IL-1β, IL-6, and TNF-α) at baseline and 24 hours post-treatment. Flow cytometry was used to confirm elimination of microglia using PLX5622.

Results: PLX5622 eliminated microglia (< 0.5% remained) without significant differences in physiological sleep or peripheral cytokine levels (IL-6, TNF-α, IL-1β) compared to control diet indicating microglia do not play a role in physiological entrained sleep. There was an overall treatment effect on sleep and both LPS and TBI increased sleep (cumulative minutes/day) compared to baseline regardless of diet (F(3,16)=4.635, p=0.0162). There were no differences in sleep in mice on control diet administered LPS compared with mice on control diet subjected to TBI suggesting the acute increase in sleep following TBI may be initiated by a similar mechanism as LPS-induced sleep. Microglia were necessary to regulate inflammation-induced sleep. Mice on PLX5622 administered LPS or subjected to TBI had increased sleep over 3 days compared to mice on control diet that were administered LPS or subjected to TBI. PL5622-LPS mice had increased IL-6 at 24 hours compared to control diet-LPS mice (F(2,10)=25.99,p < 0.0001).

Conclusions: Decades of research have been predicated on the prevailing yet unverified assumption that an inflammatory trigger increases sleep through microglia activation. Results from this study establish, for the first time, a role for microglia in the feedback loop among sleep, inflammation, and TBI. Microglia are necessary to mitigate inflammation and inflammation-induced sleep disturbances following TBI and other neuroinflammatory diseases.

THE IMPACT OF SURGICAL DECOMPRESSION ON SLEEP DISORDERED BREATHING IN PEDIATRIC PATIENTS WITH CHIARI I MALFORMATION

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Introduction: Chiari I malformation (CM) involves the herniation of the cerebellar tonsils through the foramen magnum. CM may compress the brain stem and impact the control of breathing, resulting in obstructive sleep apnea (OSA) and central sleep apnea (CSA). Primary management of symptomatic CM remains surgical decompression. Even so, there remains little research assessing the effect of decompression on sleep disordered breathing (SDB), particularly in pediatrics. The objective of this study is to evaluate the impact of surgical decompression on SDB in pediatric CM patients.

Materials and methods: This was a retrospective chart review of all children diagnosed with CM between the ages of 1 month and 17 years of age who had a polysomnogram (PSG) pre- and post-surgery, between January 2008 and October 2018. Patient demographics, symptoms, PSG data, and surgical methods were recorded. PSG differences, pre- and post-surgery, were compared using the Wilcoxon test for paired samples.

Results: Of the 21 children included in the study, 13/21 met the diagnostic criteria for SDB, while 8 (38%) had OSA, and 8 (38%) had CSA prior to surgery. Of which 6/8 and 5/8 were severe for OSA and CSA respectively. Postoperatively, OSA resolved in 2 patients (25%), with severe OSA remaining in 5/8; CSA had resolved in 3 patients (37.5%), with severe CSA remaining in 4/8. Despite a SBD prevalence of 10/21 following decompression, significant improvements were observed in the total apnea-hypopnea index (p= 0.0087), obstructive apnea hypopnea index (p= 0.03), central apnea hypopnea index (p= 0.042), the desaturation index (p= 0.0095), the total number of counts during sleep (p= 0.032), the lowest oxygen desaturation during sleep (p= 0.017), and the average central event duration (p=0.020). However, following decompression, either continuous positive airway pressure (CPAP) or bi-level positive airway pressure was required in 9/13 patients postoperatively.

Conclusions: While surgical decompression led to a significant reduction in the total apnea hypopnea index, obstructive apnea hypopnea index, central apnea hypopnea index, total number of events and desaturations, many patients continued to meet the diagnostic criteria for SDB postoperatively. Furthermore, many of these children required either CPAP or non-invasive ventilation in the home. This information is important when considering the long-term management of SDB in children with CM. More importantly, given the lack of SDB resolution and continued long-term ventilation management postoperatively, further research should be designed to identify the clinical phenotypes at risk for persistent SDB post-operatively.

SLEEP SPINDLES AND SLOW WAVE ACTIVITY ARE ASSOCIATED WITH SLEEP-DEPENDENT MEMORY CONSOLIDATION IN HEALTHY OLDER ADULTS AND OBSTRUCTIVE SLEEP APNOEA

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Introduction: Sleep spindles and slow wave activity (SWA) are key electroencephalographic (EEG) features of NREM sleep that play a critical role in memory consolidation. The beneficial effect of sleep on memory appears to weaken with increasing age. Changes in sleep micro-architecture that occur in older adults such as reduced SWA and spindles may underlie impaired sleep-dependent memory consolidation (SDMC). Obstructive sleep apnea (OSA), a prevalent sleep disorder in older age, is also associated with changes in sleep micro-architecture. This pilot study examined quantitative sleep EEG correlates of declarative SDMC in older adults with OSA and controls.
Materials and methods: Participants with OSA (n=21, 13 male, age 56±16, apnea hypopnea index, AHI 69±53) and age-matched healthy controls (n=23, 10 male, age 61±17, AHI 8±6.8) underwent in-lab overnight polysomnography. They completed a 32 word-pair task administered 1-2 hours before bed. Overnight consolidation was assessed 1 hour after waking following an 8 hour sleep opportunity. Power spectral analysis was performed on all-night EEG recorded at F3-M2 and C4-M1 electrode sites. We calculated slow wave activity (slow oscillations (SO) absolute power 0.25-1 Hz; and delta EEG power (0.5-4.5 Hz) in NREM sleep at the frontal region. Spindle density (11-16 Hz, events p/min, at central and frontal regions) in stage N2 was derived using an automated spindle detection algorithm. Between group differences in spindles, SWA and memory scores were examined. Correlations between EEG measures and overnight recall were assessed. Data are mean ±SD, SWA measures were log transformed for statistical analyses.
Results: There were no significant between-group differences in spindle density (OSA: 0.95 ± 0.73/h vs Controls 0.93 ±0.48/h, $p=0.91$), SWA (SO: 255.8 ± 307.4 μV^2 vs 375.8 ± 398.9 μV^2, $p=0.35$; delta power: 322.5 ±180.2 μV^2 vs 393.9 ±257.5 μV^2, $p=0.39$) or overnight recall (94.6 ±15.2 % vs 94.7 ±14.6 %, $p=0.98$). Within the entire sample (n=43), a greater memory recall was correlated to a higher spindle density at frontal ($r=0.26$, $p=0.035$) but not central regions ($r=0.12$, $p=0.29$). SWA in NREM was positively associated with recall (SO: $r=0.49$, $p=0.005$; delta: $r=0.56$, $p=0.001$). In sub-group analyses, SWA was significantly related to recall in both the OSA group (delta: $r=0.51$, $p=0.046$) and the control group (SO: $r=0.74$, $p=0.002$; delta: $r=0.62$, $p=0.013$). AHI was not significantly associated with memory recall in the OSA group ($p>0.05$).
Conclusions: Despite the sleep fragmentation and hypoxemia associated with OSA, sleep spindles and slow frequency brain activity in NREM sleep were similar to controls and associated with overnight declarative memory consolidation in both groups. Targeted interventions to boost spindles and slow wave activity may enhance memory consolidation in older adults, even those with OSA.

Neurological Sleep Disorders Affecting Sleep
Board #188 : Poster session 2

PREVALENCE OF EDENTULISM AND SLEEP DISTURBANCES FOLLOWING STROKE

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Introduction: Many authors have demonstrated the association between edentulism and various clinical, neurological (e.g. stroke) and sleep disorders such as obstructive sleep apnea (OSA). Edentulism may influence the prevalence of sleep disturbances, including OSA, poor sleep quality, excessive diurnal somnolence and restless leg syndrome in participants following stroke, and thus having consequent higher disabilities and negative outcomes.
Methods: This study verified the prevalence and classification of stroke in 130 patients, the influence of sleep disturbances (sleep quality, risk of obstructive sleep apnea, restless leg syndrome, and excessive daytime sleepiness) was measured by questionnaires. We also investigated the number of teeth and the nocturnal use of dental prostheses
Results: The prevalence of ischemic stroke was 94.6%, with minor stroke severity and no significant disability or slight disability. Regarding the evaluation of sleep, our sample had poor sleep quality, higher risk of obstructive sleep apnea, diagnosis of restless leg syndrome and presented no excessive daytime sleepiness. We also found a higher prevalence of missing teeth or edentulous, as the majority used total and removable dentures and half of them slept with them.
Conclusions: Despite the overlap of edentulism, sleep disturbances and stroke, we found higher prevalence of poor sleep quality, higher risk of obstructive sleep apnea, and presence of restless leg syndrome on edentulous patients after following stroke, with minor stroke severity. This indicates the need for further studies on treatments and prevention of sleep disturbances and edentulism in stroke patients.

SLEEP-WAKE CYCLE RECOVERY AFTER MODERATE TO SEVERE TRAUMATIC BRAIN INJURY: ARE ULTRADIAN RHYTHMS INVOLVED?

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Introduction: Recent studies showed that survivors of moderate to severe traumatic brain injury (TBI) have severe fragmentations of sleep and wake episodes across 24 h during their hospital stay, despite having a normal melatonin rhythm. In most cases, the 24-hsleep-wake cycle reappears before hospital discharge. However, very little is known about how the 24-h sleep-wake cycle recovers. More specifically, whether ultradian rhythms are present before the occurrence of a consolidated 24-h sleep-wake cycle is unknown. The aim of the present study was to verify whether ultradian sleep-wake rhythmicity is present in hospitalized patients with moderate to severe TBI.

Materials and methods: 35 patients with moderate to severe TBI (30 ± 12 years old, 24 males) were compared to 27 patients (34 ± 15 years old, 21 males) with orthopedic or spinal cord injury (OSCI) hospitalized in the same environment. Patients were included once they reached medical stability and were no longer continuously sedated. Their sleep-wake cycles were assessed using actimetry (Actiwatch-L or Actiwatch-Spectrum; Philips Healthcare) on a nonparalyzed arm for 14.5 ± 5 days in the TBI group, and 11.3 ± 3.3 days in the OSCI group, with one sample per minute. Activity data of each patient were segmented into 3-day windows and activity counts were averaged in 15 min bins. To assess rhythmicity, autocorrelations were calculated on each 3-day window for lag times extending from 0 to 1.15 days. The highest positive autocorrelation peak was identified for each 3-day window and for each subject. Groups were compared using chi-square statistics.

Results: In the first three days of recording, corresponding to 22.2 ± 12.2 days post-injury in TBI subjects and 12.2 ± 9.1 post-injury in OSCI subjects, 36.4% of TBI patients showed a clear rhythm close to 24 h (range: 20-25 h) compared to 63% of OSCI patients. Among patients who did not exhibit a circadian sleep-wake rhythm in the first three days of recording, significant ultradian peaks were found (range: 3-19.5 h), most of which had a 3 to 8 h period. In fact, 36.4% of TBI patients exhibited an ultradian sleep-wake rhythm between 3 to 8 h, compared to 11.1% of OSCI patients (χ^2 (2) = 5.97; p = 0.05). During the last three days of recording, no OSCI patients exhibited a 3 to 8 h ultradian rhythm but 12.1% of TBI patients still showed a significant 3 to 8 h rhythm (χ^2 (2) = 3,56; p=.152).

Conclusions: Using autocorrelations, we identified ultradian sleep-wake rhythms, most of which were within a 3 to 8 h period. This ultradian rhythmicity was more frequently observed in TBI patients compared to a control group of OSCI patients. Whether ultradian sleep-wake rhythms are driven by physiological processes or caused by the environment (e.g. medication schedule, nurse interventions) warrants further investigation. Ultradian rhythm could represent a transition period from fragmented sleep to a consolidated sleep-wake cycle.

SLOW HEMODYNAMIC OSCILLATIONS DURING WHOLE NIGHT RECORDING AND INTERACTIONS WITH EPILEPTIC DISCHARGES: A SIMULTANEOUS ELECTROENCEPHALOGRAPHY-NEAR INFRARED SPECTROSCOPY CASE REPORT STUDY

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Introduction: Cerebral hemodynamic fluctuations during human sleep have been studied in order to better understand the neurophysiology of sleep (NäsiT *et al.,*2011). However, spontaneous hemodynamic oscillations during sleep in epilepsy remain largely unknown, whereas sleep stages might also influence the hemodynamic response associated to transient epileptic discharges (EDs). Simultaneous EEG with Near Infra-Red Spectroscopy (NIRS) is a new non-invasive tool to study the hemodynamic responses elicited by EDs and their interactions with sleep, through whole night recordings. NIRS can monitor fluctuations of deoxy-hemoglobin and oxyhemoglobin signals during prolonged recordings. Our goals were to perform whole night EEG-NIRS recordings a) to investigate spontaneous oscillations of oxyhemoglobin concentration during different sleep stages, particularly low frequency oscillations (LFO: 0.04-0.15 Hz); b) to evaluate the impact of the presence of EDs on ongoing slow hemodynamic oscillations and c) to assess the interaction between hemodynamic changes associated to EDs and sleep stages.

Materials and methods: An overnight EEG-NIRS recordings was performed on a 30-year-old patient diagnosed with drug-resistant epilepsy. EEG was acquired using 21 scalp-electrodes placed according to 10-20 system and NIRS with 8 sources and 18 detectors. The position of NIRS sensors over the presumed epileptic focus and its homologous contralateral area were guided by prior EEG and MEG source localization of similar EDs. In order to maximize NIRS sensitivity to the underlying cortical region, we applied our personalized NIRS optimal montage strategy (Pellegrino *et al.,*2016, Machado *et al.,*2018). The resulting personalized NIRS montage covered the left frontal MEG source, its contralateral homologous region as well as a control region in the left parietal area. All transient EDs, corresponding to bursts of bi-frontal polyspike-waves starting in the left side, were visually marked and their corresponding hemodynamic responses were analyzed according to the sleep stages during which they occurred (wakefulness, light-sleep (N1+N2), slow-wave sleep and rapid eye movement sleep).

Results: We found that spontaneous LFO hemodynamic activity decreased during slow-wave sleep when compared to other sleep stages in both frontal regions, in agreement with previous NIRS results reported in healthy subjects (Näsi T *et al.,*2011). Moreover, the occurrence of EDs during light-sleep was associated with an increased activity in LFO in both frontal regions when compared to the same sleep stage without EDs. Finally, irrespective of the sleep stage, the resulting hemodynamic NIRS responses to these EDs were characterized by bilateral frontal decrease in oxyhemoglobin, whereas no change was measured in the control region.

Conclusions: Our results indicate that a) spontaneous cortical hemodynamic behavior during sleep was not altered in this patient with epilepsy; b) the occurrence of epileptic discharges was associated with an increase of fluctuations in LFO, which might favor seizures in light- sleep; c) the negative hemodynamic response associated to these epileptic

abnormalities suggests a locally altered neuro-vascular coupling. A better understanding of the underlying mechanisms and their interaction with sleep needs to be confirmed on a larger population.

Other
Board #336 : Poster session 3
SLEEP QUALITY IN HEMODIALYSIS PATIENTS

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Introduction: *Fatigue, poor sleep and low sleep are one of the most important factors that reduce the quality of life in patients undergoing chronic hemodialysisThe purpose of this study was to evaluate the relationship between sleep quality and therapeutic measures in dialysis and other clinically relevant factors in dialysis patients.*
Materials and methods: In this study 80 Patients referring to the hemodialysis clinic of Baharlo Hospital in 1397 were chosen.The PSQI questionnaire, laboratory reports such as serum calcium, phosphorus and hemoglobin levels and information about patients medications , dialysis shifts, weekly dialysis schedules, background history of illness, body mass index, age and sex of patients were extracted from the patient´s case.To determine major risk factors for poor sleep logistic regression and considering low power of the study Forward logistic regression was used.
Results: 67 pationts (83%) completed the study.46 patients were male (68.7%). 26 patients (38%) were good sleepers (PSQI < 5). In multivariate logistic regration model including serum calcium, phosphorus ,hemoglobin, dialysis shifts, body mass index, age and sex of patients, only sex remined significant.
Conclusions: In hemodialysis patients, men reported beter sleep quality than weman regarless of age, laboratory reports oad body mass index.
Acknowledgements: This research has been supported by Tehran University of Medical Sciences. The authors wish to thanks sstaff of occupational sleep research center and hemodialysis center in Baharloo Hospital for their invaluable help.

A COURSE ON BEHAVIOURAL SLEEP INTERVENTIONS AND CBT FOR SLEEP DISORDERS WITHIN A MASTER DEGREE PROGRAMME: THE FIRST TWO ACADEMIC YEARS OF EXPERIENCE WITH CLINICAL PSYCHOLOGY STUDENTS

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Introduction: Given the prevalence of sleep disorders and both the efficacy and effectiveness of behavioural / cognitive-behavioural interventions for a variety of sleep problems, in particular CBT-I for insomnia, we believe a course on this topic should be incorporated within the master degree programmes in psychology. Therefore, at our University, within the master degree in clinical psychology we are offering one semester optional course called *Psychological Interventions on Sleep Disorders*. The aim of the present work is to summarize the syllabus and to analyse the students' perceptions about the course, based on the two first editions, relying on the pedagogical surveys conducted at the university.

Materials and Methods: A total of 73 psychology master degree students have voluntarily registered at the course - 32 at the 1st edition (2017/18) plus 41 at the 2nd (2018/19). Syllabus topics: 1.Defining sleep and the circadian sleep-wake cycle. Normal sleep across life span. 2.Sleep Disorders (SD) and its classification (DSM-5;ICSD-3). 3.Symptoms, prevalence, aetiology, and development of SD (most relevant ones in clinical psychology). 4.Main psychological models for insomnia. 4.1.Other psychological conceptualizations for SD. 5.Main assessment methods used by sleep psychologists. 6.Sleep education and "sleep hygiene". 7.Specific behavioural, cognitive and non-pharmacological interventions for SD: insomnia (e.g., CBT); nightmares, sleepwalking, night terrors, other parasomnias (e.g., image rehearsal therapy); shift work, delayed sleep-phase, other circadian rhythm sleep-wake disorders (e.g., chronotherapy; light therapy); narcolepsy/hypersomnolence disorders (e.g., naps scheduling); sleep-related breathing (e.g., CPAP adherence therapy) and movements disorders.
Data were collected via institutional university anonymous questionnaires assessing the pedagogical aspects of the course (i.e., standardized online questionnaires applicable to all curricular units, distributed at the end of the semester). Items used in the present study ask each participant to assess a given course in a variety of parameters, each rated in a 5-point scale ranging from 1 to 5, higher scores representing better quality.

Results: A total of 49 students (67.12%) out of 73 completed the voluntary pedagogical surveys, 23 on the 1st edition and 26 on the 2nd. Mean scores on each item of the questionnaire (addressing: recommended bibliography and other learning materials; overall quality of learnings; learning results; non-redundancy concerning curricular contents of other courses; articulation between theoretical and practical contents within the course; students active participation in the learning processes; development of analysis and critical reflection/thinking skills; students overall self-assessment of their performance) ranged between 4.18 and 4.43, with most students' answers (90.3%) falling in the categories 4 or 5. Overall inter-item mean score was 4.28.

Conclusions: Results on the first two semesters of the course were very encouraging according to students' perceptions. By offering a course on CBT-I and behavioural interventions for sleep disorders at the master degree level, we hope to contribute to increase their delivering in health contexts in the near future.

Acknowledgements: To the Faculty of Psychology and Sciences of Education - University of Coimbra, and the Portuguese FCT Centre for Research in Neuropsychology and Cognitive and Behavioral Intervention-CINEICC, which support this presentation. To the teaching team

of cognitive-behavioural therapies at FPCE-UC.

PERCEIVED VERSUS OBJECTIVE QUALITY AND DURATION OF SLEEP IN LONG-STAY HOSPITAL INPATIENTS: MIXED METHODS STUDY

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Introduction: Long-stay hospital inpatients suffer considerable sleep and circadian rhythm disturbances, due to environmental and internal factors. Ageing is also associated with changes in sleep and circadian rhythms, such as greater nocturnal sleep fragmentation and daytime sleepiness. Some studies show possible association between frailty and poor sleep quality, while daytime sleepiness has been linked with poor functional recovery in older adults. There are little data on hospitalized older adult sleep quality, duration and associated perceptions. We compared perceived versus objective sleep quality and duration in long-stay hospital inpatients (older adults) to inform clinical management strategies and interventions.
Materials and methods: Long-stay (2+ weeks) older adults over 64 years admitted to the Assessment Treatment and Rehabilitation ward (Dunedin Public Hospital) able to give an informed consent were invited to participate in the study. We collected actigraphy (Actilife GT3X) data (7+days), subjective sleep questionnaire Pittsburgh Sleep quality index (PSQI) and a research-team designed qualitative sleep questionnaire on sleep perceptions. Demographic, hospital stay and clinical data were collected. Descriptive statistics for the study sample were derived, and paired t-tests to compare subjective and objective sleep measures were used. Thematic analysis was performed on the qualitative data. We are currently conducting additional analyses, incorporating quality of life measures.
Results: Data were collected on 35 older adults, each of whom contributed mean (SD) 11.4 (8.1) days of actigraphy data. 54.3% were female with mean (SD) age of 79.8 (7.2) years and 87% identified as New Zealand European. Mean (SD) length of hospital stay was 21.0 (9.6) days. 42.0% and 42.0% were admitted for reconditioning following medical illness or stroke. For all patients on the ward, the average (SD) length of sleep as captured by actigraphy was 8.2 (1.7) hours. Average (SD) sleep latency was 5.3 (6.5) minutes. Patients significantly underestimated the duration of sleep, comparing to actigraphy measurements (p=0.02). 26 study participants contributed qualitative data. 50.0%, 42.3% and 30.8% patients described their sleep as fragmented, delayed or short, respectively. 23.1%, 50.0% and 57.7% of the study participants mentioned pre-sleep routine, quiet room or acceptance of their state as factors that help them sleep, respectively, while 53.9%, 50.0%, 38.5% listed noise, other patients or interruptions from nurses, as the key factors that negatively affect sleep. Internal factors, such as "not feeling at home", "other life concerns" and "repetitive thoughts", "health concerns" and "pain and disease" were listed as they key factors that negatively affect sleep by 38.5%, 34.6%, 26.9% and 23.1%, respectively. 53.9%, 19.2% and 15.4% of the participants mentioned hospital setting, sickness or age as factors that negatively influenced sleep quality and duration expectations, respectively. 46.2% of the patients stated feeling lack of control; 61.5% and 50.0% mentioned acceptance and ability to adjust as the main themes.
Conclusions: Multiple factors impact on inpatient sleep, and large proportion of patients have negative perceptions and expectations on their sleep.

ESTABLISHING FIRST SLEEP CENTER IN MONGOLIA

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Sleep medicine is an emerging field in Mongolia and physicians are getting interested in treating sleep disorders. Neurologists are especially interested in this field as patients with neurological disorders are often associated with sleep disorders such as sleep apnea, hypersomnia, insomnia and restless legs syndrome.

We would explain how we have established sleep center, the essentials in setting up a sleep center in countries where sleep medicine has not been established.

From 2017 Project for implement medical equipments to GHSSS. From 2017-2018 we prepared to establish sleep center in Mongolia. To set up sleep lab we did a lot of job and would like to divide main 3 parts as a :

• Place to set up sleep laboratory
• Procurement of PSG, CPAP
• Staff training

Preparation to establish sleep center: In setting up a sleep center, suitable space for sleep lab, equipment for sleep studies and treatment, and human resource need to be prepared. Under the discussion with the hospital director and Japanese sleep specialist, we reversed two suitable rooms for sleep lab in the new in-patient building under construction.

PSG machine: As for the diagnostic tools, we introduced two Polysomnography devices under the international support funding and government funding. Japanese CPAP device was introduced for treatment, and necessary education for the use of CPAP was provided.

Staff training:

• Initial doctor trained in Germany and Japan. 1 more doctor and 1 nurse did 1 month training in Austria, Innsbruck University hospital Sleep center.
• 2 nurses have trained in the local center.
• We still have to improve our skills in abroad to develop sleep medicine in Mongolia.

2019.03.15 we did Opening ceremony of Sleep center: Opening ceremony of the first Mongolian sleep center was held on the World Sleep Day.

Collaborate with diagnostic / treatment device manufacture to introduce reasonable equipment and receive continuous support. Work with a specialist sleep center to obtain necessary technique and knowledge to operate sleep center.

From 15th November, 2018 we did 97 sleep study. 37 of them obstructive sleep apnea, 3 of them narcolepsy, 15 of them had restless leg syndrome, 42 of them had insomnia and other sleep problems.

However we are only one in Mongolia, we are trying to improve our skills and quality of service.

EFFECTS OF SLEEP EXTENSION ON DAYTIME BLOOD PRESSURE IN SLEEP-DEPRIVED ADOLESCENTS

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Introduction: Short sleep duration associated elevated blood pressure (BP) in adolescents has been documented in cross-sectional studies. Experimental sleep restriction is found to lead to increased BP in adults. Whether sleep extension would lead to BP changes remains undefined. This study aimed to examine whether natural sleep extension during holidays would lead to a reduction in BP in sleep deprived adolescents.

Materials and methods: This was an observational study involving 3 weekly study periods that included
(1) 7-day school attendance, followed by
(2) 7 days of school holiday, and then
(3) another week of school attendance.
During each study period, subjects underwent sleep-wake pattern monitoring by actigraphy for at least 5 days (including ≥1 day of weekend) and 24-hour ambulatory blood pressure (ABP) monitoring on a weekday. Non-obese healthy adolescents aged between 12-16 years without sleep disorder were eligible to participate. Subjects with self-reported weekday time in bed < 8 hours and self-perceived sleep insufficiency were classified as Sleep Deprived group, while those with self-reported weekday time in bed ≥8 hours and self-perceived sufficient sleep were categorised as Normal Sleep group. Post-hoc analysis was conducted by dividing subjects into Sleep Extended (sleep duration increased by ≥1 hour during holidays) and Sleep Stable (sleep duration increased by < 1 hour during holidays) groups to examine the effects of sleep extension on BP measurements.

Results: A total of 155 subjects underwent screening, of whom 7 were not eligible to participate due to obesity (n=5) and presence of sleep disordered breathing (n=2). 148 consented to take part. A total of 25 subjects (17%) dropped out because of refusal or lost to follow-up. Another 24 (16%) were excluded from the final analysis because they had less than 5 days of actigraphy data at one or more visits. The remaining 99 subjects had complete dataset, of whom 49 and 31 were categorized into Sleep Deprived and Normal Sleep groups respectively.The Sleep Deprived group had a greater increase in weekday sleep duration from school days to holidays when compared to the Normal Sleep group (+82±62 c.f. +46±51 min, p=0.009). However, the effects of holiday on daytime BP was insignificant (p=0.45 and 0.077 for systolic (SBP) and diastolic BP (DBP), respectively). Interaction between sleep deprivation and holiday on daytime BP was also insignificant (p=0.14 and 0.29 for SBP and DBP, respectively).
Respectively 32 (65%) and 11 (35%) subjects from the Sleep Deprived and Normal Sleep groups were further classified as Sleep Extended during the holidays. The holiday effects on daytime SBP (-2.2±0.8(SE) mmHg, p=0.010) and DBP (-2.2±0.6(SE) mmHg, p< 0.001) were significant only in the Sleep Deprived-Sleep Extended group, accompanied by a significant increase in weekday sleep duration of +118±40 min (p< 0.001). The reductions in daytime SBP [-0.9±1.1(SE), p=0.42] and DBP [-1.7±1.0(SE), p=0.10] in the Normal Sleep-Sleep Extended group were insignificant.

Conclusions: Increase in sleep duration during school holidays leads to reduced daytime blood pressure in sleep deprived adolescents.

IRON DEFICIENCY IN INDIGENOUS POPULATIONS IN CANADA AND ALASKA: A SCOPING LITERATURE REVIEW

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Introduction: The World Health Organization reports that iron Deficiency (ID) is the most common micronutrient deficiency in the world. Indigenous people in Canada have experienced unique challenges during their nutritional transition away from traditional foods (Nutrition Canada 1975, FNFNES 2014). In a recent national study of Indigenous nutrition, 31% of the respondents of Indigenous communities in the Atlantic report food insecurity. Despite ongoing research, the causes of ID remain unclear. In 2018, Indigenous health clinicians, healers and allies from the Eastern Door Centre in Elsipogtog First Nation began a collaboration with the H-Behaviors Lab (BCCHR/UBC) with the question: *Is ID affecting the health of children in Elsipogtog and what can we do about it?* Thus, the goal of this scoping literature review is an exploration of the prevalence and etiologies of ID for the creation of a shared framework towards an increased understanding. Our ultimate goal is improving the health of Indigenous children.

Materials and Methods: A literature search in the databases MEDLINE, PubMed, and EMBASE was conducted using two search topics: "Indigenous" (MEDLINE & EMBASE: University of Alberta Indigenous Peoples "Canada - General" and "United States - Alaska" search filters; PubMed: Aboriginal, Indigenous, First Nations, Inuit, Métis, Native, Indian, or Eskimo) and "iron deficiency" (="iron" plus deficiency, sideropaenia, dysfunction, absorption, an(a)emia, and disorder). In total, 177 results were returned. Inclusion criteria for publications were a Canadian or Alaskan study population, Indigenous study population, English language, human population, mention of iron/ID, and online availability of full-text publication.

Results: 55/177 fit the inclusion criteria: prevalence studies (n=15; 11 cross-sectional, 1 longitudinal, 3 review); iron supplementation studies (n=3; cross-sectional), explanatory models (n=32; 19 cross-sectional, 2 case series, 2 longitudinal, 2 controlled trial, 2 review, 4 other methodologies), and other themes (n=5; 2 cross-sectional, 1 longitudinal, 1 review, 1 other). Indigenous Canadians and Alaskans demonstrated levels of ID that were much higher than that of the greater Canadian/U.S. population, despite generally adequate intakes of iron. Explanatory models for this discrepancy, independent of the shift away from traditional food consumption, were *Helicobacter pylori* or other infections, concurrent facilitating nutrient deficiencies, and bottle-feeding/evaporated milk consumption in place of breastfeeding. A strong association between *H. pylori* infection and ID (7/8 studies and two reviews) emerged as a significant explanatory model. Recent trends investigate the mechanisms surrounding traditional food consumption and concurrent nutritional deficiencies as a model in ID.

Conclusions: The current literature suggests a complex and multifaceted set of etiologies

that contribute to ID in Indigenous communities within Canada and Alaska. Despite this, there is no specific mention of Indigenous peoples in Canadian iron supplementation guidelines. This warrants a review of clinical best practice surrounding iron and *H. pylori* detection, breastfeeding, and nutrient supplementation. Further discussions surrounding clinical practice should center on the inclusion of Indigenous voices, and also increase collaboration between academia and Indigenous communities.

GIFTED CHILDREN: A CHARACTERIZATION OF SLEEP AND ITS ASSOCIATION WITH DAYTIME FUNCTIONING

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Introduction: Intellectual giftedness is characterized by an intellectual development superior to peers (QI > 120) while emotional and relational development corresponds to the age norms (Silverman, 2009). This asynchronous development pattern can lead to erroneous diagnoses, socio-emotional problems and academic difficulties (Webb et al., 2016). Given the regulatory role of sleep on daytime functioning, we investigated the sleep of intellectually gifted children and tested for its relationship with standard measures of intellectual, emotional and behavioral functioning.

Materials and methods: Seven gifted children (6 boys, mean age = 10.58, *SD* = 2.11) and 9 typically developing (TD) children (8 boys, mean age = 10.33, *SD* = 2.14) were studied. Giftedness was determined by the intellectual quotient (Wechsler Intelligence Scale for Children III and the Raven´s Standard Progressive Matrices). Sleep was evaluated objectively using polysomnography and subjectively with the Children's Sleep Habit Questionnaire (CSHQ). The Child Behavior Checklist (CBCL) measured the emotional and behavioral functioning. Nonparametric Mann-Whitney *U*-tests were used to compare the groups on sleep variables and daytime functioning. The correlation between sleep and intellectual / emotional / behavioral functioning was assessed with *Kendall´s tau-b* coefficients.

Results: Polysomnographic data showed that gifted children had significantly more sleep spindles per minute of stage 2 than the TD group ($p = 0.01$). They also displayed more stage 4 nonREM sleep (N3b) in the first third of the night ($p < 0.01$), and less in the second third ($p < 0.01$). The CSHQ revealed that gifted children displayed more bedtime resistance compared to TD children ($p = 0.03$). Gifted children scored higher on the CBCL total problems scale ($p = 0.02$); they were more anxious/depressed, inclined to withdrawal, and had more somatic complaints and internalizing behavior problems on the CBCL ($p < 0.048$). The total CSHQ score was positively correlated with the total CBCL score in gifted children ($p = 0.02$) but not in TD children ($p = 0.54$).

Conclusions: These results suggest that IQ in gifted children shares a common neurobiological factor with nonREM sleep thalamo-cortical hyperpolarization (more sleep spindles and slow-wave sleep). The results also show that gifted children experience emotional/behavioral problems and that these difficulties are linked with sleep difficulties. These results highlight the need to better understand the sleep of gifted children because: 1) they could be considered as a population at risk for sleep disorders; 2) clinicians will need to define the therapeutic strategy as being focused on sleep itself or on daytime correlates, or both.

Acknowledgements: N/A

THE EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON SLEEP QUALITY OF CLINICAL POPULATIONS: A SYSTEMATIC REVIEW

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Introduction: Sleep disturbances, including reduced sleep quality and increased sleepiness, represent a major health concern that impact individual's well-being and the socioeconomic system. They reduce daily function and are associated with cognitive deficits, psychological impairment and the presence of other health conditions such as Parkinson's disease or chronic pain. Common interventions to treat sleep disturbances include short-term pharmacology and cognitive behavioral therapy. However, these interventions are associated with significant side effects and poor treatment adherence, respectively. Transcranial direct current stimulation (tDCS) is a non-invasive modulation technique that is used as a therapeutic alternative in the management of different clinical conditions. It is also thought to improve sleep disturbances by regulating the sleep-wake cycle through the modification of cortical and subcortical pathways. We conducted a systematic review with the main objective of evaluating the effects of transcranial direct current electric stimulation on objective/subjective sleep quality measures in different clinical populations. Secondly, we aimed to assess the different methodologies that were used and the associated adverse events.

Materials and methods: A search was performed in MEDLINE, Web of Science, EMBASE, EBM reviews, PsycINFO, and Google Scholar databases. Selection of citations was based on the following criteria: 1) adult patients diagnosed with chronic insomnia or with any other disorder where sleep quality is reported; 2) intervention with active tDCS; 3) available baseline and post-treatment sleep measures, and comparison with sham techniques when available; 4) use of objective sleep measurements such as polysomnography (PSG) or actigraphy, or subjective sleep-related instruments such as the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) or Patient-Reported Outcomes Measurement Information System (PROMIS). Risk of bias and quality of studies were assessed through the Cochrane Risk of Bias Tool for Randomized Controlled Trials.

Results: A total of 2127 individual citations were identified after duplicates removal, and 12 articles met the inclusion criteria. Sleep quality data was obtained for a total of 224 patients. Sleep was the primary outcome in 7 studies and the secondary outcome in 5. Only two insomnia studies were identified. Other studied conditions included Parkinson's disease (k=3), chronic pain (k=2), or restless leg syndrome (k=1) among others. Sleep quality was measured objectively in 3 studies (PSG=3) and subjectively in 15 (PSQI=5, ESS=3, PROMIS=2, others=5). The main brain areas stimulated were the left dorsolateral prefrontal cortex (k=8) and the primary motor cortex (k=5). Sleep quality improvement was reported in 7 studies. Studies with a higher number of tDCS sessions tended to exhibit positive treatment outcome. Mild adverse events were reported (i.e. transient headache, redness of skin, fatigue). Overall, risk of bias was high, mainly due to the random sequence generation, allocation concealment and selective reporting categories.

Conclusions: tDCS appears to be safe and to have some potential in improving sleep quality in clinical populations, especially in treatment regimens that include more stimulation sessions. Further efforts are needed to reduce bias and improve quality of reporting in order to clarify conclusions in the use of this alternative technique for the management of sleep disturbances.

EFFECTS OF SINGING BOWL EXPOSURE ON KAROLINSKA SLEEPINESS SCALE AND PUPILLOGRAPHIC SLEEPINESS TEST

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Introduction: Tibetan singing bowls are thought to originate from Himalayan fire cults and date back to the 5th century BC. The aim of this study was to investigate the effects on objective and subjective sleepiness of a 20-minute stay above a large struck singing bowl compared to a relaxation period above a silent singing bowl.

Materials and methods: Fifty-eight healthy non sleep-deprived subjects were recruited for the study, 48 met inclusion criteria and participated on two days, one week apart, during the same timeslot. The Karolinska sleepiness scale (KSS) was used to evaluate current subjective sleepiness, and the relative pupillary unrest index (rPUI) was used to assess objective sleepiness. The intervention consisted of a 20-minute stay in the supine position in a hammock while the singing bowl, positioned beneath, was struck seven times. The controlled comparator was a 20-minute stay in the same hammock above the same singing bowl, but without the singing bowl being struck. After these two interventions subjective and objective sleepiness were again re-evaluated with the KSS and the rPUI. On the following weekend, participants underwent the same procedure in the other group.

Results: The mean rPUI values after relaxation in the struck and silent singing bowl groups were 0.735 and respectively 0.705 (p=0.444). There was no significant difference between the groups in the rPUI. The mean KSS value after relaxation with the struck singing bowl was 3.708 compared with 4.292 (p=0.031) for the silent singing bowl. There was a significant difference between the KSS values after both interventions.

Conclusions: This study evaluated the influence of a struck singing bowl on sleepiness during the daytime in healthy persons. Subjective sleepiness, evaluated using the KSS, was significantly lower after relaxation above a struck singing bowl compared to relaxation above a silent singing bowl. The difference was also significant in women, whereas men showed no difference. Objective sleepiness, measured by the rPUI, was not different in both groups. These results suggest that a singing bowl, in a struck condition, may be effective in enhancing subjective alertness and used in the context of situations requiring intellectual focus and/or high levels of concentration.

Acknowledgements: The authors thank the healthy volunteers for their participation, and the Grassmayr factory for providing the space and the bowl for this study.

INTEGRATING IRON RESEARCH IN CLINICAL PRACTICE: A SERVICE DESIGN PROJECT FOR INVESTIGATING DISRUPTIVE SLEEP & WAKE-BEHAVIOURS

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Introduction: Children/youth with neuropsychiatric/-developmental disorders often present with disruptive (up-to self-injurious) behaviours, characterized by hypermotor restlessness and hyperactive like behaviours at day-/night-time. Such H-behaviours are associated with iron deficiency, but supplementation has been discussed controversially. Iron supplementation reduces ADHD and RLS-induced insomnia symptoms but also may be harmful due to its pro-oxidative characteristics. This raises the question regarding best practice and to what degree iron is safer or more harmful than pharmacological treatments. To answer these open questions, we are suggesting a personalized N=1 approach, which — via randomization of treatment — makes patients their own controls (NRCT=1). Treatments may be chosen according to individualized environmental (e.g. diet) and biological (e.g. pharmacogenomics) criteria and support the implementation of Personalized Medicine. Currently, we are refining and harmonizing methodologies and preparing the foundation for conducting proof-of-concept trials. In this quality-improvement project, we have developed a communications concept for how quality improvement and research should be implemented in clinical sleep/wake medicine.
Methods: (A) Review and re-imagine existing research consent forms for clinical, genetic and brain-imaging-based phenotyping with three teams of 4-5 students (highschool, university-level science and design students); (B) Identify opportunities for optimizing the service design of the newly established self-injurious behaviours clinic (SIB), including when research should be communicated; (C) Design a set of communication materials, which integrate these new suggestions.
Results: For (A), using a modified Delphi process: (i) the research teams designed a persona and storyboard (ii) refined the consent form for lay-audiences (appropriate for a grade 7 reading level); (iii) developed additional sections that would benefit the participant; (iv) revised the layout & information design; (v) evaluated the consent form design with high school students; (vi) iterated and refined the visual design; (vii) reviewed the revised consent form with the project principal investigator; (viii) prepared the consent form for re-submission to the research ethics board for approval. For (B), we created a patient journey map to identify engagement from referral to being invited to opt in/out of donating their data for research purposes; For (C), we designed: (i) an invitation letter (ii) an information booklet clearly highlighting the needed in-depth-phenotyping data but separating between quality-improvement and research (iii) research consent form which invites patients to participate at the end of the clinical-care process.
Conclusion: Advances of modern medicine make new protocols for standardized quality improvement projects and research initiatives highly necessary. Families of children/youth with NPDD, e.g., severe self-injurious behaviours are one of the most vulnerable populations for coercion in research situations. The suggested communications concept avoids any coercion situation and informs patients using modern communications concepts. Most importantly, all measures were reviewed by potential end-users at multiple stages and developed further - all measures are downloadable at https://sleepnetwork.org/iron-

conundrum/.

PROGESTAGEN-BASED CONTRACEPTIVES AND SUBJECTIVE SLEEP REPORTS IN PREMENOPAUSAL WOMEN

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Introduction: Progesterone have known hypnogenic effects and the use of hormonal replacement therapy in postmenopausal women leads to improvement in sleep quality. Previous reports have suggested that progestogen-only contraceptives might be a more adequate option for premenopausal women complaining of insomnia. However, to date no information regarding the delivery route has been assessed.

Materials and methods: This study sought to evaluate the impact of different types of progestogen-only hormonal contraceptive use on subjective sleep self-reports among premenopausal women through a web-based cross-sectional trial. Sleep assessment tools comprised the Epworth Sleepiness Scale (ESS) and the Insomnia Severity Index (ISI). Statistical comparisons were performed between hormonal contraceptive users and those who reported no current use. Considering that the delivery route of the progestagens might impact their potential effects on sleep, levonorgestrel intrauterine devices users were compared with the users of other progestagen-only contraceptives. Sleep-related comparisons were initially performed in an uncontrolled way (raw analysis), followed by a controlled analysis in which the effects of hormonal contraceptives were corrected by potential confounding factors (age, Body Mass Index and income).

Results: A total of 2,055 premenopausal women between 18 and 40 years-old participated answering an online questionnaire evaluating hormonal contraceptive use, sleep-related characteristics and related features. Among the total sample, 1,286 participants met the inclusion criteria; of which 70 were currently taking progestagens-only contraceptives. Comparisons between users of levonorgestrel intrauterine devices and users of other progestagen-only hormonal contraceptives demonstrated a lower sleepiness score, as measured by ESS, among levonorgestrel intrauterine device users in both raw and corrected analysis (intrauterine device users: 9.12±4.57; other progestagens-only: 11.58±4.59).

Conclusions: Sleepiness was lower among levonorgestrel intrauterine device when compared with user of other types of contraceptives. Progestagen-only hormonal contraceptives are a better contraceptive choice for premenopausal women who complaint of insomnia, since it seems to have smaller impacts on self-reported sleep variables.

Other
Board #072 : Poster session 2
SLEEP AND CIRCADIAN HEALTH IN AUSTRALIANS AGED 5 TO 85 YEARS

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Introduction: Nationally representative data on sleep and circadian health in Australian adults is lacking and this hampers public health promotion and advocacy efforts. Recent national health survey collected data on bed- and wake-times, use of sleep medications, and shift work which may help to characterise sleep and circadian health in the country.
Methods: We analysed data from 11,476 respondents to the Australian Health Survey carried out by the Australian Bureau of Statistics in 2011-2013. Respondents were aged 5 to 85 and were asked about last night's bed-time and wake-time and to indicate whether this was typical of usual sleep for that night of the week. Primary carers responded for children. Respondents aged 15+ years were asked about shift work patterns in the last 4 weeks and the use of sleeping tablets or capsules for mental health.
Results: Of adult respondents, only 1.2% reported using sleep medications, but 60.1% of users reported use for more than 3 days or nights weekly, and 72.2% of users had been using these medications for over 6 months. Of those in the workforce, 16.8% were shift workers. Of shift workers, 53.7% were on rotating shift with periodic changes, 23.0% were on regular evening/night/graveyard shift, 9.0% worked irregular shifts, 6.6% worked regular mornings, 3.0% regular afternoons, 1.6% worked split shifts with the remainder being involved in on-call and other types of shift work. Typical sleep duration was reported by 68.1% of the population with 14.3% indicating that they usually slept more and 10.3% indicating that they usually slept less. No typical sleep was reported by 3.0%. Those with typical sleep reported sleeping 8.3 hours on average, those who usually slept more averaged 7.4 hours, whilst those who typically slept less slept 9.3 hours and those who did not have usual sleep slept 8.2 hours on average. Further analyses will examine the appropriateness of sleep duration by age, sleep patterns across the different shift-working groups, and the health correlates of short/long sleep and shift work.
Conclusions: Understanding the prevalence and distribution of sleep and circadian disruption in the population will help to inform public health interventions.
Acknowledgements: We thank the Australian Bureau of Statistics for data access.

Board #084 : Poster session 1
PREDICTORS AND CORRELATES OF CHANGES IN SLEEP DURATION OVER 3 YEARS: DATA FROM A COMMUNITY-BASED COHORT

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Introduction: Habitually short (≤6h) and long (≥9h) sleep duration are associated with morbidity and mortality. Understanding predictors and correlates of changes in sleep duration may help to prevent transition to the extreme sleep durations acknowledged to increase health risk.
Methods: Participants came from the community-based 45 and Up cohort study in NSW, Australia. Self-reported sleep and sociodemographic and health variables were collected in 2006-2009 and again 3-years later. Predictors and correlates of transition to short/long durations and transition to normal sleep were explored using logistic regression models.
Results: Of N=58,325 participants (53.5% male; mean age 62, SD 10 years), the majority (70.6%) had stable sleep durations at 3-year follow-up. 7.0% transitioned to short sleep, 7.6% transition to long sleep from normal sleep, 5.9% went from short to normal and 7.7% went from long to normal duration. Male gender, older ages, language other than English predicted transitions to both extreme and to normal sleep. Lower levels of education were associated with transition to extreme sleep but not to normal sleep. Transitions to extreme sleep durations were correlated with changes in marital status (losing or gaining a partner), changes in housing, work status, becoming overweight/obese, and quitting smoking. Both increases and decreases in paid work were protective against extreme sleep durations. Transition to normal sleep was only associated with changes in paid work hours and reductions in alcohol consumption.
Conclusions: Variability in sleep duration is consistently linked to demographics known to be at increased risk for poor health, whilst changes in work hours appear to be the primary determinant of changes in sleep time after demographic factors are accounted for. Further analysis accounting for chronic health conditions will examine if this observation results from a healthy worker effect or if the results are consistent with work being beneficial for healthy sleep.

VIGILANCE & WAKE-A-THONS: A NOVEL SLEEP HEALTH COMMUNICATION CONCEPT PROPOSED BY VANCOUVER SUMMER SLEEP SCHOOL STUDENTS

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Introduction: Sleep deprivation results in low vigilance and consequently, the risk for increased athletic injuries [https://activesafe.ca/]. Vigilance is defined as the state of being attentive to one's surroundings; low vigilance negatively affects both physical and cognitive performance. We hypothesize that the concept of vigilance may resonate better with youth and young athletes rather than focusing on the concept of sleep hygiene. In 2017-2018, university and high school students, as part of the Vancouver Summer Sleep School (VSSS), attended lectures, discussed the concept of vigilance, and interviewed experts on common misconceptions about sleep and vigilance. At the end of the VSSS, students were able to: (1) observe behavioral signs of sleepiness of nighttime drivers; (2) take and review "selfies" of their face, and identify vigilance fluctuations. Recognizing the potential of vigilance as a self-reflection concept, students discussed ways to raise awareness about the importance of sleep for sport skill performance and injury prevention. The objective of this study was to determine the most effective, user-driven mechanism to facilitate discussion about vigilance to youth athletes.

Materials and methods: In VSSS 2018, utilizing participatory research methodology, 20 students:
(A) *brainstormed* about possible sleep health communication concepts, which would ensure its future uptake and use by youth;
(B) *applied* a strength-weakness-opportunities-threats (SWOT) analysis for each proposed concept;
(C) *reviewed* traditional sleep hygiene/health messages, including inviting scholars to provide lectures;
(D) *discussed* the necessity for a 'novel sleep health communication concept' utilizing the immediate impact of sleep restriction and loss of vigilance through first-hand experience.

Results: Out of three suggested concepts, lecture series with experts, a sleep fair, and a Wake-a-Thon (a 24-hour-awakening) event, the latter was considered the most promising activity for raising awareness. The SWOT analysis revealed that the inclusion of various skills-related games/activities selected to demonstrate vigilance fluctuations as sleepiness increased over time, would be the most attractive method to emphasize the 'positive effects of an appropriate amount of sleep on skill performance' and to allow reflective learning with possible sustainability. Eight 'vigilance testing' games were suggested: *Pong, Relay Race, Baseball Tag, Stroop Effect Test, Object Tracking Game, Timed Simple Math, Missing Item Game,* and *Memory Patterns*. While all games test coordination, gross and fine motor skills and partly memory, Pong (derived from 'beer-Pong') tests the players' hand-eye coordination and allows reviewing similarities between alcohol intoxication and sleeping deprivation - a comparison, which empowered students to apply out-of-the-box thinking. Students created also the operational manual: https://sleepnetwork.org/vigilance-wakeathon/.

Conclusions: Students identified that a participatory research approach in the form of a

Wake-a-Thon, would best open discussion and advance vigilance, healthy sleep, and injury prevention knowledge. Further, students proposed that a highly collaborative space where they can personally experience vigilance fluctuations would be the most effective way to increase awareness of the importance of sleep on sport skill performance and injury prevention. Finally, students' identification of similarities between alcohol intoxication and sleep deprivation may further increase attractiveness of the Wake-a-Thon concept.

SLEEP COHORTS REVIEW OF EVIDENCE (SCORE): A SCOPING REVIEW AND GAPS ANALYSIS DESIGNED TO INFORM FUTURE RESEARCH

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Introduction: The purpose of this scoping review was to 1) identify and describe existing cohort studies that include sleep or circadian health information and 2) identify gaps in the current evidence base. The objective is to inform the design of future, high-impact sleep cohort studies.

The demand for sleep services exceeds capacity in many areas. While there is an increased understanding of the importance of sleep to overall health and wellbeing, only more recently have sleep and circadian assessments been incorporated into cohort studies. Therefore, many gaps remain in understanding the complex relationships and mechanisms linking sleep and circadian disruption with health outcomes. Furthermore, more research is needed to inform the development of new and improved models of care and interventions.

Methods: We limited our inclusion to prospective cohort studies with 300 or more subjects and excluded studies that collected only a single item on sleep (e.g. sleep duration) at a single time point. We required that either sleep or non-sleep outcomes be collected at multiple time points. Initially we searched Medline for systematic reviews addressing sleep published in the past 10 years. We used these to identify potential cohorts and reviewed articles of any cited, relevant studies. We supplemented our search with web-based clearinghouses, conference presentations, and recommendations from our advisory group. We abstracted key characteristics of each included cohort study (e.g., sample size, frequency of follow-up, participants' demographics, sleep measures used) and assessed studies using five quality criteria. Data about the studies were coded and summarized using descriptive statistics and made accessible using a visual interface.

Results: We identified 195 studies that met our inclusion criteria. Seventy-two studies were conducted in the U.S. Seventy-five percent of cohorts were in adults and half (70 studies) focused on middle aged to elderly, rather than people younger than 40 (15 studies). We identified 45 studies in children, equally distributed between infant, children, and teenagers. One hundred-seventy studies included multiple sleep items, of which 108 collected data at multiple time points while 62 studies collected sleep data at one time point. We focused our analyses on these more comprehensive studies. We also identified 25 longitudinal studies with only one sleep item. The majority of studies were not initially designed to study sleep; rather sleep items were added to a cohort constructed for a different purpose.

Conclusions: More cohorts were identified than anticipated. However, there remain important gaps in the evidence base. Many studies measured sleep at only one point in time, or used a single unvalidated question, making it difficult to assess the impact of changes in sleep over time or the impact of sleep on other aspects of health such as cardiovascular disease. The populations studied were frequently limited, often by the constraints inherent in the parent cohort study that was designed for another purpose. This review identifies gaps in sleep research to serve as a roadmap for high priority areas for future research.

SLEEP CONSEQUENCES AND DEPRESSIVE AND ANXIETY SYMPTOMS IN A POPULATION OF COLLEGIANS WHO HAVE LIVED AN UNWANTED SEXUAL EXPERIENCE - EXPLORATORY STUDY

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Introduction: People who suffer from sexual assault may experience important consequences such as sleep difficulty (insomnia and nightmares) as well as anxiety and depressive symptoms. Sexual assault is often defined as any sexual act to which the individual has not consented. However, in some studies (Artime & Peterson, 2015; Peterson & Muehlenhard, 2007), authors define sexual experience within two dimensions: 1) wanted or unwanted and 2) consent given or not. This study aims to explore consequences of sexual assault as defined with these two concepts.

Materials and methods: 56 Cegep students in Quebec completed questionnaires, which contain questions about demographics, clinical information, sleep (nightmares, insomnia (ISI), safety of the bedroom), depression symptoms (CES-D) and anxiety symptoms (BAI). 48% of this sample experienced an unwanted sexual experience (USE). The sample was subdivided between 4 assault patterns: 1) did not experience USE (n=29); 2) unwanted sexual experience with given consent (USE-C; n=8); 3) without consent (USE-NC; n=11) and 4) experienced both types of assault (n=8). Mean age of the complete sample was 19.5 years old (SD 2.5), including 80,6% females (n=45), 17,9% males (n=10) and 1 identified as other. Gender proportions within the 4 groups did not differ ($\chi 2=1.298$, p=.926) and there was no difference in age (F(3,52)=1.216, p=313). We used a significance level of p < 0.05 and the SPSS Software (v25) for statistical analysis.

Results: We first compared two groups : 1) all individual who experienced USE (with given consent or not) with 2) individuals who did not experience USE. Results showed that those with USE experienced more nightmare-related distress ((F(1,54)=6.224, p=.016, d=.667) and anxious symptoms (F(1,54)=4.093, p=.048, d=.541). Moderate differences, however not statistically significant, were found for depression F(1,54)=3.781, p=.057, d=.520) and insomnia F(1,54)=2.437, p=.124, d=.416). Comparing groups according to whether they gave consent or not with the same variables yielded no statistically significant differences (all p>.05). However, due to small sample size, effect sizes were explored. Moderate differences were found on insomnia (d=.363), nightmare-related distress (d=.469) and safety of the bedroom for USE-C and USE-NC groups.

Conclusions: According to our results, students who experienced USE, with or without consent, report having adverse consequences such as nightmare-related distress and anxious symptoms. USE-NC group presented more severe insomnia symptoms, more nightmare-related distress and reported feeling less safe in the bedroom. Even though this study is exploratory, these results show the importance of considering all types of unwanted sexual experience whether consent is given or not for future research.

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SLEEP AND WEIGHT STATUS IN ADOLESCENTS

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Introduction: Sleep is associated with weight status in adolescents, although few studies have studied this association while controlling for physical activity (PA), sedentary behavior (SB) and diet. Gender differences in these behaviors have been established, as have differences in the strength of the associations these behaviors have with weight status. This study uses data from the 2017 Youth Risk Behavior Surveillance Survey (YRBSS) to explore the individual and combined associations of sleep, PA, SB and diet with weight status in adolescents.

Materials and methods: Self-reported height and weight were used to calculate body mass index (BMI), which was converted into Centers for Disease Control and Prevention BMI growth chart percentiles. Overweight was defined as a BMI $\geq$ 85th percentile. Students were classified as meeting recommendations for sleep, PA, SB and diet using the following criteria: sleeping $\geq$8 hours per night; being physically active for 60 minutes/day on 7 days/week; spending < 3 hours/day engaged in SB; eating breakfast 7 days/week (BF); eating $\geq$5 servings of fruits and vegetables/day (FV); drinking < 1 can of soda/day (SODA); drinking $\geq$1 glasses of milk/day (MILK). Univariate and multivariate logistic regression analyses were used to determine whether self-reported sleep, PA, SB and diet were associated with weight status. Univariate and multivariate models controlled for sex, race/ethnicity and school grade. Sex-specific multivariate logistic regression models controlling for race/ethnicity and grade were also analyzed.

Results: All predictors in the univariate models, with the exception of FV, were significantly associated with a decreased odds of overweight. In the multivariate model, students who met SB (OR=0.86, 95% CI: 0.76, 0.98), PA (OR=0.74 95% CI: 0.65, 0.83) and BF (OR=0.69 95% CI: 0.60, 0.79) guidelines had a significantly lower odds of being overweight. Females who met PA (OR=0.72 95% CI: 0.56, 0.93), BF (OR= 0.72 95% CI: 0.59, 0.89), and sleep (OR=0.76 95% CI: 0.60, 0.95) guidelines had a significantly lower odds of being overweight, while males who met SB (OR=0.82 95% CI: 0.67, 0.99), PA (OR=0.74 95% CI: 0.64, 0.86) and BF (OR=0.65 95% CI: 0.54, 0.79) guidelines had a significantly lower odds of being overweight.

Conclusions: Meeting PA, SB and BF guidelines was significantly associated with a reduced odds of being overweight. Meeting sleep guidelines was only associated with a reduced odds of overweight status in adolescent females. This study supports the development of targeted, gender-specific intervention and prevention programs for adolescents at risk of becoming overweight or obese.

OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH HIGHER LEFT VENTRICLE HYPERTROPHY FREQUENCY IN PATIENTS WITH RESISTANT HYPERTENSION

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Introduction: Obstructive Sleep Apnea (OSA) is common in patients with hypertension, especially in those with Resistant Hypertension (RH). However, it is unclear whether OSA can contribute to target-organ damage (TOD) in patients with non-resistant hypertension (NRH) and in patients with RH.
Objective: To compare the presence of left ventricular hypertrophy (LVH), one of the major TOD, in patients with NRH and RH according to the presence of OSA.
Materials and methods: We recruited consecutive cases of adult patients with NRH and RH (as defined by standardized criteria) from our Hypertension outpatient unit. To avoid potential confounders, we excluded patients with diabetes, smokers or significant chronic kidney disease (estimated glomerular filtration rate < 45 mL/min). All patients underwent sleep monitoring with portable sleep monitor (Embletta Gold®) for the diagnosis of OSA. We defined OSA by an apnea-hypopnea index (AHI) ≥15 events / hour. The patients also performed other procedures including office blood pressure (BP), ambulatory BP monitoring (ABPM) and transthoracic echocardiography. After performing the proposed procedures, the patients were divided into four groups: patients with NRH without OSA (NRH-OSA); patients with NRH with OSA (NRH+OSA); patients with RH without OSA (RH-OSA) and patients with RH with OSA (RH+OSA). All analyses were performed without previous access to OSA and RH status. We compared the BP and echocardiograph data using analysis of variance (ANOVA).
Results: We initially screened 248 patients. So far, 50 subjects (mean age: 54±8 years old, 60% female, body mass index: 29.8±4.0 kg/m²) were included in the analysis. As expected, patients with RH took more anti-hypertensive medications than NRH but no significant differences were observed in patients with and without OSA. In patients with RH (n=22), the presence of OSA (55%) was associated with a strong tendency towards a higher frequency of LVH (RH+OSA: 92% vs. RH-OSA: 50%, p=0.05). This finding was not observed in patients with NRH (NRH+OSA: 31% vs. NRH-OSA: 33%, p=1.00). Data from office BP measurements and ABPM did not show significant differences in patients with and without OSA regardless of RH status.
Conclusions: Our preliminary data suggest that the presence of OSA may contribute to higher cardiac remodeling in patients with RH.

PRELIMINARY FINDINGS ON A PROSPECTIVE ASSESSMENT OF SLEEP AND EPIGENETIC AGING

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Introduction: DNA methylation is affected by the environment and provides an index of biological (epigenetic) age. Factors associated with poor health (e.g., smoking, inactivity) accelerate epigenetic aging. We hypothesize that shorter and more irregular sleep impact epigenetic age in young adults who tracked sleep across a 9-week interval.

Materials and methods: Twelve women (chronological ages 18.2 to 19.8 y) were selected as shorter or longer sleepers (extreme quintiles) from 503 first-semester students with daily sleep diary across the first 9 weeks at university. Sleep duration (TST) was defined from reported bedtime and rise time of the major daily sleep episode, with sleep latency and wake after sleep onset excluded. A Sleep Regularity Index (SRI) was also computed. Participants gave blood samples at study start and end. DNA methylation ages were determined at each time from Infinium HumanMethylation450 (Illumina, San Diego) arrays corrected for cell type; epigenetic ages were computed using Horvath's method. Chronological ages were subtracted from epigenetic ages at each time to compute age-difference.

Results: Epigenetic ages at Time1 ranged from 15.8 to 26.3 y (mean=20.8[SD=3.3]); epigenetic ages computed from Time2 ranged from 16 to 25.9 y (20.1[3.2]). Mean age-difference at Time1 was 2.1[3.3] y and 1.2[3.4] at Time2. Participants were grouped as shorter or longer TST by design (median TST=7.19h) and with median splits for SRI (median SRI=76.44), resulting in three groups: Good Sleep (TST and SRI above median; TST=8.0[0.1]; SRI=80.6 [SD=3.1]), Mixed Sleep (either TST or SRI above median; TST=6.9[1.6]; SRI=74.8[9.6]), and Poor Sleep (TST and SRI below median; TST=6.1[0.4]; SRI=65.8[9.9]).
Epigenetic aging patterns were consistent with our hypotheses: participants in the Good Sleep group decreased age-difference across time; Mixed Sleep group participants showed inconsistent patterns; Poor Sleep group participants showed an increased age-difference. One-way ANOVA showed statistically significant differences in group patterns ($F(2,9)=5.58$, $p=.03$); Group Marginal Mean Estimate[95%CI]: Good Sleep=-4.06[-7.24;-0.88]; Mixed Sleep=-1.10[-4.28;2.08]; Poor Sleep=2.57[-0.61;5.75]).

Conclusions: By using a prospective design, our pilot data provide unique, albeit limited, evidence connecting sleep patterns over a relatively short timeframe to molecular aging indices. Poorer sleep was associated with epigenetic aging acceleration in all Poor Sleep participants; better sleep, was associated with decelerated epigenetic aging in three of four Good Sleep participants. More work is needed to confirm findings in a larger sample, determine mechanism, and assess epigenetic aging in sleep patients. Although the sample size is limited, this pilot study has a number of strengths including a prospective design and use of daily sleep diaries across 9-weeks. To our knowledge, there are no other prospective data in which to examine the association between sleep and epigenetic aging. These pilot data add to literature highlighting adverse health effects of short, disrupted, or disordered sleep by indicating that short and irregular sleep in a young healthy sample, appears to be related to accelerated epigenetic aging.

SLEEP PATTERNS AND SLEEP DISTURBANCES THROUGHOUT PREGNANCY: AN ACTIGRAPHY STUDY

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Introduction: Majority of pregnant women reported disturbed sleep during pregnancy compared to any other time.Prior sleep research of pregnancy has been limited by varying data collection methods which create barriers for comparison across studies, small and often non-representative samples, cross-sectional designs, or are descriptive and non-hypothesis driven.[1] Therefore, we conducted a longitudinal cohort study with the collection of repeated assessments of sleep duration with actigraphy throughout pregnancy and examined the sleep pattern changes over time during pregnancy.

Materials and methods: This investigation is a longitudinal prospective cohort study. Nulliparous Women who were aged 14 to 40 years old at 6 to 14 weeks of gestation were recruited from the obstetric (OB) clinic at the Barnes Jewish Hospital in St. Louis. Repeated measures of sleep duration during pregnancy were obtained . Socio-demographic information and prior medical and obstetrical history were collected through survey questionnaires and medical record abstraction.Once enrolled, study subjects were followed up throughout pregnancy until four weeks postpartum. Assessments of sleep duration with actigraphy were made as follows: 1) 6 to 14 weeks; 2) 15 to 18 weeks; 3)19 to 23 weeks; 4) 24 to 29 weeks; 5) 30 to 36 weeks. We have recruited 339 pregnant women with 574 patient visit records and 3365 daily actigraphy data.For the outcomes, we focus on the measurements of total sleep time, sleep efficiency, wake after sleep onset (WASO), and sleep onset latency.We use mixed-effects models to investigate how the sleep duration and quality change over time during the pregnancy and how the covariates affect the sleep. We adjusted for mother's race, age, overweight/obese, hypertension history, the number of children, employment status, and education level in the final linear mixed-effects model

Results: The average age of the study sample is about 27 years old and majority has at least one additional child prior to the index pregnancy. The mean prepregnancy BMI was 28.5 with majority of the study participants being overweight, or obese (i.e., 23% and 34%, respectively). Most of the study participants were of African American race and only 39% reported being married. Most study subjects reported having less than $35,000 annual household income.. On average, the total sleep time during the third visit is 18 minutes shorter than that during the first visit (with 95%CI [-32.1,-3]) and the sleep efficiency decreased by 1% (with 95% CI [-2.07, -0.21]). Black women had worse sleep during pregnancy than white women in general with 24 minutes shorter sleep time per day (with 95% CI [-45.1,-2]), 3% less sleep efficiency (with 95% CI [-5.09,-1.84]), and 7 minutes more WASO (with 95% CI [1.3,12.34]). Comparing with the participants without hypertension, the ones with hypertension sleep less by about 38 minutes per day and with 2% less sleep efficiency.

Conclusions: We observed decreased total sleep time and sleep efficiency in late gestation during pregnancy. Our study also found racial disparity in sleep patterns and disturbances during pregnancy.

Other
Board #110 : Poster session 3
PROGNOSTIC ROLE OF DISE, POLYSOMNOGRAPHY AND CEPHALOMETRIC PARAMETERS IN IDENTIFICATION OF SURGICAL PREDICTORS ON MULTILEVEL SLEEP SURGERY OF OSA PATIENTS

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Introduction: Drug-induced sleep endoscopy is a practical technique to evaluate dynamic upper airway collapse during sleep and gives invaluable information on treatment option selection. Various studies have assessed its implication, but not many have identified predictive factor of surgical outcome. The purpose of our study was to investigate drug induced sleep endoscopy (DISE), polysomnography and cephalometric measurements as a predictor for the outcome of multilevel surgery for obstructive sleep apnea (OSA).
Materials and methods: Retrospective analysis of subjects who were selected from our sleep surgery database of our clinic, Samsung Medical Center, South Korea from Sep 2009 to Feb 2018. Surgery was performed based on preoperative physical examination and DISE findings. Data including demographic data, pre- and postoperative polysomnography, cephalometric parameters, and DISE findings were collected. Patients of moderate obstructive sleep apnea (AHI>=15) were included in this analysis and were divided into 2 groups according to postoperative polysomnography result; the success group (50% decrease in AHI and less than 20 of postoperative AHI) and the failure group. To characterize predictive factors related to successful surgical outcome, logistic regression analysis was conducted.
Results: Total 53 patients were enrolled in the present study. The number of success group was 21 (36.84%) and the failure group was 36 (63.16%). Success group had significantly higher tonsil grade on preoperative physical examination, light and deep sedation phase of DISE (p=0.004, 0.012, 0.0076, respectively), oropharynx grade on light sedation of DISE (p=0.04), velopharynx grade on deep sedation (p=0.01). Also, one of polysomnographic parameter we focused on, percentage of time with oxygen saturation less than 90% (CT90) higher than cut off value of 0.4 revealed statistical significance (p=0.001). Comprehensive grading of DISE (GDISE) which we propose in this study (more than 1 site of grade 2 at light sedation phase or more than 2 sites including deep sedation phase, p=0.01) was also significant. In multivariate analysis, predictive factor for the successful surgical outcome were CT90 (B=61.57, p=0.0001), tonsil grade (B=36.424, p=0.0003).The estimated area under the receiver operative characteristic curve of logistic regression analysis was 0.89 and the cut-off value of CT90(%) were 0.4%.
Conclusions: The aim of the present study is to evaluate and analyze factors related to surgical outcome. DISE, preoperative polysomnography parameters measures could be a useful predictor of the therapeutic response to multilevel sleep surgery. This study might contribute to the selection of surgical candidacy for OSAS to improve overall outcome of sleep surgery.

INTERVENTIONS TO ENHANCE SLEEP IN MILD COGNITIVE IMPAIRMENT AND MILD ALZHEIMER'S DEMENTIA: A SYSTEMATIC REVIEW

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Introduction: Over 50 million people live with dementia globally at an estimated cost of US $3 trillion. Suboptimal sleep is a contributory factor to progression of Alzheimer's disease (AD). This opens the possibility of targeting sleep to delay dementia onset or slow decline. Even a small benefit from improved sleep could have large individual and societal impact. Here we review interventions designed to enhance sleep in people with Mild Cognitive Impairment (MCI) or with mild AD dementia. A priori, we expected that interventions would include psychological, pharmacological, technological and lifestyle approaches. These should be employed to counteract insomnia, sleep fragmentation or circadian rhythm disorders including therapies for sleep related breathing disorders or other secondary causes of sleep disturbance. Our aim is to construct a list of tested interventions and to highlight gaps in the literature.

Materials and methods: We followed recommendations by Preferred Reporting Items for Systematic Review and Meta-analyses Statement (PRISMA) and registered in Prospero database (CRD42019126329)

The literature search used key words and MeSH index terms on seven databases: MEDLINE, EMBASE, CINAHL, BNI, PsycINFO, The Cochrane Library and trial registry WHO ICTRP.

Inclusion criteria: Participants aged >18y, ≥80% to meet established diagnostic criteria for MCI/AD, any intervention to improve sleep quality including pharmacological or non-pharmacological, with a comparison against at least one other intervention/non-exposure/placebo, must use a validated sleep outcome measure

Exclusion: Majority of study group with moderate to severe AD (Mini Mental Scale Examination (MMSE) < 20, Clinical Dementia Rating (CDR) ≥2 or any equivalent measure, case reports, only abstracts available and grey literature.

Results: Our search returned 2,552 references once duplicates were removed. Following title and abstract screening 149 full papers were reviewed. All full texts references were hand searched for suitability of additional papers. Upon full paper review with at least two authors, 7 papers were retained for inclusion in the review. At each stage a minimum of 10% were reviewed by a third author and authors met to resolve discrepancies through discussion.

Seven papers underwent quality appraisal using methodology appropriate tools from the Joanna Briggs Institute. Studies included a total sample of 520 individuals, mean age range between 61.9 and 81.5y, 52.3% female with mean MMSE across studies being 20.56 and CDR 1.35.

Five interventions were represented across the retained papers; Donepezil, Galantamine, Rivastigmine, Tetrahydroaminoacridine and Continuous Positive Airway Pressure (CPAP). Outcome measures across these studies were Actigraphy, Pittsburgh Sleep Quality Index, Polysomnography, Epworth Sleepiness Scale, Functional Outcomes of Sleep Questionnaire, Electroencephalogram spectral analysis.

Conclusions: Full analysis of the paper will be reported at World Sleep 2019.

There is currently a lack of high quality studies targeting interventions for sleep disturbances in people at risk of, or with early evidence of AD. Our overall conclusion is that few well-designed studies have capitalised on the range of psychological, pharmacological, technological and lifestyle approaches that might benefit this patient population.

THE GENDER-SPECIFIC ROLE OF PROLONGED SLEEP DEFICITS ON ADOLESCENT HEALTH: TWO LONGITUDINAL STUDIES OF YOUTH DEPRESSION AND HEALTH IN WESTERN CANADA

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Introduction: Chronic exposure to insufficient sleep may increase depression and poor health in adolescents who are particularly vulnerable to changes in both sleep and neuro-cognitive development. The cumulative effects of persistent sleep deprivation on adolescent physical and mental health, and potential gender differences, are unknown. We investigated whether cumulative sleep deprivation is linked to sub-optimal health or depression in youth (13-18 y).

Materials and methods: Longitudinal self-reported data (2011-2012) included three measures of sleep times and two measures of self-rated health (SRH) and depression (CESD). Missing data were multiply imputed using variables related to primary and secondary analyses for SRH (n=3104) and CESD (n=3071). Multivariable regression models with interaction terms estimated gender-specific associations for the full sample; post-estimation calculated adjusted mean depression scores across levels of cumulative sleep deprivation.

Results: We found 11% of youth (56% females) in BC were chronically sleep deprived. Cumulative exposure to sleep deprivation was not associated with SRH in adolescents (all P-values ≥ 0.097), but was associated with increased risk of depression in young women only. Young women reporting chronic sleep deprivation had higher mean CESD scores (19.48 [17.59-21.38]), compared to counterparts reporting no history of sleep deprivation (16.59 [15.72-17.45]). No associations were seen in young men. Findings were robust to changes in model re-specification.

Conclusions: Results indicated that chronic sleep deprivation may be an important determinant of mental health outcomes in adolescents, particularly young women, although there was little support for effects on overall health status. Chronically impaired quality of sleep should be considered in future longitudinal work. Public health efforts to promote mental health for young people may require relevant strategies to support young women in achieving recommended amounts of sleep.

SURVEY OF SLEEP PATTERNS WITHIN AN ACADEMIC CLINICAL DEPARTMENT

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Introduction: Prevalence of burnout has rapidly increased, with nearly 50% of physicians reporting it. Consequences of physician burnout include compromised physician's health, patient outcomes, and medical errors. The cost of physician turnover was estimated to be 2 to 3 times the physician's annual salary. Sleep serves a critical role in our health and well-being. Sleep deprivation and burnout is widespread in health care workers. Common consequences of sleep deprivation are similar to burnout, as mood changes, irritability, difficulty concentrating, sleepiness, etc. Disturbed sleep has been hypothesized as a mechanism that contributes to burnout, and the chronic depletion of energy stores. This survey sought to provide insight into sleep patterns of the members of a clinical department at an Academic Medical Center.

Materials and methods: An anonymous survey was sent through RedCap to all non-administrative personnel within the Department of Anesthesiology and Pain Medicine.

Results: Of 543 email addresses listed in the directory, a total of 155 subjects answered the survey. Responders were: female 41.9%, Male 57.4%, Non-binary 0.6%; almost half (49.6%) ages 20 to 40, 14.2% over the age of 60.

Participants reported sleeping a daily average over the last month of 6.7 hours mean, (min 4.5, max 9), 7 median. They estimated they needed a median of 8 hours to function well the next day. They felt sleep deprived almost always 9.7%, frequently 33.5%, or occasionally 43.2% of the time. Insomnia was reported by 22.6% of responders.

Common symptoms after a night of very little sleep included: difficulty concentrating 75.7%, lack of motivation 71.7%, increased likelihood of dozing during the day 46.7%, absent-mindedness / forgetfulness 65.8%, irritability 67.8%, mood swings 33.6%, headaches 32.9%.

A 63.9% of sample reported taking call, with a mean of 3.61 night calls per month. Level of training included: resident 21.9%, fellow 8.4%, attending 46.5%, emeritus 2.6%, Health Professional Practitioner (NP, CRNA) 17.4%, other 3.2%.

When asked if they feel burnout, 52.9% responded yes. They felt that their work performance was hindered due to insufficient sleep rarely (not every week) 52.9%, sometimes (1-2/week) 32.9%, often (more than 2 times a week) 7.7%. A 17% reported a complication and/or negative patient outcome that they believe might have been related to sleep deprivation.

Conclusions: Burnout was common across different types of providers and levels of training. Sleep deprivation, with daily insufficient sleep, and negative consequences were also very common. Sleep disturbances, which are subject to remediation, could play a role in burnout. Early detection and involvement at an individual and system level to improve both sleep deprivation and burnout are needed in healthcare professionals.

Acknowledgements: Members of the Department of Anesthesiology and Pain Medicine at the University of Washington

Other
Board #364 : Poster session 2

LATE PREGNANCY SLEEP DISRUPTION - PATHOLOGICAL OR PHYSIOLOGICAL?

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Introduction: Maternal supine going-to-sleep position is associated with increased risk of late-stillbirth ($\geq$28 weeks'). In non-pregnant populations sleep-disordered breathing (SDB) is associated with supine sleep position, sleep quality and duration, nocturnal restlessness, and Epworth Sleepiness Scale (ESS). We aimed to investigate the relationship between these sleep factors and late-stillbirth.

Materials and methods: This was a secondary analysis of an individual participant data meta-analysis that investigated maternal going-to-sleep position and late-stillbirth, with one-stage approach stratified by study and site. Inclusion criteria: singleton, non-anomalous pregnancy, $\geq$28 weeks' gestation. Self-reported sleep factors included indicators of SDB (snoring $\geq$3 nights per week and Berlin Questionnaire), sleep quality and duration, restlessness, and ESS. Multivariable analysis adjusted for major stillbirth risk factors including supine going-to-sleep position and sleep factors significant in univariable analysis.

Results: We obtained data from five case-control studies (cases 851, controls 2257), although some studies did not have data for all sleep factors. Snoring $\geq$3 nights per week (cases, n=544; controls, n=1605) and Berlin Questionnaire (cases, n=587; controls, n=1698) were associated with increased odds of late-stillbirth in univariable (snoring $\geq$3 nights odds ratio [OR] 1.45, 1.15-1.84; Berlin Questionnaire 1.54, 1.25-1.90), but not multivariable analysis. Sleep duration >9 hours (cases, n=587; controls, n=1684) and sleep that was more restless than average (cases, n=587; controls, n=1698) were associated with late-stillbirth in univariable (>9 hours OR 1.72, 1.28-2.32; restlessness OR 0.74 (0.56-0.97) and multivariable (>9 hours adjusted odds ratio [aOR] 1.60, 1.08-2.35; restlessness aOR 0.64, 0.45-0.91) analysis.

Conclusions: These findings suggest that indicators of self-reported SDB are not associated with late-stillbirth after adjustment for other stillbirth risk factors. However, long sleep duration >9 hours during the last month appears to increase the risk of late-stillbirth and sleep that is more restless than average provides some protection. These findings suggest that commonly reported late pregnancy restlessness during sleep may be reassuring for fetal wellbeing.

Acknowledgements: We would like to thank our funders and everyone involved in this study, especially the women who so generously participated in the individual studies, some women only days/weeks after losing their baby to stillbirth.

REAL TIME ADAPTIVE PULSE RATE ESTIMATION USING PHOTOPLETHYSMOGRAPHY SIGNAL DURING SLEEP

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Introduction: Photoplethysmography (PPG) signal measurement is a convenient non-invasive way to measure pulse rate and peripheral capillary oxygen saturation (SpO_2), parameters of clinical importance during sleep assessment. Although it might appear simple to quantify pulse rate by counting the number of heartbeats per 60s, pulse detection is a challenging task due to noise in the data and motion artefacts [1]. The aim of this work is to develop an algorithm that is not computationally expensive without compromising on the accuracy of pulse rate estimation. We propose a dynamic prominence number for peak detection algorithm and artefact detection algorithm for every output, calculated over a 60s window and with a step size of 5s. This does not only reduce root mean square (RMS) error, but also provides a mechanism for real-time artefact identification without use of any additional devices such as accelerometer.

Materials and methods: We have collected 103 nights of polysomnography data in EDF format for each study night from the clinic Swiss Epilepsy Center, Zurich, Switzerland. The anonymized patients' data was used after the approval from Cantonal Swiss Ethics Commission, Zurich (Swissethics BASEC Nr. 2018-01982). The channel 'Pulse Rate' was taken as reference which is derived from probe SpO2 finger sensor while the 'PPG' channel was considered for the estimation of pulse rate. The pulse rate channel has a sampling frequency of 4Hz while the 'PPG' channel has a sampling frequency of 128Hz. After evaluating 103 nights of the data, 5 nights of data were excluded due to poor recording quality. Pulse rate was calculated for every 5s, based upon the peaks observed in the last 60s of data. The prominence number during peak detection for this segment of data was taken as user defined value in percentage of range of PPG values with minimum distance of 0.4s between consecutive peaks. For the comparison, the reference pulse rate was down-sampled to 0.2Hz using median filter.

Results: After evaluating 98 nights of the data, the mean rms error of all nights was observed to be 3.5 ± 3.02bpm on pulse rate estimation. A total of 41 nights had rms error less than equal to 2 bpm and only 3 nights had rms error more than 10 bpm. The prominence number was more than 135 units of PPG for 43.25% of instances, however there were around 18.43% instances with the adopted prominence number less than 80 units of PPG. With fixed prominence value of 150 units of PPG, the mean rms error was 9.5 ± 12.43 bpm.

Conclusions: The proposed algorithm adapts prominence number for peak detection and computes the pulse rate in real-time efficiently without compromising on the accuracy.

References:

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QUANTITATIVE ANALYSES OF REM SLEEP WITHOUT ATONIA IN PATIENTS WITH LGI1 AND CASPR2 AUTOIMMUNITY

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Introduction: Voltage-gated potassium channel complex (VGKC) IgG autoimmunity has frequent sleep manifestations, especially rapid eye movement (REM) sleep behavior disorder (RBD). The discovery of leucine-rich glioma inactivated-protein-1 (LGI1) IgG and contactin-associated protein 2 (CASPR2) IgG has refined our understanding of VGKC-IgG related syndromes. VGKC-IgG seropositivity alone (negative for LGI1/CASPR2-IgG, aka "double-negative") is now considered a non-specific biomarker of autoimmunity. Previous systematic studies describing quantitative analysis of REM muscle without atonia (RSWA) in these populations have been limited.

Materials and methods: We included consecutive patients positive for VGKC, LGI1, and/or CASPR2 antibodies from the Mayo Neuroimmunology Laboratory between January 1, 2008 and December 31, 2018 who had a polysomnogram (PSG) completed at the Mayo Center for Sleep Medicine. Charts were retrospectively reviewed for demographic and clinical data. We comparatively analyzed manual and automated RSWA between age-sex matched controls, VGKC-IgG double-negatives, and LGI1/CASPR2-IgG seropositives. Percentages of phasic, tonic, and "any" muscle activities were compared in the submentalis (SM) and anterior tibialis (AT) muscles between groups. Statistical analysis involving group comparisons and regression were performed. RSWA levels were also compared to corresponding age-specific RSWA normative percentiles.

Results: Patients included LGI1/CASPR2-IgG positives (n=11, 2 CASPR2-IgG), VGKC-IgG double-negatives (n=12), and controls (n=23). The median age at neurological symptom onset for LGI1/CASPR2-IgG patients was 64 years (range 9-81 years). The majority of LGI1/CASPR2-IgG patients were males (91%). The most common reported presenting sleep symptom in LGI1/CASPR2-IgG seropositive patients was insomnia (n=6, 55%). Based on clinical symptoms and qualitative PSG data, 4 LGI1/CASPR2-IgG patients had RBD (36%). LGI1/CASPR2-IgG patients had higher RSWA densities and normative RSWA percentiles in most phasic and tonic density metrics compared to controls, including all TA metrics and in SM tonic densities (all $p < 0.05$). VGKC-IgG double-negative patients had higher SM phasic, SM any, SM/AT phasic and SM/AT any compared to controls (all $p < 0,05$), but did not have higher normative RSWA percentiles than controls. Only VGKC-IgG double-negative patients receiving antidepressants had significantly higher SM any densities than controls ($p = 0.04$), while those who did not receive antidepressants had comparable RSWA levels to controls. Patients with LGI1/CASPR2-IgG positivity had higher RSWA levels compared to controls and VGKC-IgG double-negative patients, when accounting for age and antidepressant use.

Conclusions: LGI1/CASPR2-IgG positivity was associated with elevated RSWA levels compared to controls which was a distinguishing feature. These findings may help refine the clinical phenotype of patients with VGKC-related autoimmunity. This study adds to the understanding of the sleep disturbance spectrum and topographic central nervous system involvement in LGI1/CASPR2-IgG autoimmunity.

VALIDITY OF TWO RETROSPECTIVE QUESTIONNAIRE VERSIONS OF THE CONSENSUS SLEEP DIARY: THE WHOLE WEEK AND SPLIT WEEK SELF-ASSESSMENT OF SLEEP SURVEYS

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Introduction: Prospective, daily sleep diaries are the gold standard for assessing subjective sleep but are not always feasible for cross-sectional or epidemiological studies. The current study examined psychometric properties of two retrospective questionnaire versions of the Consensus Sleep Diary.

Materials and methods: College students (N = 131, mean age = 19.39 ± 1.65; 73% female) completed seven days of prospective sleep diaries then were randomly assigned to complete either the Self-Assessment of Sleep Survey (SASS), which assessed past week sleep (n = 70), or the SASS-Split (SASS-Y), which assessed weekday/weekend sleep separately (n = 61). Participants also completed psychosocial/sleep questionnaires including the Pittsburgh Sleep Quality Index (PSQI). Sleep parameters derived from SASS, SASS-Y, PSQI, and sleep diaries were compared via Bland Altman plots, limits of agreement, mean differences, and correlations.

Results: SASS-Y demonstrated stronger correlations with prospective sleep diaries and slightly less biased estimates (r = .51 to .85, α = -0.43 to 1.70) compared to SASS (r = .29 to .84, α = -1.63 to 2.33) for TWAK, SOL, SE, and QUAL. SASS resulted in slightly less bias for TST and WASO (α = -0.65 and 0.93, respectively) compared to SASS-Y (α = 14.90 and 1.05, respectively). SASS and SASS-Y both demonstrated greater convergence with sleep diary than PSQI.

Conclusions: Results demonstrate good psychometric properties for the SASS and SASS-Y. When prospective sleep diaries are not feasible, the SASS and SASS-Y are acceptable substitutes to retrospectively estimate sleep parameters of interest to both clinicians and researchers. Retrospective estimation of sleep parameters separately for weekdays/weekends may offer advantages compared to whole week estimation.

SLEEP HEALTH LITERACY ACROSS COUNTRIES: A STUDY OF PARENTS´ ABILITY TO RECOGNISE CHILDREN'S SLEEP PROBLEMS AND HELP-SEEKING ATTITUDES TO PROMOTE CHILDREN'S SLEEP

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Introduction: Childhood sleep problems should be addressed earlier as it often persists across years. Hence, it is important for parents to recognize their children's sleep problems and receive appropriate help from professionals. The current study developed a sleep health literacy by adopting an approach of Mental Health Literacy. The aim of this study was to assess parents´ ability to recognise children's sleep problems by using vignettes of children experiencing various sleep problems and investigate their help-seeking attitudes.

Materials and methods: The current study recruited 63 parents from the UK and South Korea (34 British parents and 29 Korean parents). The Sleep Health Literacy questionnaire was developed based on literature reviews on Mental Health Literacy. The vignettes were developed from literature reviews on children's sleep problems and four sleep problems were chosen to create vignettes of young children. Sleep professionals confirmed the contents of vignettes. The questionnaire consists of open-ended questions to examine parents' recognition of sleep problems and 7-point rating questions to assess their help-seeking attitudes towards various resources such as professionals, family members, school staffs and online resources.

Results: Among vignettes of four sleep problems, the highest percentage of British and Korean parents recognised the presence of sleep problem from a sleep apnea vignette and a narcolepsy vignette: 100% British parents and 88% Korean parents for the sleep apnea vignette (correctly labelled as snoring or breathing problem by 59% British parents and 36% Korean parents) and 67% British parents and 92% Korean parents for the narcolepsy vignette (correctly labelled as narcolepsy by 11% British parents and 8% by Korean parents).

When parents rated various people as likely to be helpful for the sleep apnea and narcolepsy vignettes, general practitioners were most often rated as helpful by both British and Korean parents, followed by parents and other family members. For a circadian rhythm disorder vignette, help from parents were rated as the most helpful by both British and Korean parents, followed by other family members and GP. Among various help-seeking options, parents consistently rated friends and teachers as the least helpful. A significantly higher percentage of British parents (26%) have received a sleep-related training than Korean parents (7%).

Conclusions: Parents were able to recognise the presence of sleep problems in vignettes of various sleep problems. However, they valued parental help greater than professional help for some sleep problems. To seek appropriate help after recognising sleep problems, help-seeking attitudes of parents need to be improved. The present study also highlighted the importance of a cross-cultural approach to reflect each country's healthcare system in a parent's perception about helpful resources for children´s sleep problems.

Board #112 : Poster session 3

SLEEP LABORATORY ADVERSE EVENTS OVER A 5 YEAR PERIOD IN A QUATERNARY CARE CENTER

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Introduction: Given the increasing recognition and complexity of patients presenting for sleep studies, a strong emphasis on the safety during lab based sleep studies is important. There are limited data pertaining to the adverse events during the sleep studies. These events are rare, however provide sleep centers with insight regarding necessary protocol for risk assessment and management. The Cleveland Clinic Sleep Center recorded and characterized all adverse events observed during sleep studies over a span of five years. Our objective is to bridge gaps in the understanding of the nature and prevalence of sleep study-related adverse events, as well as the refinement of perceptive protocols regarding these events.

Methods: Adverse events during sleep tests performed in Cleveland Clinic sleep laboratories from January 2013 to December 2018 were recorded at length in a secure database, and are extensively reviewed and discussed in medical director/sleep management team meetings on a quarterly basis. Two standard protocols based on patients' need for emergency medical services are utilized to address all adverse events. Sleep tests performed were classified by type (i.e. standard polysomnography (PSG), home sleep apnea testing (HSAT), PAP titration, and multiple sleep latency testing (MSLT)). Identified adverse events were individually grouped into one of the following categories: cardiac, respiratory, neurological, psychiatric, falls, or other.

Results: During this five-year period most patients underwent a standard polysomnogram (35.60%). Split-night polysomnograms (20.60%), PAP titrations (19.00%), and home sleep apnea testing (16.00%) accounted for the majority of remaining tests. Out of the 61,626 studies performed, a total of 88 (0.14%) incidents of adverse events were reported. Of the patients who experienced an event, 52 (52/88; 59.09%) were sent to their respective emergency department, and eight (8/88; 9.09%) were admitted to a hospital for further observation and or treatment. Cardiac events were the most prevalent (48/88; 54.54%), followed by falls (18.18%). Neurological, respiratory, and psychiatric events each occurred at an equal frequency (6.82%, respectively), and remaining events were designated as other. No fatalities were reported from these adverse events.

Conclusion: While adverse events were rarely experienced, cardiac events and falls dominated among the minority of patients with adverse events. Rigorous documentation is performed in the electronic health records and the events are constantly analyzed by the Cleveland Clinic Sleep Center management and leadership team in an effort to improve the center's best practices over time.

SLEEP & SLEEP DISORDERS IN CANCER. STATE OF ART

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Sleep disorders, especially Insomnia, are very common in different kinds of cancer, but their prevalence and incidence are not well known. Disturbed sleep in cancer can be caused by different reasons and usually appears as comorbid disorder to different somatic, psychiatric diagnosis, psychological disturbances and treatment methods. There can be many different predictors for sleep disturbances in these vulnerable groups: e.g. pre-existing sleep disorders, caused by mental status in cancer or as side effect oft he cancer treatment.
Methods: A systematic literature review is conducted about sleep and sleep disorders in cancer patients including 8,073 Studies and we analysed a total of 87 publications.
Results: Twenty-six studies for the topic sleep and fatigue in cancer, and sixty-one studies for the topic sleep disorders in cancer have been analysed, one for Sleep Disorders generally, forty-four studies for the topic "Insomnia in Cancer" [eight for the "Prevalence of Insomnia in Cancer" and thirty-six for the "Treatment of Insomnia in Cancer", twelve studies for the topic "Sleep-Related Breathing Disorder (SRBD) / Obstructive Sleep Apnea Syndrome (OSAS) in Cancer", three studies for the topic "Narcolepsy in Cancer"and one study for the topic "Restless Legs Syndrome (RLS) in Cancer". The prevalence of sleep disturbences and / or sleep disorders in cancer is up to 95%.
Discussion: Sleep disturbances and sleep disorders (such as Insomnia, OSAS, Narcolepsy and RLS) in cancer patients can be predicted by very different reasons. Side effects of the cancer treatment and the psychological status because the cancer can initiate sleep disturbences and sleep disorders in cancer patients, especially Insomnia.
Keywords: Sleep, Sleep disturbances, Sleep disorders, Insomnia, Sleep-Related Breathing Disorder (SRBD) / Obstructive Sleep Apnea Syndrome (OSAS), Narcolepsy and Restless Legs Syndrome (RLS), Cancer, Fatigue

AUTOMATED SLEEP EVALUATION METHOD BASED ON EMG SIGNALS

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Introduction: Polysomnography(PSG) is the traditional method to evaluate sleep. Sleep stages can be scored by specific rules based on electroencephalography (EEG), electrooculography (EOG) and chin electromyography (EMG). Considering the complicated performance of PSG and time-consuming progress of data scoring, it is of great interest in evaluating sleep structure by non-EEG signal. As a subject falling asleep, there is a decreasing trend in EMG signals. Moreover, the EMG amplitude will reach the lowest value in REM sleep. In this research, we tried to analyze the sleep structure based on single chin-EMG signal with an automated method.

Materials and methods: Six healthy subjects（22-61yrs with mean age 39.67±13.75 yrs）participated in the study. The mean Apnea Hypopnea Index (AHI) is 1.28±0.78/h. Chin-EMG signals and sleep stages were exported. We chose five subjects to train the model and leave one out to test the model separately. There were at least 4932 epochs（30-second epoch）in training set and 859 epochs in test set.

Firstly, we pre-processed EMG by Empirical Mode Decomposition (EMD), then calculated the amplitude distribution and the relative baseline to each lowest level as well. The optimal wake relative baseline and REM relative baseline can be determined based on logistic regression and ROC curve. Then based on relative baseline, amplitude distribution, and random forest, epochs without abrupt muscle activities were classified to wake, NREM, and REM stages. After that, adjustment rules were built based on abrupt muscle activities and sleep continuity. After REM periods were determined, the undetermined epochs would be classified by the adjustment rules.

Results: For the epochs without abrupt muscle activity, the mean general accuracy is 90.78%±0.28%, with the mean *Kappa* value of 0.70±0.02. For all the epochs in the six subjects, the general accuracy are from 76.30% to 90.98%, with the mean accuracy of 84.39% and mean *Kappa* value of 0.69. The general REM accuracy are 88.30%± 10.07% in epochs without abrupt muscle activity and 90.78%±14.37% in all the epochs.

Conclusions: This novel method can classify wake, NREM and REM stages based on chin-EMG signal. Compared with traditional PSG results, the automated sleep staging indicates a substantial agreement, which could be a complementary method to evaluate sleep quality in the future.

KEYS TO IMPROVE HEALTHCARE ASSISTANCE IN SLEEP MEDICINE: CLINICAL CASES WITH COMPARATIVE BETWEEN TRADITIONAL AND MODERN METHODOLOGY

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Introduction: The management of sleep disorders has improved significantly in the last 10 years, thanks to a better knowledge and, the great technological innovation applied to sleep medicine, but there are few studies that show it with clear scientific evidence.

Materials and methods: Among more than 100,000 patients selected from 2009 to 2019, we have made a selection of those with different sleep disorders, traditionally treated in the public health system (primary and specialized care in public centers of the Valencian Community: [PCV]) and in a modern way in our centers (specialized private care at the Institute of Sleep Medicine, in Valencia [IMS]), to analyze and compare different parameters of care quality and cost-efficiency of procedures. We present 5 clinical cases and their management protocols for insomnia, sleep apnea, hypersomnia, parasomnia and Willis-Ekbom disease, with a detailed comparative analysis between both methodologies.

Results: In our sample, all these parameters analyzed improve significantly with the approach of these patients according to the IMS method, highlighting the waiting time to have a first consultation and a definitive diagnosis, the interval between diagnosis and treatment, the number of consultations and tests needed and done, the number and type of treatments used, the time interval between the first consultation and the discharge, and the degree of satisfaction 1 month after this discharge.

In addition, the effectiveness, efficiency and cost of the process are much better in IMS and patients highlight the technological resources through our website (www.dormirbien.info), home sleep tests, electronic sleep diary and consultations by e-mail, phone and videoconference.

Conclusions: Use of new technologies applied to sleep medicine brings great benefits to doctors and patients. Development of new methods to improve the quality of care and solve sleep disorders optimally has to be spread and standardized uniformly throughout the world, requiring more similar studies to prove it, more medical and technical knowledge, more research and better interaction and collaboration between public and private health systems.

Acknowledgements: To all the people who have participated and made it possible

Other
Board #113 : Poster session 3
CAREGIVING AND QUALITY OF SLEEP: DATA FROM THE JAPANESE CIVIL SERVANTS STUDY (JACS) IN JAPAN

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Introduction: The aging population in Japan is rapidly increasing. People in employment, particularly women, are often compelled to quit their jobs to care for sick and elderly family members. We aim to investigate whether caregiving adversely affects sleep quality amongst Japanese public servants.
Materials and Methods: We examined data from the Phase 4 of the JACS study that was conducted in 2014. We employed the t-test to reveal differentiation of caregiving status and sleep quality between men and women. Caregiving status was divided into three groups: (i) main caregivers (76 men and 61 women), (ii) assisting in caregiving (339 men and 190 women), (iii) non-caregivers (1,856 men and 1,042 women). We used the Pittsburgh Sleep Quality Index (PSQI) to evaluate the level of sleep quality across all groups. We referred to the Karasek's model (1979) to describe levels of occupational stress in terms of job control, demand and support. We further examined the relationship between sleep quality and caregiving through an analysis of covariance (ANCOVA). The statistical model was adjusted by age, marital status, number of children at home, presence of current chronic disease, job grade, working hours, job control at work, job demand at work, and job support at work.
Results: There was a significant difference (p< 0.001) in the global PSQI score for men (M=4.96, SD=2.58) and women (M=5.50, SD=2.61). Women were found to have poorer subjective sleep quality, longer sleep latency, shorter sleep duration and more daytime dysfunction as compared to men. However, when comparing the quality of sleep between genders and caregiving status, men were found to have poorer subjective sleep quality (p< 0.01), more daytime dysfunction (p< 0.05) and a higher global PSQI score (p< 0.01) as opposed to women.
Conclusions: Caregiving affects men and women differently. Specifically, our results suggest that in general women sleep poorly as compared to men. When men serve as main caregivers, their sleep quality is more adversely affected as compared to women.

FIRST INDIAN SLEEP REGISTRY: AN INITIATIVE OF INDIAN CHEST SOCIETY

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Introduction: Sleep apnea (SA) is a common disease affecting people of different age groups in India. Despite this fact no systematic database is available about its prevalence and pathophysiology so far. So, it was decided to collect sleep apnea pooled data in a registry via online portal. Through this registry, we would be able to understand comorbidities, aetiology and management of SA and will able to analyses data with Positive Airway Therapy (PAP) and its out results in a proper systematic manner. We would also be able to assess the quality of sleep studies conducted so far across India over the period and will be able to facilitate multicenter co-operational in India in creating the awareness of SA among general population as well as for the medical eternity.
Aims: Formulation of a cross sectional database for defining SA across patients in India.
Materials: Sleep - Apnea Indian Registry database (www.indiansleepregistry.in)
Method: All the data of sleep apnea from different doctors, who have agreed upon participation in the registry will be collected in the online registry from more than 20 sites (hospitals, research centers, institutes etc) across India.
Study design: Participation in the registry will be based upon good clinical practice of the doctors after seeking appropriate approval from ethics committee or institutional review board. Cases of sleep apnea will be entered online at the baseline and after one year (follow up). Each site will be trained for data entry in order to maintain the quality of data submitted. Each site will be requested to share the raw data with the central scoring site to assure the correct diagnosis of sleep apnea and appropriate feedback about the raw sleep data shall be provided. This data collection will be ongoing for 5years.
Conclusion: With the help of S-AIR registry, each participating site will be able to access their data online for further references. The preliminary learning generated from the registry shall be shared at the WSS conference. In totality, this study will help us in understanding the epidemiology, aetiology, pathophysiology etc. of sleep apnea across Indian population.
Acknowledgement: We are thankful to Indian Chest Society for showing their interest in our plan of study and supporting us. We also thank all the doctors who have registered themselves with this registry and contributed in making it a great success.

Other
Board #203 : Poster session 2
PEDIATRIC SLEEP MEDICINE ORGANISATION IN EUROPE

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Introduction: The Assembly of National Sleep Societies (ANSS) is an associate membership body of the European Sleep Research Society (ESRS), representing the members of 31 European National Sleep Societies with more than 8000 associated members. The aim of the study was to evaluate the state of pediatric sleep medicine between ANSS member states.
Materials and methods: An internet survey, concerning the organisation of pediatric sleep medicine in ANSS member states, was distributed among the presidents of 31 European National Sleep Societies. The survey included 9 questions about pediatric sleep centres, their specialisation, age range of the patients, sleep study types and regular pediatric sleep meetings in different European countries. Question about school start timing was also added to the questionnaire.
Results: 25 European National Sleep Societies responded to the questionnaire. In 20 of the responding countries have specialised pediatric sleep centres. Their number is the highest in Spain, with 20 different pediatric sleep centres. In most of the other responding countries there are up to 5 pediatric sleep centres. Most of them accept children until the age of 18 years, with Greece, Ireland and France being the exceptions, admitting children up to the age of 14, 16 and 17 years respectively. 86% of all European pediatric sleep centres are dealing with children with all kinds of sleep disorders, the rest of them are mainly specialised in diagnosing and treating pediatric sleep disordered breathing. With 50 pediatric sleep professionals Denmark and Spain have the highest number of physicians specialised in the evaluation of pediatric sleep disorders, while in Poland and Sweden have no sleep professionals managing exclusively children with sleep disorders. In majority of European pediatric sleep centres all types of sleep studies are performed. All but 7 countries have the possibility of performing polysomnography in children inside the sleep laboratory, with pediatric sleep centres in Poland and Slovakia offering in-lab polysomnography as the only available sleep study type for children with sleep disorders. More than half responding European National Sleep Societies have regular pediatric sleep meetings which are usually a part of an annual national sleep conferences. In most of the countries school starts between 8 and 9 a.m. for students of all age ranges. In some countries, however, there is a trend towards earlier timing of school start for adolescent and young adult students, as early as 7 a.m.
Conclusions: Children with sleep disorders are in most European countries assessed in specialised pedaitric sleep centres where they are seen by a pediatric sleep specialist. With in-lab polysomnography still being the golden standard for the evaluation of sleep disorders due to its obtrusiveness more emphasis should be put in the standardisation of pediatric ambulatory sleep studies where the ANSS can play a facilitating role. In most of the European countries the timing of the school start is between 8 and 9 a.m. and ANSS can help in reversing the trend toward even earlier timing for adolescents and young students.
Acknowledgements: To presidents of all participating national sleep societies.

Board #114 : Poster session 3

THE RELATIONSHIP BETWEEN NASAL RESPIRATORY FUNCTION AND THE MORPHOLOGY OF CRANIOFACIAL AND UPPER AIRWAY IN DIFFERENT MANDIBLE SAGITTAL PATTERN POPULATION

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Introduction: The craniofacial structure affected the size and morphology of the upper airway. But the upper airway structure cannot completely replace an assessment of respiratory function. Few studies have yet investigated the relationship among nasal respiratory function, upper airway morphology, and craniofacial structure.
Materials and methods: 47 healthy subjects(14 male, 33 female, aged 25.17±5.25) were selected and divided into three groups. 16 were in Class I group, 15 were in Class II group, and 16 were in Class III group. The nasal airflow and nasal resistance were detected and upper airway for adults with different craniofacial skeletal patterns were measured.
Results: There were significant differences among the three groups regarding dominant-side nasal inspiratory capacity, bilateral nasal inspiratory capacity, nasal partitioning ratio-inspiration, and velopharyngeal minimum cross-sectional area. The values were significantly higher for the skeletal class III group than the skeletal class I and II groups. A correlation analysis showed that the nasal airway resistance were mostly negatively correlated with SNA, but the upper airway volume and cross-sectional area were positively correlated with SNB and negatively correlated with ANB. The nasal inspiratory and expiratory capacity was positively correlated with the skeletal transverse dimension. The nasal resistance was negatively correlated with the skeletal transverse dimension. And the volume and cross-sectional area of upper airway were mainly positively correlated with the skeletal transverse dimension.
Conclusions: Craniofacial skeletal morphology may affect nasal respiratory function and the upper airway. There may be differences in nasal respiratory function and upper airway morphology between the skeletal class III population and skeletal class I and II populations.

GENDER DIFFERENCES IN SLEEP HYGIENE ASSOCIATED WITH POOR SLEEP IN ADOLESCENTS WITH ADHD SYMPTOMS

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Objective: The aim of this study was to examine gender differences in sleep hygiene and objective sleep measures in relation to symptoms of ADHD in an adolescent population. We hypothesized that adolescents with high levels of ADHD symptoms would present with more inadequate sleep, and that females would demonstrate worse sleep hygiene practices and sleep patterns.

Methods: 105 adolescents (70 females) aged between 13 and 18 years old (M=14.82, SD=1.33) participated in the study. Levels of ADHD symptoms were characterized by T-Scores on the ADHD subscale of the Youth Self Report. Sleep hygiene was measured by the Adolescent Sleep Hygiene Scale, with higher scores indicating poorer sleep hygiene, and sleep patterns were assessed using sleep variables, including sleep continuity, duration, and efficiency measured objectively using actigraphy.

Results: Correlational analyses were conducted separately for males and females. In females, higher levels of ADHD symptoms were correlated with poorer sleep hygiene ($r = .51$, $p < .001$), later bedtimes ($r = .32$, $p < .01$) and less time in bed ($r = -.32$, $p < .01$) as measured by actigraphy. In males, higher levels of ADHD symptoms were strongly correlated with daytime sleep ($r = .52$, $p < .001$) and substance abuse ($r = .54$, $p < .001$) factor scores of the sleep hygiene scale. Less time in bed ($r = -.52$, $p < .001$), shorter sleep duration ($r = -.40$, $p < .01$) and less immobile minutes ($r = -.48$, $p < .01$), as measured by actigraphy, were associated with higher levels of ADHD symptoms in males.

Fisher's r-to-z transformations were performed to compare the differences in strength between correlations in males and females. Using a one-tailed test of significance, the correlation between ADHD symptoms and adolescent sleep hygiene scale total scores ($z = 1.77$, $p < .05$), and physiological ($z = 2.14$, $p < .05$), behavioural arousal ($z = 2.38$, $p < .01$) cognitive/emotional ($z = 2.63$, $p < .01$) and sleep stability ($z = 2.1$, $p < .05$) factor scores were found to be significantly higher in females than in males. The substance factor scores were found to be significantly higher in males than females ($z = 2.2$, $p < .05$). The correlations between ADHD symptoms and sleep variables were also compared using the same method and sleep efficiency was found to be significantly higher in females than males ($z = 1.70$, $p < .05$).

Conclusion: Higher levels of ADHD symptoms were associated with poorer sleep hygiene and inadequate sleep patterns. Gender differences were also found where females practiced overall poorer sleep hygiene, as well as experienced worse sleep patterns than males. These findings support the promotion of healthy sleep hygiene practices in an adolescent population with high levels of ADHD symptoms.

SLEEP QUALITY AND ANXIETY AMONG WOMEN WITH TEMPOROMANDIBULAR DYSFUNCTION: A COMPARATIVE STUDY

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Introduction: Sleep is a complex neurobiological process with important functions ultimately leading to stronger physiological and psychological resilience. Therefore adequate sleep is an absolute requirement for health and well-being. Temporomandibular disorders (TMD) include a broad range of conditions related with pain and/or dysfunction within the temporomandibular joints and/or masticatory muscles. Theses are often accompanied by sleep complaints and psychiatric disturbances such as anxiety.The main objective of this study was to evaluate and compare sleep quality and anxiety domains in women with and without temporomandibular disorder (TMD).
Materials and methods: 200 female patients (100 with - PTMD group and 100 without PTMD - control group) were included with a mean age of 34,9±8,7 yo and 33,5±8,0 yo, respectively (p=0,3). Portuguese versions of Pittsburgh Sleep Quality Index (PSQI) and Stait-Trait (STP).Personality Inventory were used to assess sleep quality and anxiety domains. For statistical analysis were used Mann-Whitney, Kruskal-Wallis/Dunn, Qui-square ann exact Fisher tests.
Results: Sleep complaints were significantly higher and above the normal limit (5) within the TMD women (9.2 ± 3.6) compared with control group (4.3 ± 5.2). Sleep Efficiency was lower and indicated impaired sleep for TMD group (75.6 ± 18.7%) but not for controls (88.1 ± 9.1%). STP was also significantly higher in the TMD group (46.7±9.3 versus 37.8±7.5).
Conclusions: TMD may have a detrimental impact either in sleep quality and anxiety which may therefore promote a deleterious interaction worsening the prognosis.

CONTRIBUTIONS OF PARENTS' REPORTS OF CHILDREN'S SLEEP AND CHALLENGING FAMILY CONTEXTS AT AGE FIVE TO TEACHERS' REPORTS OF CHILDREN'S CLASSROOM ENGAGEMENT AND ACADEMIC ACHIEVEMENT TWO YEARS LATER

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Introduction: The early school years pose considerable cognitive and behavioral challenges for children. During this period, children engage with learning material, focus and pay attention, listen carefully, follow rules, participate, and work persistently and autonomously (Collins, Madsen & Susman-Stillman, 2002). These classroom engagement behaviors contribute to children´s course of academic success (Ladd & Dinella, 2009; Skinner, Kindermann, & Furrer, 2009); however, children vary in their abilities to respond to school-related expectations (Ladd, Buhs, & Seid, 2000). Hence, understanding factors that contribute to children's adaptive functioning in the school context is important. Exposure to maternal depression and maladaptive parenting practices during early childhood has repeatedly been identified as risk factors for school maladjustment (Kazdin & Whitley, 2003). Despite increasing interest in the respective contributions of mothers' and fathers' parenting to children's outcomes (Lewis & Lamb, 2003) little attention has been paid to relationships among mothers' and fathers' depressive symptoms and parenting behaviors, and their mutual effects, and effects on their children's school adjustment. Children's sleep problems have also been associated with poorer school functioning (Quach et al., 2009). Disruptions in bio-regulatory systems, including sleep, may mediate relations between exposures to negative family emotional environments and children's adjustment (El-Sheikh, 2011). The current study examined the direct and indirect links between maternal and parental depressive symptoms, taking into account contributions of mothers´ and fathers´ negative parenting and children's emotional dysregulation and sleep at age five, in predicting teacher reports of children´s school functioning two years later.
Materials and methods: Based on a sample of 785 (mothers and fathers) from the Quebec Longitudinal Study of Child Development (1998-2005) we used structural equation models to examine how depressive symptoms of mothers and fathers relate to their children's school adjustment (teacher report) directly as well as indirectly via children's emotional dysregulation problems (depressive and anxiety symptoms), children's sleep (night-time sleep duration and sleep latency), and harsh parenting practices. Parental and child variables were measured when children were 5 years old. At age 7, teachers reported on children's school adjustment (academic achievement and classroom engagement).
Results: Structural equation models showed that mothers' and fathers´ depressive symptoms contributed indirectly to children´s classroom engagement through harsh parenting (mothers' depression (b= .136)à parenting (b=-.143) à engagement; Fathers´ depression (b= .098)à parenting (b=-.130) à engagement). Mothers' and fathers´ depressive symptoms also contributed indirectly to children´s academic achievement through children´s emotional dysregulation (mothers' depression (b= .09)à dysregulation (b=-1.33) à achievement; Fathers´ depression (b= .051)à dysregulation (b=-1.33) à achievement). In addition, prolonged sleep latency directly predicted children´s classroom engagement (b =.18). It indirectly predicted classroom engagement via maternal harsh parenting (latency (b= .085)à parenting (b=-.14) à engagement), and academic achievement via mothers´ harsh parenting (b= .18).
Conclusions: Our findings identify important areas of support for young school-aged children and their families. Reductions in children's sleep latency at age five could both

potentially reduce harsh maternal parenting and improve children's classroom engagement and academic achievement.

ONLINE MEDICAL EDUCATION IMPROVES KNOWLEDGE OF PHYSIOLOGIC MECHANISMS OF SLEEP AMONG NEUROLOGISTS AND PRIMARY CARE CLINICIANS

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Introduction: Understanding the pathophysiologic mechanisms of sleep has important clinical implications, including helping to explain how sleep architecture changes with age as well as the causes and management of insomnia. Given the volume of people with insomnia and the aging population within the United States, it is important that clinicians are aware of how the brain regulates sleep. An online educational activity was developed with the goal of knowledge among neurologists and primary care physicians (PCPs) regarding the biologic factors involved in the propensity for sleep.

Materials and methods: An online educational intervention was developed in the form of a 30-minute video lecture with synchronized slides. Educational effectiveness was assessed with a repeated pairs pre-/post- assessment study design in which each individual served as his/her own control. Responses to 3 knowledge-based and 1 confidence-based questions were analyzed. A chi-square test assessed changes from pre- to post-assessment. Cramer's V was used to calculate the effect size of online education. Data from the assessment were collected between March 18, 2019 and April 4, 2019.

Results: A comparison of responses from pre- to post-assessment questions demonstrated a considerable educational effect for neurologists (n=148; V=0.24; P< .01) and an extensive educational effect for PCPs (n=656; V=0.378; P< .01). Participation in this educational intervention showed improvements for both groups in the following areas (P< .05): the neurotransmitter system involved in modulating sleep and wakefulness; the nucleoside involved in homeostatic sleep drive; and the stage of sleep that declines the most among older adults. Activity participation resulted in 34% of neurologists and 49% of PCPs reporting a measurable increase in confidence in the knowledge of the neurobiology of sleep in older adults.

Conclusions: This study demonstrated the success of a targeted online, video lecture on improving neurologists' and PCPs' knowledge of the neurochemical mediators of sleep and how sleep changes with age. Future education should continue to address the neurobiology of sleep and the impact of age on sleep.

ASSOCIATION BETWEEN SLEEP DURATION AND THIRST: POPULATION-BASED STUDY

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Introduction: During sleep, hydration homeostasis is maintained by the circadian rhythm-dependent release of vasopressin, an antidiuretic hormone. Despite of restricted water intake and insensible water loss during sleep, vasopressin helps moderate hydration status. Vasopressin level peaks in the late sleep period. Curtailments of the late sleep may increase risk of dehydration and subsequently increase thirst. In the representative sample of adult population, we demonstrated an association between thirst and sleep duration.
Materials and methods: A stratified random sample (2501 subjects; age 19-92 years old, mean 47.9 ± 16.4, 1242 male) from the general population was evaluated, in 2018, using face-to-face interviews about sociodemographic characteristics, height, weight, habitual sleep duration, and time-in-bed at night on weekdays and weekend, sleep-related profiles, and comorbid medical conditions. Average sleep duration and thirst status were determined. The association of thirst with sleep duration was analyzed, independent of beverage (including water) and alcohol intake, chronotype, DM, BMI, smoking and exercise status and sociodemographic factors (sex and age). We estimated logistic regression models between self-reported usual night-time sleep duration (≤5, 6, 7, 8 (reference), and >9hr/day) and thirst defined when the response to the question "How often do you feel thirsty?" was "frequently" or "always". When the response was "not at all", "little" or "to some degree", they were defined non-thirst.
Results: The thirst group consisted of 155 subjects (6.2%). Average sleep duration were 7.33 ± 1.03 hours. Very short sleep duration (≤5hr) was associated with significantly higher feeling of thirst compared with normal sleep duration (8 to 9hr) (OR: 5.421 95% CI 2.28, 12.9; p=0.000). Additionally, adults who reported 5 to 6hr of sleep had higher odds (OR: 2.241 95% CI 1.03, 4.86; p=0.041) of feeling thirst than adults who reported 8 to 9hr of sleep. No consistent association was found with sleeping more than 9 hours. Sleep duration was not associated with hydration-related behaviors. The amount of beverage (water included) intake were not different between short sleepers and normal sleepers.
Conclusions: The results from this survey cohort provide evidence at the population level that short sleep duration was associated with thirst. Considering the physiology connecting hydration status and sleep, one can speculate that short sleep duration leads to dehydration, which subsequently causes thirst. However, results from this cross-sectional study should not be viewed as causal. Unlike previous research, sleep duration was not associated with the amount of beverage (water included) intake. Longitudinal and experimental research is needed to further examine processes linking sleep duration and thirst status.
Acknowledgements: Inha Hwang contributed to the analysis and interpretation of data, and drafted the manuscript; Chang-Ho Yun conceptualized and designed the study, analyzed and interpreted the data, and revised the manuscrpit. All work was performed at Seoul National University Bundang Hospital, Seongnam, Republic of Korea.

DISPARITIES IN SLEEP DURATION BY INDUSTRY OF EMPLOYMENT AND OCCUPATIONAL CLASS AMONG NATIVE HAWAIIAN/PACIFIC ISLANDERS AND NON-HISPANIC WHITES IN THE UNITED STATES

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Introduction: Short sleep duration, which is associated with increased morbidity and mortality, has been shown to vary by occupation and industry. There is a bidirectional relationship between work and sleep, and some prior studies have found that the prevalence of short sleep is highest among Black professionals and lowest among White professionals. Few studies, however, have investigated differences in the work-sleep relationship between Native Hawaiian/Pacific Islanders (NHPIs) and White populations.
Materials and methods: By using data from a nationally representative sample of US adults (n = 20,828) in the National Health Interview Survey in 2014, we estimated prevalence of short sleep duration among NHPIs (10%) and among Non-Hispanic Whites for each of 7 industry categories and occupational classes (e.g., Professional/Management; Service; Laborers) using survey weights and age standardization (against U.S. 2010 population).
Results: Mean age was 49±0.2 and 41±0.5 years for Whites and NHPIs, respectively; women made up 52% of both groups. NHPIs were more likely than Whites to report short sleep duration across all occupational classes and industry of employment categories except food and accommodation services. The NHPI-white disparity was widest among those who held service occupations. Compared to their White counterparts, the prevalence of short sleep (< 7 hours) was higher among NHPI participants in professional/management (11 vs. 6%), service (14 vs. 7%), and laborer (15 vs. 11%) occupational classes. Recommended sleep (7-9 hours) and waking up feeling rested were lower among NHPIs across all occupational classes. Use of sleep medications was higher among whites across all occupational classes. Short sleep was lowest among participants in professional/management occupational classes among both NHPIs and Whites.
Conclusions: The work environment may contribute to racial/ethnic disparities in short sleep. Further investigations are warranted.

ASSOCIATION OF SLEEP PATTERNS WITH OBJECTIVE MEASURES IN IRANIAN CHILDREN: A CROSS-SECTIONAL STUDY

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Introduction: A variety of studies have shown that the sleep pattern is related to the growth indices in children. To the extent that inappropriate sleep pattern is associated with lower weight and body mass index (BMI), shorter height, and central obesity. The aim of this study was to determine the association of Sleep Patterns with growth indices in 7-12 years old children.

Materials and methods: The participants were selected consecutively and randomly (n=272) from four elementary schools in Qazvin city during November 2015 to March 2016. Children Sleep Habits Questionnaire was used to collect data on sleep´s quality and habits; while growth indices measured via standard methods. Pearson Correlation coefficient and multiple linear regression were used to investigate the relationship between sleep patterns and growth indices.

Results: participation rate was 95.22%. Pearson correlation coefficient showed that height had a negative correlation with wake time (r: -0.204; p: 0.001), bedtime resistance (r: -0.225; p< 0.001), sleep anxiety (r: -0.229; p< 0.001), and parasomnia (r: -0.157; p: 0.012). After adjustments on sex and age in multiple linear regression, neck size showed a positive relationship with weekday nap duration (b: 3.130; p: 0.001) and weekend nap duration (b: 1.713; p: 0.002). For sleep quality, there was a positive relationship between height and sleep duration (b: 0.017; p: 0.003), while a negative relationship was found with bedtime resistance (b:-0.041; p: 0.003), sleep anxiety (b:-0.039; p: 0.001), and night wakening (b:-0.013; p: 0.047). waist and neck circumference showed a relationship with total sleep scores (b:-0.190; p< 0.001 and b: 0.277; p< 0.001).

Conclusions: there was a significant association between sleep pattern and growth indices among elementary school children. Regarding the effect of sleep disturbances on the academic performance and daily activities of students, much more attention should be paid to the patterns of their sleep.

INTERNET SEARCHING VOLUME BETWEEN INSOMNIA AND NARCOLEPSY

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Introduction: Google Trends is an open tool that provides relative Internet search volume on specific queries and allows us to estimate indirectly public interest in search terms. It provides the corresponding averages of the search volumes that numbers are representing search interest proportional to the highest point in the chart for the time. To estimate the public interest of narcolepsy, we compared the search volume between insomnia and narcolepsy with Google Trends.

Materials and methods: The relative search volume is referred to as the Google Trend Index (GTI). GTI with queries for the insomnia-related terms (insomnia, insomniac) and narcolepsy-related terms (narcolepsy, narcoleptic) were downloaded from Jan. 2004 to May. 2019. To obtain the absolute search volume ratio between insomnia-related terms and narcolepsy-related terms, the proportions of GTI insomnia over GTI narcolepsy, GTI $_{insomnia/narcolepsy}$ were computed. Searching regions included the United States, Canada, United Kingdom, Australia, and worldwide.

Results: The insomnia-related terms were more searched than narcolepsy-related terms in all regions: mean GTI $_{insomnia/narcolepsy}$ United States 4.61±0.88, Canada 6.38±1.95, United Kingdom 6.53±1.84, Australia 5.72±2.19, worldwide 7.15±1.33.

Conclusions: These findings suggest high public interest and fear of narcolepsy considering at least 60 times the higher estimated prevalence of insomnia over hypersomnia (3-30% vs. 0.05%).

ASSOCIATIONS OF PSYCHOSOCIAL FACTORS, SHORT SLEEP, INSOMNIA, AND FRAGMENTATION AMONG AFRICAN-AMERICANS, THE JACKSON HEART SLEEP STUDY

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Introduction: Insomnia accompanied by short sleep duration is an emergent risk factor for hypertension. Identifying risk factors for insomnia and short sleep duration, and the combined phenotype, insomnia-short sleep phenotype (ISSP) among African-Americans may help to target interventions and potentially reduce hypertension burden. We tested the associations between psychosocial factors (e.g. stress, depression, anxiety, hostility) and insomnia, short sleep, and (ISSP) among African-Americans.

Materials and methods: The study sample included 824 Jackson Heart Sleep Study participants. Insomnia was defined by the Women's Health Initiative Insomnia Rating Scale (WHIIRS $\geq$10); short sleep by wrist actigraphy-based short sleep duration (< 6 hours); and ISSP by the presence of both insomnia and short sleep. Psychosocial factors included perceived stress (Perceived Stress Scale $\geq$ 18), depressive symptoms (Center for Epidemiologic Studies Depression Scale-20, excluding restless sleep, $\geq$ 16), anxiety (State-Trait Anxiety Inventory score $\geq$ 38), and hostility (Cook-Medley Hostility Scale). Logistic regression models were fit to test associations between psychosocial factors and each sleep phenotype in separate models adjusted for demographics, body mass index (BMI), and physical activity.

Results: JHSS participants had a mean age of 63.4 years (standard deviation: 10.7), 33.6% were male, 53.6% had a college degree and the mean BMI was 31.9 kg/m^2(6.9). Insomnia and short sleep were common, 22.8% and 26.1%, respectively, and 7% had the ISSP. Higher scores of perceived stress, depressive symptoms, anxiety, and hostilitywere associated with insomnia and ISSP, P< 0.01 all. However, only high anxiety was associated with short sleep duration, adjusted odds ratio (aOR)=2.00 (95% confidence interval: 1.34, 2.98).

Conclusions: Stress and mood were related to insomnia symptoms, but only stress and not mood was associated with short sleep duration. Psychosocial factors may be intervention targets for improving sleep among African-Americans, who have a higher prevalence of poor sleep.

Other
Board #087 : Poster session 1

EXPOSURE TO AIR POLLUTION IS ASSOCIATED WITH LOWER SLEEP DURATION AND HIGHER ODDS OF SNORING AND SUSPECTED OSA IN CHINA

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Introduction: Air pollution is a pervasive, complex mixture of substances known for their associations with environmental and public health risks, but little is known about its effect on sleep. Components of air pollution may cross the blood-brain-barrier causing neurotoxicity and contribute to sleep disparities. Exposure to air pollution (i.e., fine particulate matter ($PM_{2.5}$) and black carbon (BC)) may also cause respiratory inflammation and contribute to sleep-disordered breathing. We aimed to evaluate the link between air pollution and sleep duration, snoring, and suspected obstructive sleep apnea (OSA) in 3 Chinese provinces.
Methods: Among 782 Chinese adults (40-79y) enrolled in the INTERMAP-China Prospective (ICP) Study, we obtained detailed information on their socio-demographic factors, medical history, and behaviours including sleep measures (sleep duration per day (h/min), snores (no/yes), and stops breathing during the night (i.e., suspected OSA (no/yes)). Personal exposure to $PM_{2.5}$ was measured over 2 days in the winter and summer seasons and analyzed for mass (n=741) and BC (n=737). We conducted mixed effects regression with random village-specific intercepts to evaluate the association between air pollution and sleep duration. Logistic regressions were conducted for snoring and suspected OSA using quartiles of $PM_{2.5}$ (Q_1 (referent; < 52.1μg/m^3); Q_2 (≥52.1-74.3); Q_3 (≥74.3-116); and Q_4 (≥116)) and BC (Q_1 (referent; < 0.79μg/m3); Q_2 (≥0.79-1.48); Q_3 (≥1.48-2.36); and Q_4 (≥2.36)). Age, gender, waist circumference, smoking history, secondhand smoke exposure, physical activity, socioeconomic status, comorbidity, outdoor temperature and province of residency were considered as confounders; and, effect modification by age (≥63y), gender, smoking history, and secondhand smoke exposure were evaluated by subgroup analyses.
Results: Approximately 62% of participants obtained adequate sleep (7-9h), while 15% slept less and 23% slept more hours than the recommendation. Nearly 60% of participants reported snoring, and 13% had suspected OSA. Exposure to air pollution was associated with lower sleep duration (a 1-ln(μg/m^3) increase in $PM_{2.5}$ (95% CI): -10 min (-22, 2); and, a 1-ln(μg/m^3) increase in BC: -5 min (-14, 3)). Compared with Q_1 $PM_{2.5}$, greater odds of snoring (OR (95% CI): 1.3 (0.8, 2.1); 1.4 (0.8, 2.2); and, 1.3 (0.8, 2.2)) and suspected OSA (1.5 (0.8, 3.3); 1.6 (0.8, 3.5); and, 2.7 (1.2, 5.9)) were found in higher exposure (i.e., Q_2, Q_3, and Q_4, respectively). Similarly, higher exposure to BC was also associated with higher odds of snoring (Q_4: 1.3 (0.8, 2.1)) and suspected OSA (Q_3: 2.0 (1.0, 3.9); Q_4: 1.9 (0.9, 4.0)). These associations also varied in subgroups, e.g., among ≤63y, the odds of suspected OSA was significantly higher (Q_4: 3.8 (1.1, 14.1)) for $PM_{2.5}$, while in current smokers, the odds of snoring were significantly higher (Q_4: 4.7 (1.2, 19.5)) for BC.
Conclusions: We found that exposure to air pollution was associated with lower sleep duration, higher odds of snoring and suspected OSA. These associations may also be dose-dependent and vary in subgroups, such as older adults and current smokers.

SLEEP QUALITY AND DISORDERS IN SMOKERS AND NON-SMOKERS' PEOPLE: A COMPARATIVE STUDY

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Intruduction: Dependence on cigarettes is a disorder which may affect different dimensions of health, including sleep status. This analytical-cross sectional study aims to compare sleep quality and risk of sleep apnea in smokers and non-smokers of Kermanshah province.
Materials and methods: With regard to statistics of Kermanshah health center, 50 different clusters of the city were selected randomly; 8 to 13 subjects in age range of 20 to 60 were selected from each cluster according to inclusion criteria of the study (a sample including 390 subjects, two groups of 195 subjects). The subjects were assessed via demographic form, the Pittsburgh sleep quality index (PSQI), and the Berlin questionnaire (BQ). Data analysis was carried out in SPSS software version 23 using appropriate statistical tests.
Results: The resulting scores of sleep quality variables indicated that there is a significant difference between mental sleep quality, sleep disorders, taking sleeping pills, and inappropriate performance through the day in smokers and non-smokers ($P < 0.05$). Sleep quality is not good in smokers, and they have significantly higher snoring and drowsiness in comparison with non-smokers ($P < 0.05$). Furthermore, findings indicated that sleep apnea is significantly higher in smokers ($P < 0.05$). The findings also revealed that consuming more than 10 cigarettes in a day reduces sleep quality and increases obstructive sleep apnea ($P < 0.05$).
Conclusion: Results showed the cigarette smoking leads to respiratory disorders and reduced sleep quality.

SLEEP, CIRCADIAN, AND COGNITIVE DYSFUNCTION IN CIRRHOTIC PATIENTS WAITLISTED FOR LIVER TRANSPLANT

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Introduction: Sleep and circadian disruption is commonly reported in patients with liver cirrhosis, but it has not yet been systematically characterized before and after liver transplant (LT). Up to 80% of cirrhotic patients suffer from cognitive impairment, and post-LT improvement is inconsistent. Associations between the timing and magnitude of sleep, circadian, and cognitive dysfunction before and after LT are unknown. As the first step of a longitudinal observational study, we aimed to characterize pre-LT sleep, circadian rhythm, and cognition.

Materials and methods: 49 stable cirrhotic patients (29 males, median age 59) waitlisted for LT wore a wrist actigraphy for 14 consecutive days at home and completed validated sleep questionnaires (PROMIS) and cognitive assessment (NIH Toolbox). 35 age/gender-matched healthy controls wore a wrist actigraphy. Sleep was scored using actigraphy and sleep diaries. Rest-activity patterns (interdaily stability (IS), intradaily variability (IV), relative amplitude (RA), and activity during the periods of the least active 5-h (L5) and the most active 10-h (M10)) were derived using non-parametric analyses. Cognitive performance was scored against demographic-matched population norms as T-scores.

Results: Rest-activity patterns in cirrhotic patients were more fragmented (median IV 0.90 vs. 0.84, $p=0.027$), less stable (median IS 0.40 vs. 0.452, $p< 0.001$), and lower in amplitude (median RA 0.76 vs. 0.91, $p< 0.001$), compared to controls. Impaired sleep quality in cirrhotics was evidenced by both PROMIS questionnaires (Sleep Disturbance T-score 55.9±10.8 vs. 42.9±6.4, Sleep-Related Impairment T-score 55.7±8.9 vs. 42.6±8.6, $p< 0.001$) and actigraphy (median sleep efficiency 83.1% vs. 90.2%, $p< 0.001$; wake after sleep onset 80min vs. 35.3min, $p< 0.001$; sleep period time 507min vs. 445min, $p=0.001$; sleep midpoint 03:54:26±01:30:56 vs. 03:14:39±00:53:29, $p=0.014$) compared to controls. Cognition was impaired by one standard deviation below demographic-matched population norm (T-score 39.5±8.6 vs. 50±10, $p< 0.001$). More severe cognitive impairment was associated with higher fragmentation (IV; rho -0.30, $p=0.04$), lower stability (IS; rho 0.31, $p=0.03$), and lower daily activity count (M10; rho 0.30, p=0.04). No association was found between cognitive performance and sleep variables.

Conclusions: Sleep, circadian rhythms, and cognition were impaired in cirrhotic patients compared to controls. In cross-sectional analysis, cognitive impairment was associated with circadian disturbance but not with sleep variables. Longitudinal data will examine pre-to-post-LT changes in sleep, circadian rhythm, and cognition and their impacts on health outcomes.

SLEEP, TIREDNESS AND SCHOOL ADJUSTMENT AMONG 15-TO 20-YEAR-OLD FINNISH ADOLESCENTS

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Introduction: Previous research has shown the importance of sleep for both academic performance and for overall well-being. Further, there is evidence suggesting that short sleep duration, later bedtimes, and poor sleep quality are negatively associated with academic performance in secondary education students (Curcia, Ferrara & De Gennaro, 2006; Wolfson & Carskadon, 2003). This study aims to identify the association between sleep, tiredness and adolescents´ adjustment in school.
Materials and methods: The cross-sectional data were collected from 1 141 Finnish upper secondary students (45% girls; mean age=17.0, SD=1.2 years) with paper-and-pencil questionnaires as part of normal schoolwork. Bedtimes were asked by question "What time do you usually go to sleep on school days?". Sleep quality was investigated by using the Pittsburgh Sleep Quality Index. Daytime tiredness was measured with four items (e.g., "How tired do you feel during school days?"). The participants answered single questions concerning school adjustment, support needs, psychological well-being and substance use.
Results: Preliminary results showed that self-reported sleep factors and daytime tiredness were negatively associated with school achievement, support needs, liking school, skipping classes, being late from school, thoughts about quitting school, psychological well-being and substance use ($p < .05$).
Conclusions: We suggest that adolescent sleep should be taken more closely into account in health education and in society in general.

Board #342 : Poster session 1

CHARACTERISTICS OF SLEEP QUALITY MEASURED BY PITTSBURGH SLEEP QUALITY INDEX INA AND SLEEP PATTERN USING MUNICH CHRONOTYPE QUESTIONNAIRE IN PRIMARY BRAIN TUMOR PATIENTS

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Background : The increasing number of surviving primary brain tumor patients is one of the reasons to evaluate sleep quality with PSQI INA. A change in sleep pattern of primary brain tumor patients can be observed using MCTQ INA

Objective : To describe sleep quality and pattern in primary brain tumor patients.

Methods :a descriptive cross sectional study performed on post operative primary brain tumor patients selected consecutively in December 2018 - April 2019 at Neurology and Neurosurgery outpatient clinic Dr Hasan Sadikin General Hospital Bandung. All subjects were compos mentis. Depression and anxiety were excluded with Hospital Anxiety Depression Score.

Results : There were 80 subjects,77.5% were women. Mean age was 42.52 year old(18-79 year old). 97.5% subjects coslept, 81.25% of them were married. 65 % of subjects were housewives. 55% subjects have more than minimal wages. 10% of subjects drank 1 - 3 glasses of coffee, no alcoholics were included. 7.5% have history of antiepileptics usage, 2.5 % subjects undergone radiation and 1.25% chemotherapy. Sella was the most common location of all tumors (26.25%), meningioma meningotelial (46.25%) was the most frequent type. Good sleep quality is found among 56.25 % subjects. Sleep pattern was morning chronotype, sleep duration was 6-7 hours in PSQI INA (68.75%)and 285-500 minutes in MCTQ INA. Sleep latency were found below 30 minutes in PSQI INA (87.5%) and MCTQ INA.

Conclusion : Sleep qualities were good. Sleep pattern found was morning chronotype, with sleep duration between 6-7 hours.

Keywords :MCTQ INA, primary brain tumor, PSQI INA, sleep pattern, sleep quality

TRAUMATIC BRAIN INJURY AND 14-YEAR RISK OF INCIDENT SLEEP DISORDERS AMONG 364, 494 US MILITARY VETERANS

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Introduction: Subjective sleep complaints are common in the acute phase of traumatic brain injury (TBI). Several clinical studies have described the prevalence of subjective sleep complaints immediately or shortly following the occurrence of TBI. However, little is known about the long-term risk of clinical sleep disorders after TBI.
Materials and methods: This is a retrospective cohort study of all patients diagnosed with a TBI and evaluated in the Veterans Health Administration (VHA) healthcare system from 10/1/2001-9/30/2014, and a 1:1 age-matched sample of patients without TBI. TBIs were identified both through the Comprehensive TBI Evaluation database and via routine clinical care from the National Patient Care Database. Development of sleep disorders was defined as any inpatient or outpatient diagnosis of insomnia, hypersomnia, sleep-disordered breathing or sleep-related movement disorders based on International Classification of Diseases 9th edition (ICD-9) codes after the first date of the TBI diagnosis or the random selection date for those without TBI. Any veteran with prevalent sleep disorders was excluded. We used cox proportional hazard models to examine the risk of incident sleep disorders associated with TBI. We also explored whether the association between TBI and sleep disorders differs in the presence of post-traumatic stress disorder (PTSD), and introduced a time lag of 2 years to make sure incipient sleep disorders in TBI patients were excluded and to determine the direction of the relationship.
Results: The analytic cohort included 182,247 veterans with any TBI and 182,247 age-matched veterans without TBI (average age 48.6±19.8 years, 12.7% women). After an average follow-up of 3.4 (0-14) years, 78,860 (21.6%) of the veterans developed sleep disorders. After adjustment for gender, race, education, income, and medical and psychiatric conditions, those who had TBI were 60% more likely to develop any sleep disorders compared to those without TBI [Hazard ratio (HR) = 1.60 (1.58-1.63)]. The adjusted HRs (95% CI) for sleep apnea, insomnia, hypersomnia and sleep-related movement disorders were 1.47 (1.43-1.50), 1.70 (1.66-1.74), 1.73 (1.64-1.82) and 1.54 (1.39-1.71), respectively. The association did not differ appreciably by PTSD status, and remained after introducing a 2-year time lag.
Conclusions: In this cohort of over 364,000 veterans without sleep disorders, TBI patients had an increased risk of developing clinically-diagnosed sleep disorders, particularly insomnia and hypersomnia. The robust finding of 2-year time lag analysis made it less likely that sleep disturbances only reflect acute-phase TBI symptomatology. Findings support improved prevention and integration of long-term management strategies for sleep disorders in caring for veterans with TBI.

Other
Board #117 : Poster session 3
LOWER MELATONIN CONCENTRATIONS AND SLEEP QUALITY IN PATIENTS WITH TYPE 2 DIABETES AND OBESITY

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Introduction: There is a close relationship between melatonin as a circadian regulator and insulin, glucagon and somatostatin production. This study aimed to describe subgroups of type 2 diabetes mellitus (T2DM) patients that may benefit from melatonin clock-targeting properties.

Materials and methods: The study involved 38 participants: 26 type 2 diabetes patients, and 12 participants without diabetes in the control group. The study involved 20 women and 18 men aged 26 to 86 years.

The doctors of the enrolled patients were asked to complete a questionnaire on their patients´ diabetes and co-morbidity treatment. Each participant was asked to complete two questionnaires. The first questionnaire consisted of questions regarding history of diabetes and lifestyle factors: dietary, smoking, alcohol and caffeine-containing beverage intake habits. Each participant also completed the questionnaire of Pittsburgh Sleep Quality Index (PSQI). PSQI is an effective tool for assessing sleep quality in adults. The "good" and "poor" quality of sleep is determined by evaluating the seven components. Standard biochemical venous sample testing was performed. In addition, one sample of saliva was collected for melatonin testing immediately after awakening (6:00 to 6:30 AM). Following sampling, the sample was refrigerated within 30 minutes, and frozen at -20 ° C within 4 hours. On the day of testing, samples were defrozen and centrifuged at 1500 x g for 15 minutes, then the samples were brought on an analyte plate within 30 minutes. Testing was performed with The Salimetrics® Melatonin Enzyme Immunoassay Kit in accordance with the manufacturer´s instructions (Salimetrics: Melatonin ELISA Kit (Saliva) -Salimetrics Assays The data were processed and analyzed using Microsoft Excel and IBM SPSS 20. Non-parametric statistical methods were employed. The results are shown as median (interquartile range). Continuous variable differences between the two groups were analyzed with Mann-Whitney test, and Spearman´s rank correlation coefficient was used for correlation testing.

Results: This study showed a trend of higher PSQI score correlation with a lower melatonin concentration.

Subjects with PSQI score ≥ 5 had a median melatonin concentration of 6.6 pg/ml vs those with PSQI score < 5 :14.6 .

The overall BMI of the study population was 31.5 kg/m^2. Patients with DM had a significantly higher BMI than the control group: 36.1 kg/m^2 vs 23.2 kg/m^2, respectively. Melatonin concentration in participants without obesity (BMI < 30 kg/m^2) was significantly higher than that in obese participants.

Obese participants had a significantly higher PSQI score than non-obese subjects.

When analyzing concentration of melatonin in T2DM patients and participants without the condition, a significantly higher concentration was observed in the control group.

Conclusions: The current study evaluated melatonin levels and sleep quality in T2DM and obese patients. We showed that both T2DM and obesity were associated with lower melatonin levels. Furthermore, obesity was also associated with poor sleep quality according to the PSQI score.

Other
Board #342 : Poster session 2
ASSOCIATIONS BETWEEN NEIGHBOURHOOD DESIGN, NEIGHBOURHOOD SOCIOECONOMIC STATUS AND SLEEP IN ADULTS

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Introduction: Evidence suggests that the built environment (BE) may influence sleep. Neighbourhood characteristics within the BE such as overall walkability, destination density, and land use mix may affect sleep duration via time to sleep initiation and sleep disturbance. Neighbourhoods with similar street patterns often share common BE characteristics. For example, grid street patterns are associated with higher walkability, higher population density, and higher destination mix, while curvilinear patterns are often associated with lower walkability, lower population density, and fewer destinations. Moreover, adults living in more low socioeconomic status (SES) neighbourhoods report lower sleep duration. Our study is the first to investigate the association between street pattern and sleep duration in neighbourhoods of varying socioeconomic status.

Materials and methods: In April 2014, a stratified random sample of Calgary (Canada) adults (n=10500) residing in neighbourhoods characterized by three distinct street patterns (grid, warped grid, and curvilinear) and four neighbourhood SES quartiles (most advantaged, somewhat advantaged, somewhat disadvantaged, and most disadvantaged) were invited to complete an online survey. Among those completing the survey (n=1023; response rate=10.8%), 805 provided complete sleep and sociodemographic data. Covariate-adjusted linear regression estimated the difference in mean daily sleep duration by neighbourhood street pattern and SES. Covariate-adjusted multinomial logistic regression estimated odds ratios for the association between neighbourhood street pattern and SES and sleeping less (< 7 hours/day) or more (>8 hours/day) compared to a 7-8 hour/day duration. Interaction effects between street pattern and SES were also tested.

Results: The sample was predominantly female (62.9%), white (88.2%), with a mean age of 51.4 years (SD 13.7). On average, participants slept 7.3 (SD 0.98) hours/day. 65.3% achieved sleep durations of 7-8 hours/day. Relative to other neighbourhood types, adults living in disadvantaged curvilinear neighbourhoods reported the lowest mean sleep duration at 6.9 hours/day. A significant (p< .05) interaction was observed between street pattern and SES. Adults in disadvantaged grid and warped-grid neighbourhoods undertook an additional 0.53 hours and 0.59 hours of sleep/day, respectively, compared with adults living in advantaged curvilinear neighbourhoods. Street pattern and SES were not associated with achieving recommended levels of sleep, in adjusted multinomial logistic regression models.

Conclusions: Adults living in low SES curvilinear neighbourhoods on average spent less time sleeping than adults living in low SES grid, warped grid, and high SES neighbourhoods. In Calgary, low SES curvilinear neighbourhoods tend to be geographically located on the periphery, which could increase time spent commuting, and subsequently decrease the time available for sleeping. These neighbourhoods also tend to be located nearer to major traffic corridors, a potential source of noise pollution, that may negatively impact sleep duration. Low SES neighbourhoods tend to have higher volumes of emergency dispatch calls, which may be an additional source of noise pollution, and in turn sleep disturbance. Future research may explore if there are differences in the relationship between street pattern and SES and sleep differs by age or sex and may investigate individual BE characteristics impact on sleep.

EFFECTS OF DIFFERENT MATTRESSES ON SLEEP QUALITY IN HEALTHY SUBJECTS: AN ECG-BASED STUDY

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Introduction: Very few studies have evaluated the effect mattresses have on sleep quality, and the ones that have been done only included small numbers of subjects or sleep-deprived population or single nights or insufficient measures. The effects of different mattresses on sleep quality in healthy subjects remain unclear. Therefore, this study aimed to explore whether different mattresses had impacts on sleep quality.

Materials and methods: 150 healthy volunteers were recruited for the study to compare their sleep quality while using different mattresses. Each subject was instructed to sleep 10 consecutive nights in their home mattress (defined as baseline nights) prior to the change of a new memory foam mattress (MLILY Cloud, China, size 180cm*200cm*25cm) for the next 10 consecutive nights (defined as study nights). All subjects were asked to keep their sleep routine and room environment (including lights and temperature) during the study. A portable ECG device was used to collect data during sleep for cardiopulmonary coupling (CPC) analysis, which is a widely used approach for sleep quality measure and is recommended for home sleep testing. Subjects are considered eligible if they have at least two baseline nights and two study nights, all with total sleep time over 4 hours and with valid ECG recordings. Sleep measures derived from CPC analysis were averaged for two baseline nights and for two study nights respectively. Changes of main CPC outcomes were analyzed including TST (total sleep time), LFC (low frequency coupling, an indicator of unstable sleep), HFC (high frequency coupling, an indicator of stable sleep), and HFC latency. LFC ratio, HFC ratio and HFC latency were used as three-dimensional measures to cluster the subjects with good sleep versus unsatisfied sleep.

Results: 117 subjects (84 females, mean age 43.69 ± 14.03 yrs, BMI 22.64 ± 2.44 kg/m^2) were eligible and included in the analysis. For sleep quality compared between baseline and study nights, no significant differences were found on CPC measures among these healthy subjects. However, when subjects with unsatisfied sleep (n=20, defined as the bottom group using three-dimensional CPC measures) were identified, significant differences were found on HFC latency (59.63 ± 15.33 minutes vs 46.68 ± 19.79 minutes, p = 0.023), suggesting improvements on sleep after switching to the new mattress.

Conclusions: Different mattresses have impacts on sleep, and better-designed mattresses might improve sleep quality. Possible mechanisms may include mattress types and materials, firmness, and skin temperature. Certain mattresses may be optimal for promoting sleep comfort and quality, but long-term follow-up and evaluation are necessary to assess the effects from mattress change. Future studies are encouraged to investigate whether mattress can improve sleep quality in the population with sleep disturbances or those with unsatisfied sleep.

NEIGHBOURHOOD SOCIO-ECONOMIC FACTORS AND INFANT SLEEP HEALTH

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Introduction:
Sleep health (which includes multiple dimensions such as duration, continuity, efficiency, and quality), particularly in the early years, is important for development and improves overall health. Unfortunately, there are large socioeconomic gradients in sleep health, from childhood through adulthood. Recent findings suggest that children from neighbourhoods with poorer socioeconomic conditions have worse sleep problems. The current study aimed to investigate the associations between neighbourhood factors and sleep health as early as infancy.

Materials and methods:
Secondary data analysis was conducted for a sample of 2455 women (M_{age}= 30.78 years old, SD= 4.49) from the All our Families longitudinal cohort study, for whom early pregnancy neighbourhood data could be geocoded and who completed a written questionnaire at 12 months postpartum. The Vancouver Area Neighbourhood Deprivation Index (VANDIX) was calculated usingthe 2011 National Household Survey census data from Statistics Canada. Neighbourhood disorder was measured using the 2011 Community Crime Reports from Calgary Police Services. Mothers rated the perceived safety of their neighbourhood and reported on their infants' sleep duration, awakenings, and onset latency at 12 months postpartum.

Results:
Bivariate correlations suggested that shorter sleep duration among infants was associated with neighbourhood deprivation (r = -.092, p = .002), disorder (r = -.079, p =. 006), and mothers' perceptions of their neighbourhoods being unsafe (r = -.085, p = . 004), while a longer onset latency was associated with neighbourhood deprivation (r = .093, p = . 001) and perceptions of unsafety (r = .083, p = . 005). Multilevel modeling analyses indicated that both neighbourhood disorder (b = -.170, p < .001) and maternal perceptions of unsafety (b = -1.339, p = .002) uniquely predict shorter sleep duration after accounting for family-level factors including ethnicity, income, breastfeeding and co-sleeping. Neighbourhood deprivation was indirectly related with less sleep among 12-month-old infants through more reports of disorder (ab = -.009, p= .008) and perceptions of less safety (ab = -.118, p = .037).

Conclusions:
Both neighbourhood and family factors influence infant sleep health. Policy efforts to increase neighbourhood safety and public health initiatives to increase awareness of bedtime practices could help improve infant sleep health.

ASSOCIATIONS BETWEEN OBJECTIVE AND SUBJECTIVE MEASURES OF SLEEP QUALITY AND HEMOGLOBIN A1C IN PROFESSIONAL ATHLETES

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Introduction: Sleep disturbances have been linked to poor glycemic control in patients with Type 2 diabetes[1]. It is unclear if sleep disturbances are associated with poor glycemic control even among those in peak physical condition. The purpose of this study was to examine the relationship between objective and subjective sleep quality parameters and hemoglobin A1c (A1c; glycated hemoglobin, representing average blood glucose over previous 3 months) among elite athletes.
Materials and methods: Twenty six professional, male athletes (mean ±SD: age, 23.7±4.4 years; height, 182.8±7.6 cm; weight, 76.2±8.6 kg) completed an extensive blood analysis, which included a test for A1c. Subsequently, 20 players participated in a SleepCheck™ screening, which included an at-home sleep test and a questionnaire tailored for athletes that assessed subjective snoring, insomnia, fatigue and sleep quality complaints. Objective sleep metrics were collected by an overnight ECG recording. All analyses were based on these 20 players.
A preliminary analysis explored linear and non-linear correlations between both objective and subjective sleep data and A1c. A stepwise regression analysis accounting for multicollinearity was then conducted using the objective sleep metrics to further elucidate the relationship between sleep and A1c biomarkers.
Results: The first analysis revealed strong associations with both objective and subjective indicators of sleep quality. A1c was not associated with total sleep time ($r =.04$, $p = .85$), and examinations of non-linear associations with sleep quality were not significant. Higher levels of A1c were associated with a greater incidence of self-reported, non-refreshing sleep ($r = -.48$, $p = .01$) and more daytime sleepiness ($r = -.53$, $p = .005$) experienced over the last month.
The stepwise regression results showed that there was a direct relationship between A1c and a group of objective sleep measures: sleep fragmentation, sleep latency, Sleep Quality Index, deep sleep duration and wake after sleep onset. It also confirmed that total sleep time was not associated with A1c.
Conclusions: Results suggest that even among populations in excellent physical condition, poor sleep quality may still place individuals at risk for elevated A1c. Athletes with excessive sleep fragmentation may therefore experience both immediate and long-term effects related to glycemic control. In the short term, the combination of poor sleep quality and elevated A1c could impact an athlete's endurance and performance. Future research will 1) explore the relationship between sleep disturbances and other blood markers related to performance and health; and 2) examine the utility of SleepCheck™ screenings as a component of routine athlete monitoring.

Reference: [1] Lee, S et al. (2017). The impact of sleep amount and sleep quality on glycemic control in type 2 diabetes: a systematic review and meta-analysis. *Sleep medicine reviews*, *31*, 91-101.

BEHAVIORAL SLEEP MEDICINE TRAINING IN AUSTRALIA: AUDIT OF THE APS PRACTICE CERTIFICATE IN SLEEP PSYCHOLOGY

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Introduction: There are currently no accredited behavioural sleep medicine training programs in Australia. The Australian Psychological Society (APS) collaborated with the Australian Sleep Association (ASA) to address this education gap, and developed an online behavioural sleep medicine training program, the APS Practice Certificate in Sleep Psychology. The Practice Certificate was launched in 2013 and consists of four modules: 1) Introduction to Sleep Psychology; 2) Insomnia; 3) Circadian Rhythm Sleep-Wake Disorders; 4) Obstructive Sleep Apnoea and CPAP Adherence. To date no review of the practice certificate has been undertaken. The current study aimed to conduct an audit of the APS Practice Certificate in Sleep Psychology to establish the number of health professionals completing the practice certificate and collate program feedback.

Materials and methods: Data on program participation in the APS Practice Certificate in Sleep Psychology was extracted from the APS Institute database. Program feedback from completing participants was also collated. Non-identifiable descriptive data was transferred to study researchers.

Results: From 2013 to 2018, 946 health professionals (98% psychologists) completed Module 1. Four hundred and twenty eight health professionals (99% psychologists) completed Module 2, 197 (97% psychologists) completed the Module 3, and 137 (96% psychologists) completing Module 4. In total, 121 health professionals completed all four modules of the APS Practice Certificate in Sleep Psychology. Feedback themes reported by program completers included 1) Too much repetition of content across modules, particularly across Modules 1 & 2; 2) Poor/ambiguous wording of practice and assessment questions; 3) More case studies and video demonstrations needed.

Conclusions: The APS Practice Certificate in Sleep Psychology is the first online, behavioural sleep medicine training program for health professionals in Australia. To date, only 121 health professionals (majority psychologists) have successfully completed the Practice Certificate. There are currently 29,598 registered psychologists in Australia and the data highlights more needs to be done to train Australian health professionals, in particular psychologists, in behavioural sleep medicine. The APS has convened an Expert Reference Group to formally revise and update the Practice Certificate in Sleep Psychology which will commence in 2019 and aim to increase the numbers of psychologists completing training in behavioural sleep medicine.

Acknowledgements: Thank you to the Australian Psychological Society for providing us with access to this data.

Other
Board #118 : Poster session 3

SLEEP QUALITY AND PAINFUL TEMPOROMANDIBULAR DYSFUNCTION: A CASE CONTROL STUDY

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Introduction: Sleep is a complex neurobiological process with important functions ultimately leading to stronger physiological and psychological resilience. Therefore adequate sleep is an absolute requirement for health and well-being. Temporomandibular disorders (TMD) include a broad range of conditions related with pain and/or dysfunction within the temporomandibular joints and/or masticatory muscles. Theses are often accompanied by sleep complaints and disturbances. In this study, sleep quality and painful temporomandibular disorders were evaluated in order to investigate their interaction.

Material and methods: The Portuguese (Brasil) version of Pittsburgh Sleep Quality Index (PSQI), European Academy of Craniomandibular Disorders Questionnaire and Diagnosis Criteria from Research Diagnosis Criteria- Axis I were completed by patients referred from primary care clinicians to a specialized TMD Unit in the Specialized Dental Center of the State of Ceará, Brasil, from August to October 2017. Sleep quality was compared between 50 patients with painful TMD (TMD group) and 50 age and gender matched controls.

Results: The TMD group (70% females) had a mean age of 39.9 years old and the control group (88% females) a mean age of 42.4 years old (p>0.05). All patients of the TMD group presented with myalgia, most of them (78%) bilateral. 62% of TMD patients had spreading muscle pain within the affected muscle (myofascial pain), while 42% had myofascial pain with referral beyond the muscle limits, most commonly unilateral (34%), headache attributed to TMD (78%) with disc displacement with reduction (40%). Poor sleep quality (PSQI>5) was experienced by both groups with TMD patients having worse sleep (PSQI score of 7.0 ±3.7) compared to controls (5.4 ±3.5). TMD group also presented with lower rates of "good sleep" (30% versus 44%; p< 0.05) and higher sleep disturbance (20% versus 6%; p< 0.05). A strong negative correlation was observed between subjective sleep quality domain from PSQI and TMD diagnosis (r= -0.77).

Conclusions: Our study reports higher rates of impaired sleep quality in painful TMD patients compared to age and gender matched controls. Together with the observation of a strong negative association between sleep quality and TMD, our findings corroborate those of previous works on interactions of sleep, pain and painful TMD.

WORK START TIMES AND SLEEP IN COMMUNITY-BASED ADULTS IN THE UNITED STATES

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Introduction: Over 35% of adults in the United States obtain insufficient sleep (< 7 hours). While early school start times has been frequently identified as a major driver of insufficient sleep in adolescents, few studies have considered the role of early work start times on the sleep duration of adults. The literature on sleep and work schedules has primarily focused on conventional shift work schedules or well-defined occupations (e.g., medical, transportation), with the relationship between sleep and traditional work schedules rarely considered in community based populations. The aim of this study was to examine the relationship between work start times, sleep schedules, and sleep duration in a large sample of community-based adults in the United States.

Materials and methods: In Spring 2017, 6862 community-based adults in the greater Denver, Colorado metropolitan area completed online surveys as part of a larger study examining the impact of changing school start times on students and their families. All participants had at least one student (grades K-12) enrolled in the school district and identified themselves as working full-time. Survey questions asked about weekday bedtime and weekday wake time. Total sleep time was calculated from bedtime to wake time, with insufficient sleep defined as < 7 hours. Work start time was categorical (< 6:00am, 6:00-6:59am, 7:00-7:59am, 8:00-8:59am, >9:00am).

Results: Seventeen percent of adults in this population began work before 7:00am. Significant differences in bedtime, wake time, and total sleep time were found between work start time categories ($ps< 0.001$). Greater differences between work start time groups were found for wake times (25 to 30 minutes later per each hour of later work start time) than for bedtimes (11-22 minutes per each hour of later work start time), resulting in increased total sleep time for those who started work later (8-14 minutes per each hour of later work start time). Within work start time categories, the percent of adults obtaining insufficient sleep was greatest for early work start times (< 6:00am = 39.8%, 6:00-6:59am = 28.9%) and decreased with each hour of later work start (7:00-7:59am = 20.7%, 8:00-8:59am = 17.0%, 9:00-9:59am = 16.1%).

Conclusions: In this community-based sample of working adults early work start times were related to earlier wake time, shorter total sleep time, and increased likelihood of obtaining insufficient sleep. Early work start times need to factor into the conversation about how to improve sleep health for adults in the United States.

Acknowledgements: This study was supported by a Robert Wood Johnson Foundation's Evidence for Action Grant

Other
Board #344 : Poster session 1
RELATIONSHIP BETWEEN MENIERE´S DISEASE AND SLEEP DYNAMICS

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Introduction: Several recent reports have described the relation between sleep disorders and Meniere´s disease. Many clinicians may also have had the experience of patients who say their dizziness are less noticeable when they sleep well. Therefore, sleep disorders might be one of stressor for Meniere's disease. One possibility that may affect patients sleep quality is the obstructive sleep apnea (OSA). As a mechanism of these phenomena, we focused on brain activity during sleeping and examined changes in sleep dynamics after excluding OSA and discussed the relationship with dizziness symptoms.

Materials and methods: Among patients with Meniere´s disease who first visited our department from January 2010 to December 2017, we analyzed patients who were diagnosed OSA by polysomnography (PSG).The results of PSG (Respiratory Events, Sleep Stages) and self-administered questionnaires (Epworth Sleepiness Scale: ESS, Pittsburgh Sleep Quality Index: PSQI, Dizziness Handicap Inventory: DHI, Hospital Anxiety and Depression Scale: HADS) were evaluated retrospectively, before and after treatment of continuous positive airway pressure (CPAP).

Results: We analyzed 23 patients (male: female = 16: 7, median age = 68.5 years old). In the polysomnography, CPAP treatment improved the respiratory event due to sleep apnea （$p<0.01$）. In non-REM sleep stages, N1 decreased （$p<0.01$） and N2 increased （$p<0.01$）, significantly. N3 was also increasing, although there was no statistically significance （$p=0.27$）. From these observation, in non-REM sleep, it seems to be shifting to deeper sleep. REM sleep also increased significantly （$p=0.025$）. In the self-administered questionnaire s, sleep disorder(ESS: $p=0.039$, PSQI: $p=0.02$), dizziness disorder （DHI: $p<0.01$）, anxiety and depression （HADS: $p<0.01$）, all subjective symptoms were significantly improved. In the sleep stages, non-REM sleep shifted to deeper sleep, and REM sleep increased. Various subjective symptoms have improved as a result, related to reduction of arousal index.

Conclusions: Improvement of breathing events during sleep may cause smooth brain activities and contribute to higher QOL of patients with Ménière´s disease who suffered with OSA.

Acknowledgements: N/A

TO EVALUATE THE PULMONARY MANIFESTATIONS OF ACROMEGALY

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Introduction: Acromegaly is a rare endocrine disease. The most common respiratory complication recognized is sleep apnea. Acromegaly patients show an estimated risk of mortality from respiratory diseases 1.85 times higher than the general population.
Materials and methods: A total of 68 subjects have been recruited.Clinical symptoms and laboratory parameters were recorded in all cases. Various investigations like Growth Hormone, X-Ray, CT scan, Polysomnography, PFT and Echocardiography were performed as per the routine.Mean age of patient (45.12.±29.36), & for comparison purpose, 34 normal controls (n=15) of mean age (42.56±28.13). The normal value of growth hormone (IGF-1) is age-dependent, so for Age 20-30: 232-385, Age 30-40: 177-382, Age 40-50: 124-290, Age 50-70: 71-269 (Unit: ng/mL=µg/L) is kept as reference.
Results: In the PSG test, 20% of patients had AHI less than 5, 44% had AHI 5-15, 16% had AHI 15-30, and 20% had AHI more than 30. Mean AHI of acromegaly patients was 16.39 ± 3.8, whereas Control subjects (n=34) had a mean AHI of 13.05 ± 5.27. The incidence of central apnea in acromegaly patients (n=34) was 29.2%, mixed apnea 12.4% and obstructive apnoea 58.4%, whereas in control subjects, mean Central apnoea of 11.2%, mean mixed apnoea of 11.1% and mean obstructive apnoea of 77.7% respectively. All the subjects with AHI above 5 were symptomatic: excessive daytime somnolence, fatigue, or lack of freshness in sleep.
Conclusions: The incidence of OSA in acromegaly is high, and patients even with mild OSA are symptomatic. The incidence of central apnea is significantly more in acromegaly patients as compared to control.
Acknowledgements: This project fully funded by uttar pradesh council of science and technology.

Board #173 : Poster session 2

SUVN-G3031, A POTENT AND SELECTIVE HISTAMINE H3 RECEPTOR INVERSE AGONIST FOR THE TREATMENT OF NARCOLEPSY WITH OR WITHOUT CATAPLEXY - DIFFERENTIATING FACTORS WITH COMPETITOR CLINICAL CANDIDATES

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Introduction: SUVN-G3031 is a selective and potent H3 receptor inverse agonist in the clinical development for the treatment of narcolepsy with or without cataplexy. Evaluation for safety, tolerability and pharmacokinetics in healthy human volunteers (Phase-1) and long term safety studies in animals have been successfully completed for SUVN-G3031.
Materials and methods: Extensive nonclinical profiling was carried out for SUVN-G3031 and H3R receptor antagonists / inverse agonists that are currently in active clinical development for the treatment of sleep related disorders. The nonclinical parameters like inter-species binding affinity, selectivity profiling, in- vivo and in- vitro ADME features, nonclinical efficacy, neurochemistry and safety were compared.
Results: SUVN-G3031 has no inter-species variation in binding affinity at H3R with >100 fold selectivity. Unlike competitor compound, SUVN-G3031 has no binding affinity at sigma 1 and 2 receptor up to the highest tested concentration of 10 μM indicating abuse liability for SUVN-G3031 is theoretically remote. It has no inhibition and induction liability towards major CYP enzymes and transporters. SUVN-G3031 has moderate (30%) plasma protein binding. SUVN-G3031 has superior oral pharmacokinetic properties and brain penetration in rat than the competitor compound. EEG study indicated superior wake promoting profile of SUVN-G3031 as against the compound in active clinical development. SUVN-G3031 elicited a dose dependent and marked increase in tele-methylhistamine levels in hypothalamus, a brain region with significance in wake-promotion. SUVN-G3031 showed negligible affinity towards hERG channel with IC50> 10 μM and had no effects on any ECG parameters up to 25 mg/kg in dog telemetry study. SUVN-G3031 showed no convulsion or signs of other CNS safety up to the tested dose of 100 mg/kg, p.o. Unlike competitor compound, SUVN-G3031 has no effects on fertility and embryo-fetal development up to the highest tested doses.
Conclusions: Nonclinical studies demonstrated superior differentiating features of SUVN-G3031 over compounds that are currently in active clinical development for the treatment of sleep related disorders. Phase 2 POC study for the treatment of Narcolepsy is being planned in USA.
Acknowledgements: None

SLEEP HABIT AND INTERNET USE AMONG JAPANESE PRESCHOOLERS

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Objectives: Sleep habit during childhood is affected by daytime activity such as school nap schedule and internet use of the children and caregivers. The aim of the study was to elucidate the difference of sleep habits among preschoolers in different daytime conditions and also to identify the impact of parental internet use on children.
Methods: All public kindergartens and nursery schools in Yamaguchi City, Japan participate in the study. Child and Adolescent Sleep Checklist was distributed to all caregivers of children between 4-5 years of age. Five hundred and seventeen responses (response rate: 62.9%) were included in the analysis. Sleep habits were compared between children attending kindergartens and nursery schools. Sleep habits and internet use of children were also compared with the caregiver usage of internet.
Result: More than half (56.9%) of the children attending nursery schools took regular nap after lunchtime, but 50.2% of children attending kindergartens did not take a nap. Mean duration of nap was significantly longer, bedtime on weekdays and weekends were significantly later, and wake time on weekdays was significantly earlier in children attending nursery schools than children attending kindergartens. In addition, bedtime resistance and unrefreshed feeling in the morning was significantly prevalent among children attending nursery schools. Use of internet of children was twice as longer (0.2 vs 0.4 hours on weekdays and 0.4 hours vs 0.8 hours on holidays) among children whose caregiver use internet more than two hours. Wake time of children was significantly later among children whose caregiver use internet more.
Conclusions: Children attending nursery schools took regular nap and they showed later bedtime and had more problems before and after bedtime. Regular nap at nursery schools was associated with sleep problems of preschoolers. Use of internet of caregivers significantly affect the use of internet of children and also impair sleep habit of children. Careful attention is needed on daytime nap habit and caregiver internet use to maintain better sleep habit among preschoolers.

EFFECT OF ODOR PRESENTATION BEFORE AWAKENING FROM A SHORT SLEEP ON ALERTNESS

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Introduction: In this study, peppermint, which is known to have an arousal effect, was presented before subjects woke up from a short rest period. The purpose of this study was to obtain primary data to design better awakening environmental conditions by examining how awakening action influences alertness after waking.

Materials and methods: An in-subject experimental design was used in this study. A total of twenty subjects (mean age: 21.2 ± 0.8 years), ten male and ten female students without sleep disorders, participated. The subjects were instructed to enter the laboratory at 10:30 PM, to answer a questionnaire, and then to conduct the Stroop color-word test to measure cognition. The subjects were then allowed to sleep for a short time, from 00:00 AM to 04:00 AM. Polysomnography was performed during the sleep period. Thirty minutes before awakening, either a peppermint scent containing 1wt/wt% or odorless air (control) was presented to the subjects. After waking up to the sound of an alarm, the subjects completed the 30-minute cognitive task again. This study was conducted with the approval of the Shiga University Ethics Review Board.

Results: There was no difference between the reaction time after wakefulness when subjects were presented with peppermint scent versus the control condition. However, the number of incorrect answers in the first half of the task increased significantly when peppermint was shown ($p = 0.04$) to the subjects. This result suggests that the presentation of peppermint before awakening may have decreased the subjects' alertness upon wakefulness. The taste of the peppermint scent is one factor where the smell presentation before waking up produced a negative effect. It is known that aroma affects the biological reaction of preference, and an aroma can affect the mood of an individual depending on their degree of preference.

Moreover, the number of incorrect answers in this study increased significantly in subjects who felt that the peppermint smell was unpleasant ($p = 0.000$). In particular, the tendency was remarkable in the first half of the cognitive task. Therefore, in this study, the effect of the taste of the scent was enormous and may have masked the action of peppermint on wakefulness.

Conclusions: This study revealed that the presentation of taste before awakening was largely influenced by preference and that inhaling the scent of peppermint did not affect cognitive function.

Other
Board #342 : Poster session 3
EXPLORING RELATIONSHIPS AMONG SLEEP, EATING, AND PHYSICAL ACTIVITY BEHAVIOURS IN THE POST-SECONDARY POPULATION

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Introduction: Post-secondary students are a vulnerable population for sleep problems, irregular eating patterns, and decreased physical activity. Poor sleep and dietary habits may lead to increased risk for obesity and other co-morbidities. Thus, the purpose of this study was to explore relationships of sleep behaviours with eating and physical activity behaviours among post-secondary health science students.

Materials and methods: Using a cross-sectional study design, participants completed an on-line questionnaire using validated and reliable measures that assessed sleep behaviours (Pittsburgh Sleep Quality Index [PSQI]; Epworth Sleepiness Scale [ESS]), eating behaviours (Three Factor Eating Questionnaire [TFEQ]; National Cancer Institute Daily Fruit and Vegetable Screener), physical activity (International Physical Activity Questionnaire [IPAQ]) along with sociodemographic characteristics and self-reported height and weight. Descriptive statistics for measures were performed for all participants. Independent t-tests and chi-square test were conducted to determine significant sociodemographic and health characteristic differences between those that did and did not meet sleep recommendations (7 to 9 hours per night). Adjusted binary logistic regression analyses controlling for body mass index (BMI) examined whether eating and physical activity behaviours were significantly associated with those that met sleep recommendations.

Results: Participants (n=245) were on average 23 years of age and female (83%), and the majority were full-time students (92%). Mean BMI was within a healthy range (mean 24.58 SD 5.55), with the majority reporting low physical activity levels (65%). The mean PSQI global sleep score was 7.4 (SD 3.3) indicating poor overall sleep quality (mean score >5). Over one-third of participants were categorized as being at high risk for daytime sleepiness and rated their sleep quality as being very or fairly poor over the last month. On average, participants were not meeting the daily recommended fruit and vegetable servings (2.44±1.82 SD per day) and they consumed ~ 3 servings of caffeinated beverages and ~1.5 servings of alcohol per week. About half of participants (n=115, 46.9%) were not meeting the sleep recommendations. Compared to participants meeting sleep recommendations (n=130, 53.1%), those not meeting sleep recommendations were significantly ($p< 0.01$) more likely to be employed, work more hours per week, and have higher BMIs (25.60±6.41 SD vs. 23.68±4.49 SD). Adjusted binary logistic regression analyses controlling for BMI found no statistically significant differences for any eating and physical activity behaviours between participants meeting and not meeting sleep recommendations. However, a non-significant trend revealed that participants not meeting sleep recommendations were more likely to have greater emotional eating and uncontrolled eating behaviours compared to those meeting the sleep recommendations. BMI was found to be significant ($p< 0.05$) in all models.

Conclusions: Findings suggest students, in general, have poor sleep and eating behaviours. Thus creating healthy academic environments should be a high priority for campuses around the world. Supportive campus programs focusing on, healthy sleep behaviours and nutrition education should target students who self-identify with these issues, as well as the entire student community.

COMPACT AND SIMPLE SLEEP ASSESSMENT BY SAMSUNG SLEEP QUESTIONNAIRE

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Introduction: There are many sleep questionnaires to measures self-rated sleep symptoms. The questionnaires selected for sleep assessment may vary by physicians, but in general, demographic background, sleep habits, symptoms of sleep related breathing disorders, symptoms of sleep disturbances, and mood symptoms are assessed. These questionnaires may provide in-depth sleep assessment, however sometimes it can be too many questionnaires for patient and physician to review. We developed 'Samsung Sleep Questionnaire (SSQ), the simple and compact questionnaire to see sleep problems at a glance.

Materials and Methods: The 'Samsung Sleep Questionnaire' (SSQ) was developed by sleep specialists in Samsung Medical Center (SMC). The 11 most informative questions to ask in clinic to optimally assess patients with sleep disorders are selected. All questions are 'yes or no' question. The questions are: 1-Do you snore during sleep, 2-Have you told to have apnea during sleep, 3-Do you wake up more than twice during sleep to go to the bathroom, 4-Do you have trouble falling asleep, 5-Do you toss and turn at night, 6-Do you talk during sleep, 7-Do you act out your dreams, 8-Do you recently nap more often, 9-Do you wake up at night with cramp-like pain in your limbs, 10-Do you consider yourself to have sleep disorder, 11-Do you want to visit sleep specialist for your sleep symptoms. The questionnaire was than compared to level I polysomnography (PSG) and other questionnaires: Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Stanford Sleepiness Scale (SSS), Epworth Sleepiness Scale (ESS), and K-Beck Depression Inventory (K-BDI).

Results: A total of 752 patients who visited SMC with were enrolled, and 694 patients (183 females, 26.4%) who completed the SSQ and PSG were assessed. The mean age was 51.7±14.9 years), and mean BMI was 26.1±4.8 kg/m^2. The SSQ was sum up to be total score from 0 to 11. The SSQ score revealed correlation with other questionnaires: PSQI (r=0.398, p< 0.001), ISI (r=0.452, p< 0.001), SSS (r=0.210, p< 0.001), ESS (r=0.183, p< 0.001), K-BDI (r=0.353, p< 0.001). The SSQ score with PSG parameters: Sleep latency (r=0.517, p< 0.693), Sleep efficiency (r=-0.156, p< 0.001), Wake After Sleep Onset (WASO) (r=0.163, p< 0.001), Apnea-Hypopnea Index (AHI) (r=0.0230, p< 0.001), Arousal Index (r=0.184, p< 0.001), Lowest O$_2$ saturation (r=-0.140, p,0.001).

Conclusions: The SSQ is developed to assess sleep disorders by simple and compact method. The SSQ score shows correlation with previous well-known sleep questionnaires, and objective measures by PSG. The correlation may be weak, but it can be used in cases to avoid exhaustive questionnaires.

AUTOMATIC SLEEP QUALITY QUANTIFICATION FROM HYPNOGRAM WITH MACHINE LEARNING APPROACHES

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Introduction: Sleep quality is directly related to overall health and wellness. Although it is important to quantify the quality of sleep, the existing techniques are insufficient to explain sleep quality because these techniques are based mainly on sleep duration or depth. A methodology that is able to effectively quantify the sleep quality is required. In this study, we propose a Sleep Score based on hypnogram pattern with machine learning algorithm.
Materials and methods: 688 hypnograms of polysomnography were consecutively enrolled. Each hypnogram was analyzed and divided into four groups (grade 1 to 4, with 1 being the best and 4 being the worst sleep quality) based on the numbers of sleep cycles, intervals among cycles, proportions of each sleep stage, N3/REM sleep, and numbers of awakening.. We use Markov chain to obtain sleep stage transition probabilities that represent sequential patterns of each subject's hypnogram. We then used these transition probabilities to construct a logistic regression model that predicts the probability of each grade. Finally, we derived a sleep quality score by a weight sum of predicted probabilities.
Results: Subjects' mean age was 49.6 ±15.17 years (ranged 15-88) and male predominant(71.3%). Four groups consisted of 142 of grade 1, 117 of grade 2, 322 of grade 3, and 107 of grade 4. As the grade increased, there was a significant increase in the mean age ($p < 0.001$) and mean apnea-hypopnea index ($p < 0.001$).
We found that the sleep scores of each grade obtained by the proposed approach were clearly distinguished, and these results were statistically validated.
Conclusions: The sleep score is a simple and intuitive way to understand sleep. In this study, we verified that hypnogram based sleep score was obtained by machine learning algorithm accordingly. This Sleep Score can be useful to monitor progress and treatment responses in people with sleep disturbances.
Acknowledgements: none

Other
Board #345 : Poster session 1
THE EFFECTS OF MINDFULNESS ON ADHERENCE TO CPAP IN PATIENTS WITH ESTABLISHED CARDIOVASCULAR DISORDERS

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Introduction and Objectives: Adherence to continuous positive airway pressure (CPAP) therapy for obstructive sleep apnoea (OSA) is poor in patient with cardiovascular (CV) disease. We assessed the effectiveness of a mindfulness program (MP) intervention in addition to best practice standard care to improve adherence to CPAP therapy in people with low adherence to CPAP and established CV diseases.

Method: Out of 325 patients with established CV disease (secondary prevention or resistant hypertension or atrial fibrillation), with a new diagnosis of OSA and treated by CPAP treatment we identified those with low adherence at one month (less than 2 hours of CPAP therapy per night). Among the total cohort 32% (n=104), were considered non adherent. Participants were assigned to MP randomly and participated to a 8 weeks structured program. The primary outcome was the difference between the groups in CPAP adherence at 1-month, 2-month, 3-month after MP was started. Sleep quality and level of of attention (Mindfulness Awareness Attention Scale) were also assessed. This is a pilot study and thus limited by its sample size.

Results: The number of hours of CPAP use per night in the MP group at 1 months was 4.12 hour and was 3.02 hours in the control group (p = .02). This represents 36 % better adherence in the MP group relative to the control group. These differences were maintained throughout follow up. Patient from the MP group also reported improvements in sleep quality.

Conclusions: Eight weeks MP is an effective intervention that improves CPAP adherence rates compared to standard care alone in patient with established CV disorders and OSA but also sleep quality in patient with established CV diseases.

SLEEP PARAMETERS OF CANCER PATIENTS IN GAZIANTEP-TURKEY : A PILOT STUDY

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Introduction: Sleep-related complaints are very common and frequently underrated problems in cancer patients. The cancer itself or cancer's treatment associated symptoms give rise to some disturbances associated with wellness, functional status and the quality of life. These disturbances may create sleep-related symptoms like insomnia, fatique and daytime sleepiness. The knowledge of sleep problems in cancer patients may supply the treatment options to the sleep problems and reenforcement to the treatment of cancer. Therefore our aim is in this study to define the sleep disturbances in cancer patients.
Materials and methods: Seventy two cancer patients (18-65 years old) were included in to the study. The Pittsburgh Sleep Quality Index [PSQI], EpworthSleepinessScale [ESS] and Insomnia Severity Index [ISI] were used to evaluate the sleep quality, day time sleepiness and insomnia severity respectively. Average nighttime sleep duration , daytime sleepiness, sleeping hours and complaints of frequent awakening were recorded. Inaddition, the patients were asked to determine the questionnaire that best describes their sleep problems. All evaluations were performed at the beginning and during chemotherapy (after the 2nd cure).
Results: The mean age of the patients was 41.00 ± 9.08 years. Fortysix percent of patients were females, and 36% were males. Fourty-seven (47%) of the individuals were breast cancer, 39% were lung cancer and 14% were stomach cancer. In all patients, sleep-related parameters deteriorated between two measurements ($p=0.01$). Sleep quality of individuals were decreased while frequency of waking, ınsomnia severity and day time sleepiness were increased ($p< 0.05$).76% of individuals indicated that PSQI stated to their sleep disturbance better.
Conclusions: The chemotherapy in cancer patients cause deterioration in sleep quality in paralel with increased sleep related complaints. The PSQI is the suggested tool for evaluation of sleep in cancer patients. Paying attention to reduce sleep complaints during chemotherapy in cancer patients should be included in oncological rehabilitation programs.

FATIGUE, SLEEP AND OBESITY BEFORE AND AFTER CHEMOTHERAPY IN PATIENTS WITH BREAST CANCER

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Introduction: Sleep disturbances, changing weight and fatigue are highly prevalent in women with breast cancer; side effects of chemotherapy may worsen pre-existing sleep problems. The aim of this study examination of fatigue, sleep and obesity before and after chemotherapy in women with breast cancer.

Materials and methods: Ninety two women between 18-65 years were included in this study. Body mass index, menapause, changing weıght and waking status were recorded before and after chemotherapy in women with breast cancer. In addition, the sleep quality was evaluated by the Pittsburgh Sleep Quality Index and the fatigue severity by the Brief Fatigue Index. SPSS 21.0 was used for statistical analysis**.** Comparisons were made with Wilcoxon test before and after treatment

Results: After chemotherapy, deterioration in sleep quality, increase in body mass index and feeling themselves as fatique were determined ($p < 0.05$). These complaints were seen more severe in women having menapause after chemotherapy than who had it before chemotherapy ($p < 0.05$).

Conclusions: It is considered that reducing the side effects of chemotherapy, gaining the weight control, increasing sleep quality and reducing fatique symptoms with the aid of individual rehabilitation programs could supply positive effects in quality of life in women with breast cancer during chemotherapy and survival period.

OVERVIEW ON THE USE OF META-ANALYSIS IN SLEEP MEDICINE

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Introduction: Sleep medicine is a recent multidisciplinar area that includes different medical disciplines, such as Cardiology, Neurology, Psychiatry, Pulmonology, Otolaryngology and Pediatrics. In each of these disciplines, meta-analyses are a common way to synthesize data in an evidence-based manner. Regarding Sleep Medicine, the number of publications is growing and evidence is accumulating, but meta-analysis seem still rather uncommon.

Material and methods: A bibliographic search was conducted in Web of science (1945-2017) to demonstrate the importance of meta-analysis in Sleep Medicine. We extracted the total amount of articles per year published in each those six areas composing Sleep Medicine, further evaluating the number of meta-analysis published in each area. The average of these values was taken as a comparator for the values directly related to the field of Sleep Medicine. As there is no specific "sleep medicine" category in Web of Science, a single search for "sleep" would probably retrieve many false positives results (i.e. articles mentioning "sleep" in the abstract but not being directly related to Sleep Medicine). We randomized 200 articles from the original search and evaluated if they actually pertain to Sleep Medicine (i.e. articles in which population, intervention or outcomes are primarily related to sleep). The percentage of sleep medicine-related articles over the 200 evaluated articles were used as a correction factor for every sleep medicine-related statistic. Additionally, we analyzed which countries have the largest publication record regarding sleep-related meta-analysis.

Results: A total of 130 over the 200 articles from the initial "sleep" search were directly related to Sleep Medicine, resulting in a correction factor of 0.65. After analyzing the data, it was observed that the amount of meta-analyses being published in Sleep Medicine has been growing, reaching 163 indexed meta-analyses in 2007; against a single publication in 1990. The percentage of meta-analysis in sleep medicine (0.06%) is lower than in the average of the areas that compose it (0.14%). The number of meta-analysis published in all areas shows a mean growth rate per quinquennium of 20.86% between 1991 and 2015, ranging from 8 to 31%. While the growth rate in the number of meta-analysis in sleep medicine is 15.81%, ranging from -10 to 38%. Regarding the number of meta-analysis published by country, USA, China and England are the most productive countries in most of the meta-analysis publication rankings.

Conclusion: Meta-analysis are an important way to synthesize data in medicine, leading to the higher possible level of medical evidence and usually leading to robust and reliable conclusions. Despite reasonably common in other medical fields, meta-analysis in sleep medicine are rather uncommon. Sleep-related meta-analysis is an area with broad potential for growth, as its publication record are still smaller and grows less than in other areas. Sleep researchers should be encouraged to perform and publish meta-analyses on their field of research whenever there is sufficient data.

SLEEP QUALITY IN CHILDREN HOSPITALIZED DUE TO RESPIRATORY DISEASES IN THE NATIONAL INSTITUTE OF RESPIRATORY DISEASES (INER)

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Introduction: Sleep is fundamental for disease recovery, being involved with an adequate functioning of the immune system and wound recovery. During hospitalization there is a decrease in sleep quality, which has important consequences in the evolution of the patient. Among pediatric patients there are few studies evaluating sleep quality during hospitalization, and none of those are focused on respiratory diseases or study the patients for more than one night. One of the objective ways to evaluate sleep in children is actigraphy, which has been the most common way to evaluate sleep quality during interment so far. We therefore aim to assess sleep quality in children hospitalized due to respiratory diseases (pneumonia and asthma exacerbation) using actigraphy for all the duration of the hospitalization.
Materials and methods: All children from 2.5 to 14 years hospitalized to the pediatric pulmonology ward due to pneumonia or asthmatic exacerbation receive an actigraph to be used during internment. Also, the parents are asked to fill a questionnaire about sleep symptoms and habits are home, receive a sleep diary and are also asked to fill an hourly activity log. Are relevant data are taken from the hospital file, including times of physician and nurse examinations. At the time of discharge the actigraph is returned to the researchers and the information is downloaded for its analysis. The statistical analysis will analyse the difference in sleep time and quality (reported as efficiency) between the disease groups, different ages and with the time recommended by the AASM. Also, the most frequent causes for sleep disruption will be reported, and the change in time and quality across the hospitalization period will be analyzed with ANOVA and mixed regression.
Results: A sample of 48 children was calculated considering that a total sleep time of 540 minutes has been reported while the recommended is 600. 4 children have been recruited from July 1st. Al these children have been hospitalized with a diagnosis of pneumoniae, 2 females and 2 males, with ages of 2.67, 2.12, 5.5 and 3.57 years. According to the actigraphy, total sleep times and sleep efficiency are disminished in the first days of internment, with total sleep time (including naps) ranging from 557 to 707, and sleep efficiency from 74.9 to 80.51. Both improve during internment and are around the recommended for age at discharge, with efficiency ranging from 85 to 95% and sleep time from 620 to 776. Lights and sounds have been reported as interrupting children's sleep.
Conclusions: All children included have shown low sleep efficiency and total sleep time that improve during hospitalization. This may be related to their symptoms at internment and their improvement or may be related to first night phenomenon. As more patients are included in the protocol, we expect to prove this trend and find data that explains it satisfactorily.

SLEEP PATTERNS AND DISTRACTORS IN COLLEGE STUDENTS

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Introduction: Good sleep is imperative for good health, yet adequate sleep is often not a priority, especially among young adults. The National Sleep Foundation (NSF) recommends 7 - 9 hours of sleep for young adults (18-25 years). However, adequate sleep remains a challenge for students in this age group which impacts their health and wellbeing. The objective of this study was to better understand perceptions and habits of sleep in college students.

Materials and methods: Prospective survey conducted by Nithra Institute of Sleep Sciences, Chennai, India, from September - December 2018. A 25-item questionnaire was developed with 5 basic demographic, 16 sleep habits related and 4 general health perception questions. Permission was obtained from the College authorities and questionnaires were administered to students in their classroom by a research personnel.

Results: Of the 14 colleges approached, 6 allowed to conduct the survey. A total of 1,012 students (Age: 17 - 23) participated (Males-53.5%; Females - 46.5%).

50.4% reported difficulty in falling asleep.Bed time of most students (51.7%) was 11pm to midnight or later. Average sleep hours during weekdays was 6.5hrs and weekends was 7.4hrs ($p < 0.001$). Males slept 6.4hrs during weekdays and 7.5hrs in weekends ($p < 0.001$), whereas females slept 6.5hrs during weekdays and 7.3hrs in weekends ($p < 0.001$). There was no significant difference between average sleep hours of Males and Females during weekdays ($p=0.44$) or weekends ($p=0.23$). 91% participants admitted to using electronic gadgets after 10pm, of which 15.6% woke up frequently to check their phones. 40.7% participants said they frequently felt sleepy during their classes.

89.2% felt sleep was very important for good health and 51.9% felt 7-8hrs sleep was essential for good health. 52.4% felt that their day was not appropriately balanced between sleep and other activities and only 37% felt they were overall healthy.

Students who used gadgets after 10PM had significant difficulty in falling asleep ($p < 0.001$); and also felt frequently sleepy in class ($p=0.01$).Similarly, students who woke up during sleep to check their mobile phones felt frequently sleepy during their classes ($p < 0.001$) compared to those who don't.

In India, family members co-sleeping in a bedroom is not uncommon. In our study, 44.2% students slept in the same room as their parent(s). Analysis showed that using gadgets after 10PM or waking up frequently to check mobile phones was not significantly higher in those who were co-sleeping ($p=0.07$ and 0.18).

Conclusions: Most students understand the importance of sleep but manage to sleep less than what they feel is required and perceive the impact on wellness. There was a tendency to sleep longer during weekends and no significant gender differences observed. Delayed bed time, and use of gadgets at night time is very common, neither of which seem to be higher in those who were co-sleeping with family members.

ASSOCIAçÃO NUVEM VITóRIA: THE IMPACT OF BEDTIME STORIES IN PEDIATRIC INPATIENTS SETTING

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Introduction: Sleep problems are common during childhood. Sleep deprivation and poor sleep quality may be especially prevalent in hospitalized children or in those living in unstable or impoverished conditions, as these contexts can cause modification or loss of sleep schedules and bedtime routines, discomfort, pain, and exposure to sleep disruptors (e.g., light; noise). Promoting healthy sleep behaviors in such contexts is critical given that optimal sleep is associated with benefits to child development, emotional and behavioral regulation, and family functioning. Insufficient sleep assumes particularly important in hospitalized children as disrupted nighttime sleep alters normal hormonal regulation related to immune function and natural killer cell activity impairing illness recovery. Also, previous data showed that pediatric units in Portugal lack sleep friendly conditions, highlighting the need for sleep education measures. Some communities have begun to use volunteer initiatives to promote sleep health in children who are sleeping in sub-optimal conditions, however, little is known about the real impact of these programs and strategies.

Materials and methods: The Associação Nuvem Vitória is a Portuguese volunteer-led sleep promotion project that aims to promote sleep health in vulnerable hospitalized children. Every weeknight, from 8pm to 10pm, volunteers from this project read bedtime stories to pediatric inpatients (ages from birth to 21 years), with the purpose of promoting not only a state of readiness for sleep and physical/emotional wellbeing, but also the engagement into sleep-friendly procedures by the hospital staff at night. Storytelling appears to be effective on promoting as well as increasing the quality of sleep during the night. It´s a non-invasive therapy with low cost and safe, with impact on hospitalized children's sleep quality.

Results: Since the pilot intervention in 2016, 5 hospitals have already started their own groups who read bedtime stories to children and their families. We have now over 8.000 hours of volunteering and more than 26.000 stories read by 410 volunteers. Furthermore, some companies that contributed to fund this Association have asked for sleep education sessions for their employees, in a total of 9 sessions and 136 collaborators. Future steps include the study of the impact of this program upon children's readiness for sleep and physical and emotional well-being during hospitalization. We will be interested, also, in assessing how sleep friendly routines among hospital staff change after bedtime storytelling and whether volunteer personnel engage in personalized sleep-friendly routines after volunteer actions.

Conclusions: This is one of the few volunteer efforts around the world that target sleep health in vulnerable children. Increasing knowledge about these innovative volunteer projects will contribute to our understanding of dissemination strategies for sleep health promotion in vulnerable populations, which can in turn inform large-scale initiatives to promote pediatric sleep health through health care settings, educational systems, and public policy.

Acknowledgements: Hospital staff, volunteers and children/families involved in the bedtime stories

OBESITY IS NOT AN INDEPENDENT RISK FACTORS OF OBSTRUCTIVE SLEEP APNEA IN ASIAN HYPERTENSIVE PATIENTS

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Introduction: Obstructive sleep apnea (OSA) has been known to be a secondary cause of hypertension by the JNC VII since 2003. The prevalence of OSA in hypertension is ranged from 30-80% in Western countries. There is limited data on prevalence and risk factors of OSA in Asian hypertensive patients.
Materials and Methods: This study was a cross-sectional study and conducted at hypertension clinic, tertiary care center. The definition of OSA as a cause of hypertension is defined by presence of apnea-hypopnea index of more than 5 events/hour by polysomnography and no other identifiable causes of hypertension. Prevalence of OSA in hypertensive patients was calculated. Risk factors for OSA in hypertensive patients were also studied by using multivariate logistic regression analysis.
Results: There were 726 hypertensive patients treated at the special hypertension clinic. Of these, 324 patients (44.63%) were diagnosed as OSA. Approximately one-third of patients with and without OSA were randomly studied; 106 OSA patients and 147 non-OSA patients. There were 4 independent factors associated with OSA induced hypertension: age, gender, history of snoring, and history of morning headache. The adjusted odds ratio (95% confidence interval) of all factors were 0.97 (0.95, 0.99), 1.95 (1.03, 3.69), 7.95 (4.02, 15.73), and 3.58 (1.51, 8.48), respectively. Body mass index was not significantly related with this condition.
Conclusions: The prevalence of OSA in Asian hypertensive patients was 44.63%. The independent predictors for OSA in hypertension were age, gender, history of snoring, and history of morning headache.
Acknowledgements: None

SLEEP-RELATED EPILEPSY IN DAILY PRACTICE AT CLINIC OF NEUROLOGY-10 YEARS EXPERIENCE OF THE NON-INVASIVE VIDEO EEG LABORATORY RECORDING

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Introduction: Short-term electroencephalography is worldwide used method in patients with seizures.Pre-hospital subjective and objective findings are not always sufficient to evaluate epilepsy, even less the one related to sleep. The long-term non-invasive video EEG method utility in differential diagnostics of seizures related to sleep based on interictal and ictal epileptiform discharges with clinical correlation along video records should be considered. International League Against Epilepsy provides classification of the seizures and epilepsies. Last update was printed in 2017.

Materials and methods: A retrospective study of the consecutive reports of the 24-32 hours video EEG records in years 2008 - 2018 at clinic of neurology. We focused on demographic data, indications and sleep-related ictal and interictal findings and nowadays description of the seizures based on new ILAE 2017 classification of epileptic seizures and epilepsies.

Results: Of 1269 (100%) patients of average age 39.8 ±15.1 years, were 623 (49.1%) men and 646 (50.9%) women. We captured habitual seizure in 148 (11.6%) patients and confirmed epileptiform ictal pattern in 97 (7.65%) cases. Epileptiform interictal activity was recorded in 414 (32.6%) cases. Only sleep-related interictal discharges were found in 180 (14.2%) cases, daytime ones in 156 (12.3%) and in both circadian periods in 78 (6.1%) patients. Of 97 patients with epilepsy we captured sleep-related seizure or seizures in 28 patients. As to new classification of epileptic seizures and epilepsies ILAE 2017 we classify majority of the seizures as focal with motor activity with impairment of consciousness evolving or not into bilateral tonic clonic seizures (FBTCS) and minority as patients with generalized epilepsy with or without motor activity. Parasomnia was suspicious from epilepsy diagnose just in one case only. Myoclonic jerks of drowsiness were observed, but they were not evaluated as clinically significant. Most of the patients with epilepsy related to sleep are resistant to treatment. Two patients we have lost for SUDEP. Both had sleep-related seizures. We have not changed antiepileptic therapy during the recording. Video EEG records presentation available.

Conclusion: Simultaneous record of the sleep-related interictal and ictal video EEG patterns is clinically important for objective description of seizure origin.

Acknowledgements: We recommend non-invasive long term video EEG recording in differential diagnostics process in patients with epilepsy.

INVESTIGATING THE EFFECTS OF SLEEP HYGIENE EDUCATION ON SLEEP BEHAVIORS AND ACADEMIC PERFORMANCE IN COMMUNITY COLLEGE STUDENTS

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Introduction: Poor sleep habits and sleep deprivation are ubiquitous among college students and can lead to poor academic performance and declining physical and mental health. Current research has shown that sleep hygiene education can improve sleep habits and daytime sleepiness in adult populations. The purpose of this study was to determine the effectiveness of sleep hygiene education on academic performance and future sleep behaviors in a population of community college students.

Materials and methods: The current study examined sleep behaviors and daytime sleepiness of college students enrolled in Anatomy and Physiology I and II at the beginning and end of the Spring 2019 semester. A sleep hygiene lecture was presented during the first week of the course. Students were provided with supplementary educational materials on a monthly basis to enhance their learning. Students completed questionnaires after each exam and at the end of each month. These questionnaires provided data about sleep quality, sleep habits and daytime sleepiness. Exam scores were analyzed to provide correlations between sleep quality and academic performance.

Results: The results showed the average Sleep Hygiene Index improved significantly from January to May ($p = 0.02$). Improvements were observed in specific sleep habits including; maintaining regular sleep schedules, avoiding stimulating activities prior to bedtime and avoiding other activities in bed. While there was no significant improvement in ESS or PSQI, many students stated the project improve their sleep habits and understanding of the importance of sleep in their educational careers. No significant correlation was found sleep quality and exam grades. Students self-reported their sleep time, which could account for discrepancies in the data.

Conclusions: Sleep hygiene education presented to college students can improve sleep quality and daytime sleepiness. This information can be utilized by educators and school administrators who are looking for methods of improving academic performance in their students **Acknowledgements:** None

THE ECONOMICS OF SELF-REGULATION AS A SHIFT WORKER TO COUNTER THE SLOW VIOLENCE OF SHIFT WORK: A CASE STUDY

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Introduction: Shift work has been implicated in causing multiple comorbid conditions, including circadian disorders, mood disorders, metabolic disorders, cardiovascular disorders and cancer. Self-regulation in the form of high intensity interval training, diet and shift schedules was previously reported to help counteract the negative effects of shift work, such as anxiety, fatigue, low productivity and poor quality of life. However, there is a cost associated with self-regulation.

Materials and methods: A 5-year (2011-2016) field self-case study of a sleep technologist working 12-hour nights included a log of sleep, shift schedule, sick and mental health days, vacation days, exercise and food intake during nightshifts and days off work. Timing and type of exercise and timing and type of diet was modified over the three years to include high intensity training that included cardio, strength training and yoga, fasting and meditation. The costs of the shift worker's intervention were tracked using T4 slips for salary reductions due to change from full to part time work. Receipts were also collected from personal coaching, gym memberships, personal training sessions, physiotherapy and chiropractor visits, as well as dental costs incurred due to loss of benefits.

Results: Shift schedules changed from full time with benefits (37.5 hours/wk.) to part time with no benefits (26.25 hours/wk.) over 3 years to increase recovery time and in conjunction with daily timed exercise (02h00 on night shifts and 15h00-18h00 on days off) and strict macronutrient diet. A combination of regimented balanced diet, 12-hour fasting and guided daily meditation elevated mood, reduced fatigue and anxiety, increased productivity at work and improved work-life integration. Sick time was reduced from 9 days per year to 0 days. The cost of self-regulation included decrease in gross salary (>$85,000 to < $56,000/year) and increase in expenses to cover dental (>$1000.00/year), training for high intensity and prevention of injury (> $5000/ year), loss of paid vacation days (< $10,000) and loss of paid sick days.

Conclusions: Regular consecutive night shifts followed by at least 5 days off and a flexible day shift on a two week cycle reinforced with self-regulation in terms of daily timed exercise and meals, and a 12 hour fast led to better mental and physical health, reduced sick days, increased productivity and improved work life integration. The cost of the interventions increased while the salary decreased that makes this shift worker's process of self-regulation unsustainable. Future research on interventions to counteract the negative effects of shift work should also take into account the economic burden of the intervention itself.

Acknowledgements: Kingston General Hospital Sleep Disorders Lab, Dr. Helen Driver, Jennifer Snyder, Dr. Nicolle Domnik

DO SLEEPING CHILDREN RESPOND BETTER TO A SMOKE ALARM THAT USES THEIR MOTHER'S VOICE?

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Introduction: Being asleep increases fire-related fatality risk. This study tested whether children awaken from slow wave sleep and perform an escape procedure better to a voice smoke alarm that uses their mother's voice compared with a female stranger's voice or a low-frequency tone alarm.

Materials and methods: Using a randomized, non-blinded, repeated measures design, children 5-12 years old were exposed during stage 4 slow wave sleep (S4S) to 4 smoke alarm signals: 1) the voice of the child's mother, 2) the voice of a female stranger, 3) low-frequency 520 Hz square wave T3 tone, and 4) conventional residential high-frequency 3,200 Hz tone. The alarms were assessed for ability to awaken the children and prompt performance of a simulated escape procedure. To minimize the possibility of a sequence effect, 4 sequences of alarm signals were randomized based on the Latin Square. Voice and tone alarm recordings were played through small, smoke alarm-size speakers in the study bedrooms, which simulated realistic residential conditions and provided consistent alarm signals at 85dB, measured at the child's pillow. Subjects were taught a simulated escape procedure on the night of the study. Continuous EEG, electro-oculography (EOG), and chin electromyography (EMG) via telemetry with synchronized low-light video monitoring was conducted once bedroom lights were turned off. Each child was allowed to progress into S4S for 5 minutes before an alarm was triggered. "Time-to-awaken" is the interval from the triggering of the alarm to the initiation of at least a 3-second arousal associated with movement and subsequent awake EEG. The interval from when the alarm was triggered until the child opened the bedroom door is the "time-to-escape." If an alarm failed to awaken the subject after 5 minutes, research staff and the parent manually awakened the child. This procedure was conducted during the first and second sleep cycles on 2 separate study nights at least 3 days apart, resulting in each child being exposed to 4 different alarm signals.

Results: Among the 176 subjects, 78.4%, 83.0%, 88.1%, and 49.4% awakened and 78.4%, 81.3%, 85.8%, and 48.3% successfully performed the escape procedure within 5 minutes of alarm onset in response to the mother's voice, stranger's voice, low-frequency tone, and high-frequency tone alarms, respectively; while the median time-to-escape was 23.0, 24.0, 41.5, and >300 seconds for these four alarms, respectively. The proportions of children who awakened and escaped increased with increasing age with no association with gender.

Conclusions: The 2 voice alarms and low-frequency tone alarm significantly out-performed the high-frequency tone alarm under residential conditions with the low-frequency tone alarm and female stranger's voice alarm performing best. Compared with the voice of a female stranger, personalizing the alarm message with the voice of the child's mother <u>did not</u> increase alarm effectiveness. Future research is ongoing to assess the effectiveness of a low-frequency hybrid alarm in children with the ultimate goal to develop an alarm that is effective for all ages.

Other
Board #213 : Poster session 2
SLEEP DURATION RATHER THAN SLEEP TIMING IS ASSOCIATED WITH OBESITY IN ADOLESCENTS

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Introduction: We investigated sleep patterns including sleep duration and sleep timing of adolescents and determined which sleep-related parameters are associated with a risk of adolescent obesity.
Materials and methods: In this cross-sectional study, we evaluated 22,906 adolescents between 12 and 18 years of age (mean 15.2 ± 1.7 years; male 50.9%). Self-report questionnaires were used to assess body mass index (BMI) and sleep habits. Obesity was defined as BMI-for-age of $\geq 95^{th}$ percentile. We estimated average sleep duration, weekend catch-up sleep (CUS) duration, mid-sleep time on free days corrected for oversleep on free days (MSFsc), and social jetlag. We performed multivariate analysis to determine sleep-related factors independently associated with obesity and BMI.
Results: Average sleep duration was 7.1 ± 1.2 h, which linearly decreased with age ($P < 0.001$). However, MSFsc and social jetlag significantly increased with age ($P < 0.001$). The prevalence of obesity was 6.0% (95% confidence interval [CI] 5.7 - 6.3%). Both average sleep duration ($P = 0.001$) and weekend CUS duration ($P < 0.001$) of obese adolescents were shorter than that of non-obese controls. However, there was no significant difference in MSFsc ($P = 0.256$) or social jetlag ($P = 0.269$) between the two groups. Multiple logistic regression analysis showed that obesity was significantly associated with short average sleep duration (odds ratio [OR] 0.91, 95% CI 0.86 - 0.96), short weekend CUS (OR 0.92, 95% CI 0.89 - 0.95), and male (OR 1.81, 95% CI 1.61 - 2.04). Multiple linear regression analysis confirmed that BMI was negatively correlated with average sleep duration ($B = -0.15$, 95% CI -0.19 - -0.11) and weekend CUS ($B = -0.09$, 95% CI -0.11 - -0.06).
Conclusions: Our observations suggest that the insufficient amount of sleep rather than the sleep timing or its misalignment may play a pivotal role in the weight-gain processes in adolescence.
Acknowledgements: None.

Board #091 : Poster session 1

RELATION BETWEEN SLEEP QUALITY AND DAILY PHYSICAL ACTIVITY IN CHRONIC SCHIZOPHRENIA PATIENTS

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Introduction: In a general terms, sleep disorders are often seen as a precursor to the onset of symptoms and symptoms of psychiatric disorder. Activity amount during the daytime contributes to sleep-wake rhythm synchronization. An increase in sedentary time and a decrease in Moderate to Vigorous Physical Activity (MVPA) may impair sleep quality. Therefore, is the activity (sedentary behavior time or MVPA) of patients with chronic schizophrenia related to objective sleep index?

Purpose: The purpose of this study was to examine the correlations among objective sleep variables and daily physical activity in schizophrenia patients.

Design: Research study

Materials and methods: Twenty schizophrenia patients (twelve men and eight women, mean age: 59.0 ± 9.8yrs) constituted sixteen inpatient and four outpatient.We evaluated for objective sleep variables and daily physical activity for one week. Total sleep time (TST), Sleep efficiency (SE) and waking after sleep onset (WASO) were determined by wrist actigraphy. Daily physical activity was assessed by three-dimensional accelerometer. All subjects for this study were recruited following authorization by the Ethics Committees of the College of Nursing Art and Science, University of Hyogo.

Results: The grand mean of total sedentary behavior time, total sedentary bout, Moderate to Vigorous Physical Activity (MVPA) and METs Rate were 695 ± 104min, 121.7 ± 42.6time, 46 ± 41min and 1.1 ± 0.1METs. The sedentary behavior (behavior below 1.5 MET during wakefulness) account for about 70% of wakefulness, thus schizophrenia patient's activity was generally low Met. TST, SE and WASO were 6h58m $\pm$ 47m, 85.0 ± 6.0 % and 46.3 ± 27.3 min, respectively. MVPA was significantly positive correlated with SE ($r = 0.536$, $p < 0.05$), negative correlated with WASO ($r = -0.580$, $p < 0.01$). The sedentary behavior was significantly correlated with SE ($r = -0.592$, $p < 0.01$) and WASO ($r = 0.503$, $p < 0.05$).

Conclusions: Our results suggest that sleep quality in schizophrenia patients may be more effectively improved by increasing the MVPA or reducing the sedentary behavior.

SOMATIC SYMPTOMS AND SUBJECTIVE SLEEP QUALITY OF PATIENTS WITH STRESS-RELATED DISEASES IN AN OUTPATIENT DEPARTMENT OF PSYCHOSOMATIC MEDICINE - A RETROSPECTIVE OBSERVATIONAL STUDY

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Introduction: Pain is known to interfere with sleep. However, comprehensive studies on association between other somatic symptoms and subjective sleep quality is lacking. The present study aims to analyze factors related to subjective sleep quality in stress-related disorders.

Materials and methods: In this retrospective observational study, we included patients with stress-related disorders with primary somatic complaints, at their first visit to our outpatient department of psychosomatic medicine, between April 2018 and March 2019. Inclusion criteria included a diagnosis of depressive disorders (DD), anxiety disorders (AD), trauma- and stressor-related disorders (TSRD), somatic symptom and related disorders (SSD), eating disorders (ED), or functional somatic syndrome (FSS). We excluded patients with schizophrenia spectrum disorders, neurocognitive disorders, bipolar and related disorders, substance-related disorders, pregnancy, and any serious physical illness. To assess subjective sleep quality, we used the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) using 5/6 as cut-off global score; higher scores indicated impaired sleep. The Center for Epidemiologic Studies Depression Scale (CES-D) was used to assess depression with a cut-off score of 15/16 for diagnosis of clinical depression, higher scores indicating more severe depression. Spearman's rank-order correlation was used to analyze the relationship of global PSQI-J score of each subject with the variables of age, gender, CES-D score, and the presence of somatic symptoms. The somatic symptoms evaluated were bodily pain (BP), general malaise (GM), vertigo/dizziness (VD), digestive symptoms (DG), cardiovascular symptoms (CV), respiratory symptoms (RS), sensation of heat/perspiration (HP), and physical discomfort (PD). To determine factors affecting subjective sleep quality, we performed a multiple regression analysis, using the global PSQI-J score as the objective variable, and significant variables of the Spearman's rank-order correlation as explanatory variables. Confidentiality of participant records for identity protection was ensured.

Results: Eighty-eight patients were included in our study (19 males, 69 females, mean age 48 ± 20 years). The diagnosis of stress-related disorders was as follows: DD (13), AD (17), TSRD (11), SSD (22), ED (2), and FSS (23). The mean global PSQI-J score was 10.2 ± 4.2 and mean CES-D score was 26.7 ± 13.8. The somatic symptoms documented were BP (21), GM (8), VD (25), DG (32), CV (26), RS (13), HP (7), and PD (10) with some overlap. The global PSQI-J score was significantly directly related with BP ($\rho = 0.21$; $p < 0.05$) and CES-D score ($\rho = 0.40$; $p < 0.001$), and inversely related with GM ($\rho = -0.23$; $p < 0.05$), using the Spearman's rank-order correlation. On multiple regression analysis, the CES-D score was the only significant variable of the global PSQI-J score ($\beta = 0.36$; $p < 0.001$).

Conclusions: Subjective sleep quality was mostly impaired in stress-related disorders. It was poorest in patients with severe depression and in those with BP, but relatively better in patients with GM. Severity of depression was the only independent factor related to subjective sleep quality. Hence, somatic symptoms possibly affect sleep quality due to associated depression in stress-related disorders.

EXPLORING SLEEP PROBLEMS IN PATIENTS SEEN AT AN ADOLESCENT CONCUSSION CLINIC: A PILOT STUDY

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Introduction: Recent studies have shown that sleep deprivation, insomnia and/or daytime sleepiness increase the risk of injury/concussion in adolescents and athletes. Although sleep is essential to well-being and recovery, it is often overlooked and not emphasized. We investigated to what degree sleep/wake-behaviour-related information is captured in adolescent patients who experienced a concussion.

Materials and methods: 49 patients aged 12-18 years who had experienced a concussion due to sports injury between 2014 and 2019 were reviewed. Their referrals were made to the Adolescent Complex Concussion Clinic at the GF Strong Rehabilitation Centre (Vancouver, Canada) because either their prolonged post-concussion symptoms and/or functional disability had raised concerns and required tertiary care. Patients were seen between 7 days and 17 months after their most recent injury; two patients have not been since their most recent injury.

(A) The following information was available:

(i)The Rivermead Post-Concussion Symptoms Questionnaire (PCSQ): Likert scale of 16 symptoms commonly experienced following mild TBI.

(ii) The Kutcher Adolescent Depression Scale (KADS): Six-item Likert scale used to identify young people at risk for depression.

(iii) The Patient-Reported Outcomes Measurement Information System (PROMIS) Anxiety Short Form: Eight-item Likert scale for recognizing the manifestation of anxious behaviours.

(B) The BEARS sleep screening concept (Owens & Dalzell, 2005) was applied to extract sleep-related information from medical reports.

(C) Medication data and blood work results were also reviewed to explore indirect hints in regards to sleep disturbances.

Results: (A) At entry (when the patients were introduced to the program), sleep disturbances measured in the PCSQ correlated with (i) restlessness (PCSQ; Spearman's r = 0.554, p< 0.01) and (ii) tiredness (KADS; Spearman's r=0.566, p< 0.01). Additional correlations with PCSQ, KADS, and PROMIS questions were found, but not reported here.

(B) In 33/49 cases, sleep/wake-behaviour related information was captured with the BEARS screening concept. 33/33 cases reported excessive daytime sleepiness; 26/33 had challenges with keeping/applying routines; 19/33 reported falling asleep and 8/33 sleep maintenance problems (insomnia); only one case was at risk for sleep disordered breathing.

(C) Medication data was available in 31 cases; melatonin was most frequently used (8/31 cases). Blood work was reported in only 2 cases, which were taken 6 weeks and 3 years post-injury, respectively.

Conclusions: Sleep disturbances at entry to the concussion program correlated significantly with tiredness and restlessness. In the reports, excessive daytime sleepiness was also mentioned. This data suggests the need for a prospective approach with structured sleep assessments and the use of sleep as an outcome measure during therapeutic interventions.

PSYCHOSOCIAL AND CULTURAL INFLUENCES ON SLEEP HEALTH IN URBAN AMERICAN INDIAN/ ALASKAN NATIVE ADOLESCENTS: PRELIMINARY RESULTS FROM THE NAYSHAW STUDY

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Introduction: Poor sleep health may contribute to pervasive racial/ ethnic disparities in cardiometabolic and behavioral health outcomes, including cardiovascular disease, diabetes, and alcohol and other drug use. American Indian/ Alaskan Natives (AI/ ANs) are recognized as one of the most at-risk racial/ethnic groups in the United States for adverse cardiometabolic and behavioral health outcomes, but are rarely represented in sleep research. Of the few existing studies on sleep health in AI/AN populations, most have been focused on adults and those living on reservations. However, adolescence is a critical developmental period for the development of sleep problems as well as downstream health consequences. Moreover, urban AI/ANs constitute approximately 70% of the total AI/AN population and represent a highly disenfranchised and marginalized population who may be at particular risk for poor sleep health. The Native American Youth, Sleep, Health and Wellness (NAYSHAW) Project is the first project to incorporate longitudinal assessments of objectively (via actigraphy) and subjectively measured sleep, surveys of psychosocial and cultural risk factors and other health behaviors, and cardiometabolic markers in a sample of urban AI/AN youth. The current study presents preliminary findings concerning multi-level influences on sleep health in the NAYSHAW sample, including individual, family, neighborhood, and cultural factors.

Materials/ Methods: We examined multiple dimensions of sleep health, including actigraphy-assessed sleep duration, efficiency, wakefulness after sleep onset (WASO), and social jetlag (absolute value of difference between weekend and weekday sleep midpoints), and self-reported sleep quality and sleep disturbances (including a screener for obstructive sleep apnea). Survey assessments of individual (depression and anxiety), family (conflict and cohesion), neighborhood (safety and cohesion), and cultural factors (discrimination, historical loss, AI/AN cultural identity) were examined as potential risk factors for objective and subjective sleep disturbances, after adjusting for age and sex.

Results: Participants (N = 82) were on average 14.1 years old (SD=1.31; range 12-16) at baseline and 65.9% female. Sleep duration, on average, was 6.8 hours, which is well under the recommended sleep duration of 8-10 hours for this age group. Average sleep efficiency and WASO were 79.3% and 80.67 minutes, respectively, suggesting poor sleep continuity. Average social jetlag was 80.25 minutes (SD=44.90). At the individual level, depressive and anxiety symptoms were associated with subjectively reported poor sleep health, and anxiety was also associated with shorter WASO. Higher family conflict and lower family cohesion were associated with subjectively poor sleep health, but not with actigraphy sleep outcomes. Greater AI/AN cultural identity was associated with a lower likelihood of social jetlag. Discrimination was associated with poorer subjective sleep health. Higher neighborhood safety and cohesion were associated with better subjectively reported sleep health.

Conclusions: These preliminary results demonstrate several indicators of poor sleep health in this population, including short sleep duration, poor sleep continuity, and social jetlag. In addition, findings highlight the importance of considering multi-level influences on AI/AN sleep. Findings will be discussed in relation to challenges and opportunities to engage in culturally-sensitive research among at-risk populations, with the ultimate goal of reducing health disparities in AI/AN youth.

SLEEP AND FATIGUE IN WOMEN WITH AND WITHOUT SYSTEMIC LUPUS ERYTHEMATOSUS

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Introduction: Systemic lupus erythematosus (SLE) is a chronic autoimmune disease which affects multiple organs including the skin, joints, mucosal membranes, kidneys, and neurological and hematological systems. It is a female preponderance disease with unknown causes and its clinical manifestations vary among individuals depending on which body systems are affected. Up to 50-85% of patients with SLE experience sleep disturbances and approximately 80% report high fatigue symptoms. Fatigue has been reported to fluctuate across the day in SLE, but most studies on patients with SLE and their healthy counterparts have been primarily focused on general levels of fatigue, leaving fatigue in SLE a poorly understood symptom. A better understanding of the diurnal fatigue pattern and its correlates would facilitate designing more effective therapeutics to improve symptom management in individuals with SLE. The purpose of the study was to examine sleep and diurnal patterns of fatigue in women with and without SLE.

Materials and methods: This was a comparative correlational study involving 83 women with SLE and 84 healthy women without SLE. Data were collected from September 2015 to December 2016. Women with SLE were recruited from an outpatient rheumatology clinic at a medical center in northern Taiwan. An age-matched healthy control group of women was recruited by personal referral. Both groups of women kept a 7-day sleep-fatigue diary and completed symptom-related questionnaires. Women reported their levels of fatigue in the morning upon awakenings and in the evening before bedtimes using a 0 (not at all) to 10 (extremely) numerical rating scale, with higher scores reflecting more severe fatigue. Differences between women with and without SLE were compared using student's t test and chi-square test. The time-dependent association between sleep and fatigue was analyzed using multiple linear regression models with generalized estimating equations methods which were conducted separately for women with and without SLE.

Results: Sixty women with SLE and thirty-five healthy women were classified as poor sleepers (72.3% vs 41.7%, p < 0.01). Shorter sleep duration and more nocturnal awakenings were significantly associated with increased morning fatigue of the subsequent day in both groups of women. Higher anxiety scores, lower depression scores, and less daytime napping were significantly associated with increased fatigue in the evening in women with SLE.

Conclusions: Predictors of morning fatigue are distinct from evening fatigue in women with and without SLE. Women with SLE who report morning fatigue may benefit more from nocturnal sleep enhancement strategies while daytime napping and coping with anxiety or depression symptoms should be targeted for those who complained about evening fatigue. Future studies on SLE are warranted to examine whether a tailored intervention program based on diurnal patterns of fatigue and their distinct correlates would be more effective in alleviating fatigue than a more generic intervention approach.

LIVER ENZYMES AND SLEEP FRAGMENTATION IN OBESE PATIENTS WITH OSA

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Introduction: The primary purpose of this study was to examine liver enzymes such as Alanine Aminotransferase (ALT), and Aspartate Aminotransferase (AST) in obese patients with OSA. ALT is an acceptable marker for hepatic steatosis in epidemiological studies and can be used for both diagnostic and monitoring purpose.

Materials and methods: We prospectively approached all consecutive patients referred to the sleep clinic of the Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán (INCMNSZ), which is a tertiary healthcare center in México City. The study was approved by the INCMNSZ Institutional Committee for Biomedical Research Involving Humans (protocol # 1387); written informed consent was obtained from all patients. To be included in the study, patients had to have a BMI = 30 kg/m^2 (N = 128); in addition, they must not have had a history of hypothyroidism, hypoventilation, chronic obstructive pulmonary disease, heart failure, major psychiatric and neurological disorders, current use of psychotropics or hypnotics, they must not have been shift workers, or have been treated with positive pressure or have undergone bariatric surgery. In order to avoid confounding by other factors that might cause ALT elevation, alcohol abuse was determined clinically by a gastroenterologist and such patients were excluded. Presence of viral and auto-immune liver diseases and usage of hepatotoxic medication were also exclusions. Our final analytic cohort included 108 obese participants (47 men and 61 women).

Patients underwent two consecutive nights in the sleep laboratory for polysomnography (PSG). Recordings began at the typical bedtimes of the subjects and ended at their typical wake up time in the morning. Quantitative evaluations of sleep stages were generated visually by an experienced technologist using the American Academy of Sleep Medicine (AASM) rules.

Results: We divided the sample by those above the ALT normal limit, defined as > 40 IU/L for men and > 31 IU/L for women. The elevated ALT group had similar BMI 48.9±10.1 vs 46.9±10.5 kg/m^2, p=0.347) and severity of OSA (AHI= 39.3±31.7 vs 32.8±36.5, p=0.349) to the normal group, but, by definition, were significantly different in ALT (23.6±7.1 vs 62.6±30.1 IU/L, p=0.0001). Elevated ALT patients also were younger (34.6±11.8 vs 40.2±10.5, p=0.013 years/old) and had higher fasting glucose (109.8±16.7 vs 96.7± 15.4 mg/dl). Interestingly, despite being younger, PSG showed that elevated ALT patients had evidence of greater sleep fragmentation, with a longer wakefulness after sleep onset (WASO) (84.6±68.7 vs 63.8±38.5 min, p=0.047), and higher number of awakenings > 1 min (13.4±11.4 vs 9.5±5.0, p=0.019). AST (IU/L) also differed between normal 22.5±6.1 and high 49.7± 5.1 ALT levels group (p < 0.0001).

Conclusions: These data suggest that younger obese patients with at least moderate OSA and fragmented sleep are at greater risk of hepatic impairment. Future research should determine if sleep fragmentation is an independent factor increasing risk for transaminase level in these types of obese patients.

FIBROMYALGIA AND SEVERE OBSTRUCTIVE SLEEP APNEA EFFECTIVELY CONTROLLED WITH A MANDIBULAR ADVANCEMENT DEVICE

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Introduction: Chronic pain is known to interact with sleep in a bidirectional way favoring either persistent pain and maintained sleep complaints. Obstructive Sleep Apnea (OSA) is linked to sleep disruption and therefore is a putative mechanism for the vicious cycle of sleep disturbance and chronic pain. We present a case of a patient with Fibromialgia comorbidly cursing with OSA which was successfully controlled for both conditions with a Mandibular Advancement Device.

Case report: MC is a 61-year-old female who was originally referred to a rheumatologist for evaluation and treatment of fibromyalgia diagnosed at age of 40. Despite several pharmacological approaches with analgesic, muscle relaxants, anticonvulsants and sedatives, she remained symptomatic and with persistent severe discomfort. Furthermore the report of severe sleepiness (Epworth Sleepiness Scale - ESS =20) and self perceived disturbed sleep lead rheumatologist to ask for a sleep study (PSG) which confirmed a sleep disorder - Severe Obstructive Sleep Apnea (Apnea Hipopnea Index - AHI=43/h). Although firstly referred to Continuous Positive Airway Pressure Therapy, patient refused that option and therefore an alternative treatment with a Mandibular Advancement Device (PM Positioner) was offered. After adequate oral based evaluation, fabrication of the device and respective titration (until 8 mm of advancement:50% of maximal protrusion) clinical follow up revealed improvements on either sleepiness (ESS=3) and general symptomatology. A after clinical stabilization a post therapeutic PSG showed marked improvements with an increase in Total Sleep Time (from 334,5 min to 358 min), a higher percentage of either N3 (11,1% versus 19%) and REM sleep (14,6% versus 17%) stages, and a residual AHI of 4.4/h.

Pain Quantification Scale revealed a complete resolution of pain after respiratory oriented therapy (10 versus 0).

Conclusion: In this patient, successful treatment of OSA leaded to an absolute control of fibromyalgia thus confirming the clinical relevance of the interaction between adequate sleep and improvement of chronic pain.

EXPLORING SLEEP CONCORDANCE AND NIGHT-WAKE ASSOCIATIONS IN PARENT-CHILD DYADS USING ACTIGRAPHY

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Introduction: Recurrent sleep disturbances in children are associated with decreased subjective sleep quality and increased insomnia severity in parents. However, sleep associations using actigraphy in this dyad are less understood. It is also unclear how parent's night-time awakening corresponds to their child's awakening. This exploratory study aimed to assess sleep concordance and night-wake associations in parent-child dyads using actigraphy.

Materials and methods: N=13 non co-sleeping parent-child dyads (M_{age}=36.17±6.76y parents, 5.06±2.19y children) wore actigraphy for 14 days (total 186 nights). Min-by-min sleep concordance was determined to ascertain if parents and children were awake at the same time. Each 60-sec epoch was coded as wake/asleep for parent-child dyads and concordant epochs (e.g. both parent and child asleep, or both awake) were calculated. Concordance was determined as a percentage by dividing concordant epochs by total number of epochs and multiplying by 100. Further, a five-minute, modified blip analysis was used. For both parent and child, initiation of arousals of ≥5 minutes were noted and then the first five minutes were 'acti-blipped' for each night. These were cross referenced with each other for awakening in the 5-min a) epoch before (-1), b) same epoch (E-E), and c) epoch after (+1). Hit-rates were calculated as $\sqrt{xy}$, where x=proportion of child acti-blips matched to parents and y=parent acti-blips matched to child's acti-blips. Combined 5-minute blip hit-rates (E-E±1) were calculated for 13 true and five pseudo parent-child dyads.

Results: Sleep concordance ranged from 58-82% (M=71.42±9.37). Mann Whitney U-test revealed significant differences in a) combined hit-rate (E-E±1) between true (M=.30±.10) and pseudo (M=.10±.04) parent-child dyads (U=.00 p=.001), and b) between percentage of parent awakening within 10 minutes of child's night awakening (M=33.50±20.75) compared to percentage of child awakening within 10 minutes of parent's (M=10.83±3.60; U=11, $p<$ .001). During the 14-nights, 29% of parent awakenings occurred within 5 mins of their child's awakening. In contrast, only 6% of child's awakenings occurring within 5-min of their parents awakening.

Conclusions: Preliminary evidence demonstrates strong sleep concordance in parent-child dyads. Parents have child related night-awakenings, which can make them vulnerable to insomnia. Future studies should address possible interventions for these parents.

Acknowledgements: The authors would like to acknowledge all lab members for the support with this project.

THE IMPACT OF MODERN LIFESTYLE ON SLEEP: THE END OF A MYTH?

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Introduction: Urban lifestyle with artificial light, screens and internet connection is believed to negatively impact sleep quality compared to rural pre-modern lifestyle. However, that assumption is difficult to demonstrate in western societies due to the lack of historical data on sleep quality in the pre-industrialized era.
The aim of this study was to compare sleep quality between two subsaharan rural and urban populations with and without access to modern lifestyle.
Materials and methods: BeSAS (**Be**nin **S**ociety **A**nd **S**leep) is an ongoing cross-sectional epidemiological study started in April 2018 and comparing sleep habits and complaints of a rural and an urban population in Benin (West Africa). Participants from the rural area were recruited in Tanvè, a rural district located in Agbangnizoun city (central Benin), where inhabitants have only scarce access to artificial light, and no screens nor internet connection. Participants from an urban area with all modern facilities were randomly selected in the 3rd district of Cotonou city (the economic capital of Benin).
Pittsburg Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) were used to assess sleep quality and insomnia complaints. Data were collected by computer assisted personal interview (CAPI) using tablets by experienced investigators. PSQI global score and its components as well as ISI results were compared between the two populations after adjusting for age and sex using analysis of covariance for continuous variables and logistic regression for categorical variables. The statistical significance was set at 0.05 for p value. Ethical approval was obtained from the National ethics committee and all participants gave an informed consent.
Results: By December 2018, a total of 1133 participants were recruited: 464 (40.95%, mean age 43.5±13.1 y.o, 70.3% females) in rural area and 669 (59.05%, mean age 49.1±15.9 y.o, 58.6% females) in urban area. After adjustment for age and sex, rural subjects had a higher ISI score (mean ± SD): 6.65 ±4.12 vs 4.56 ± 4.10, p=0.0001, and a higher PSQI score (mean ± SD): 6.72 ± 3.13 vs 6.1 ± 3.11, p=0.0006 compared to urban subjects. Analysis of PSQI components showed that urban subjects had a higher sleep efficiency (mean ± SD): 81.84%±15.29 vs 73.68 ±16.11, p< 0.0001, a lower risk of complaints of sleep disorders (OR=0.48, $IC_{95\%}$: 0.33-0.69, p< 0.0001) and daytime dysfunction (OR=0.70, $IC_{95\%}$: 0.52-0.97, p=0.034) compared to rural subjects. There was however no difference between the two populations regarding subjective sleep quality, sleep latency, sleep duration and sleep drugs use.
Conclusions: Rural subjects with pre-modern lifestyle report a lower overall sleep quality and more complaints of sleep disorders including insomnia than urban subjects with a modern lifestyle. These results suggest that, opposite to common belief, pre-modern rural lifestyle without screens, artificial light nor internet connection is not protective from sleep disorders and sleep complaints. Further investigations using objective sleep assessment are currently conducted to better understand this paradoxical finding.

SLEEP DURATION AND BREAST CANCER INCIDENCE: RESULTS FROM THE MILLION WOMEN STUDY AND A META-ANALYSIS OF PUBLISHED PROSPECTIVE STUDIES

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Introduction: Short sleep duration, as a proxy for greater exposure to light at night, has been hypothesised to increase breast cancer incidence. However, findings from previous observational studies of sleep duration with breast cancer risk have been mixed. We analysed data from a large UK prospective cohort and conducted a meta-analysis of published prospective studies.

Materials and Methods: The analyses in the Million Women Study (MWS) were based on total sleep duration collected in the 3-year resurvey questionnaires during 1999-2005 from 805,083 women (mean (SD) age, 60 (5) years) who had not had a diagnosis of cancer prior to baseline. With a mean follow-up of 12.7 years, 36,257 incident breast cancer cases (ICD-10 C50) were recorded. Women were categorised according to < 6, 6, 7-8 (referent), 9 and >9 hours of sleep in 24 hours. Cox regression models yielded multivariable-adjusted breast cancer hazard ratios, hereafter called relative risks (RR), and 95% confidence intervals (95% CIs) for women with different sleep duration categories. To minimise reverse causation bias, the first five years of follow-up were excluded from the main analyses. We performed a meta-analysis of results from prospective studies of breast cancer incidence in relation to total or night-time sleep duration published up to 13 November, 2017. Using inverse-variance weighted averages of study-specific log RRs, we combined estimates of short sleep (< 7 hours) versus referent sleep duration (mostly 7-8 hours), and of long sleep (>8 hours) versus referent sleep duration.

Results: In the MWS, 66% of women reported 7-8 hours of sleep, 23% reported shorter sleep (< 7 hours), and 10% reported longer sleep (>8 hours). Compared with 7-8 hours of sleep, the RRs for < 6 and 6 hours of sleep were 0.98 (95% CI, 0.92-1.04) and 0.98 (0.95-1.02), and the RRs for 9 and >9 hours of sleep were 1.00 (0.95-1.06) and 1.06 (0.98-1.14), respectively. In a meta-analysis of our study and ten other prospective studies with a total of 1.4 million women, compared with referent sleep duration (37,664 cases), neither short (16,224 cases) nor long (4,958 cases) sleep duration was associated with breast cancer incidence (RR $_{short\ vs\ referent}$ = 0.98; 95% CI, 0.97-1.00; and RR $_{long\ vs\ referent}$ = 1.02; 95% CI, 0.99-1.05, respectively).

Conclusion: The prospective evidence does not show an association between sleep duration and breast cancer incidence.

INVESTIGATING WHETHER BRONCHODILATOR MEDICATIONS CAN PREVENT EFFECTS OF ROSTRAL FLUID SHIFT ON AIRWAY NARROWING IN ASTHMA - PRELIMINARY RESULTS

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Background: Asthma affects 8% of Canadians. Nocturnal exacerbation of asthma is a clinically important phenotype of asthma and is common in two-thirds of asthma patients [1]. The recumbent posture [2, 3] and sleep [4] increase lower airways narrowing and nocturnal asthma despite optimum treatments. Fluid accumulation in the chest can increase bronchial blood volume, and narrow the airway lumen, thus contributing to asthma severity and fatality. We hypothesized that in patients with asthma, treatment with bronchodilators cannot fully prevent that component of the airway narrowing that is attributable to rostral fluid shift.

Methods: Individuals with a diagnosis of asthma based on Global Initiative for Asthma (GINA) guidelines [5] participated in a randomized cross-over study. Participants either received Ventolin before the measurements (bronchodilator arm) or no bronchodilator (control arm), and then crossed-over to the other study arm after a week. In both visits they lay supine for 30 min and received lower body positive pressure (from 10 to 30min) to reproduce fluid shift out of the legs similar to the amount of fluid shift overnight. While supine, at 0min and 30min, airway narrowing was assessed using forced oscillation technique to estimate respiratory resistance (R5, reflecting airway obstruction) at 5Hz. Leg and thoracic fluid volumes (LFV, TFV) were measured using bioelectrical impedance. Changes in R5, LFV and TFV from 0 to 30min were compared using Mann-Whitney Test

Results: Six asthmatics, 3 male and 3 female, aged: 51±13 years, BMI 28.9±11.6 kg/m^2 participated in the study. Our preliminary results show the changes in leg fluid volume were similar in both study arms (ΔLFV:-233.4±96.2, p=0.03 on bronchodilator arm vs ΔLFV:-255.4±110.4, p=0.03 on control arm). There was a trend to larger increase in thoracic fluid volume on bronchodilator arm compared with control arm (ΔTFV: 206.1±284.7ml, p=0.2 vs ΔTFV: 75.7±72.7ml, p=0.03). Using bronchodilator there was a trend to reduction in airway resistance at 0 min (5.3±1.6 vs 4.8±1.8, p=0.22). Interestingly, in both control and bronchodilator arm, respiratory resistance increased with fluid shift (ΔR5: 0.7±0.6 cmH$_2$O/L.s p=0.03 vs ΔR5:0.3 ±0.3 cmH$_2$O/L.s, p=0.09).

Conclusion: Our preliminary results support our hypothesis that bronchodilator treatment does not prevent the airway narrowing related to rostral fluid shift. If our results are confirmed in a larger sample of asthmatics, we will be able to demonstrate the importance of rostral fluid shift in the physiopathology of nocturnal asthma.

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EFFECTS OF PREVENTING FLUID RETENTION IN THE LEGS ON OVERNIGHT AIRWAY NARROWING IN ASTHMA

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Background: In Canada, asthma is not well-controlled in 90% of asthmatics, despite the advances in pharmacological treatments [1]. Nocturnal worsening is a common feature of asthma. Recent studies showed that rostral fluid shift from the legs to the thorax during supine posture is a potential contributor to nocturnal worsening of asthma [2, 3]. We hypothesized that preventing fluid retention in the legs during the day by wearing compression stockings improves airway resistance in asthma before and after sleep.

Methods: Individuals with diagnosis of asthma based on Global Initiative for Asthma (GINA) guidelines [5] performed two full in-laboratory sleep studies two weeks apart. Before and after sleep while supine, we measured leg fluid volume (LFV) using bioelectrical impedance and respiratory resistance at 5Hz (R5) with oscillometry. After the first sleep study, the participants received below knee compression stockings (pressure of 20-30mmHg). The participants were instructed to wear the stockings for 2 weeks, during the day, for at least 8hr/day.

Results: Eleven asthmatics, 7 male and 4 female, age: 56.5 ± 11.4 years, BMI 28.8 ± 6.1 kg/m^2, FEV1/FVC%: $68.6\pm7.8\%$ participated in the study. After two weeks of wearing compression stockings, LFV and R5 decreased in the evening (ΔLFV: -192.6 ± 248.3ml, $p=0.024$ and ΔR5: -0.7 ± 0.9cmH$_2$O/L.s, $p=0.03$). However, no differences in LFV and R5 were found in the morning (ΔLFV: -197.7 ± 330.5ml, $p=0.1$ and ΔR5: -0.3 ± 1.0 cmH$_2$O/L.s, $p=0.3$). Also, there were no differences in the overnight fluid shift or overnight airway resistance between the nights ($p>0.05$).

Conclusions: Preventing fluid retention during the day reduced airway resistance in the evening but not in the morning. The mechanisms by which changes in fluid affect airway resistance remain unclear. Our participants were mild asthmatics without nocturnal asthma symptoms or fluid retaining conditions. This could be one of the reasons that compression stockings did not reduce rostral fluid shift as they did not have much fluid retention in the legs to start with. Future studies should include asthmatics with more severe asthma and those with nocturnal symptoms.

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THE EFFECTS OF SLEEP DEPRIVATION AND CHRONOTYPE ON THE PERCEPTION OF EMOTIONAL FACIAL EXPRESSIONS - AN EXPERIMENTAL STUDY

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Introduction: Sleep disruption is linked to impaired cognitive and emotional processing, which may potentially give rise to an increased risk for developing emotional difficulties. Meanwhile, previous research showed that chronotype, i.e. individual differences in their preferred timing for rest and activity, is associated with psychopathology. In this study, we aimed to examine the effects of sleep deprivation and chronotype on an individual's ability to recognize facial expressions of emotions.

Materials and methods: Young adults (N = 21, Age: 20.10 ± 1.84 years, Female = 52.4%) with normal or corrected to normal vision and no history of psychological disorders and sleep problems were recruited to take part in this experiment. Participants underwent two experimental conditions (well-rested at home vs. one-night of sleep deprivation in the laboratory) in the counterbalanced order. In both conditions, participants completed an emotional facial expression judgment task in the morning (9:00-10:00am) following rest/sleep deprivation, where they were asked to identify and rate the intensity of four kinds of emotional faces (happy, sad, fearful, and angry). Chronotype preference was measured by the reduced Morningness-Eveningness Questionnaire (rMEQ). Non-parametric tests were used to examine group differences across the conditions.

Results: Participants were classified into 3 groups based on their rMEQ scores: Evening-type (N = 6), Intermediate-type (N = 11) and Morning-type (N = 4). In well-rest condition, there was a significant difference in the accuracy of identifying fearful faces (χ^2 = 8.133, p = .017) and a marginally significant difference in the accuracy of identifying happy faces, χ^2 = 5.492, p = .064) across the three groups. In particular, morning-type group had the highest accuracy of identifying both facial expressions (1.00 ± 0.00 and 0.99 ± 0.03, respectively). In the sleep deprivation condition, there was no difference in the accuracy of identifying emotional faces among the three groups. An ART ANOVA showed a significant main effect of chronotypes on the accuracy of identifying fearful faces, $F(2,36) = 6.75$, $p <$ .01, where morning-type group had higher accuracy than intermediate-type, $t(36) = -3.05$, p = .01; and evening-type, $t(36) = -3.56$, $p < .01$. An ART ANOVA showed that there was a marginally significant interaction effect of chronotypes and sleep condition in the accuracy of identifying happy faces, $F(2,36) = 2.75$, p = .08. In particular, evening-type group had significantly higher accuracy than morning-type group in sleep deprivation condition, $t(36) = 2.30$, p = .03. In addition, morning-type group showed significantly higher accuracy when well-rested, relative to when sleep deprived, $t(36) = -2.08$, $p < .01$.

Conclusions: Our findings demonstrated the effects of sleep loss on compromising individual's ability to recognize emotional facial expression. In addition, there were differential effects of chronotype on emotional perception in response to sleep deprivation. Further research is needed to investigate the mechanism underlying the association between chronotype, sleep loss and disrupted emotional perception.

Acknowledgements: N/A

A PREDICTION MODEL BASED ON MACHINE LEARNING FOR PREDICTING THE OUTCOMES OF UPPP SURGERY IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Obstructive sleep apnea (OSA) is characterized by recurrent episodes of airway obstruction during sleep, which is a common form of sleep disorder. In general, Uvulopalatopharyngoplast(UPPP) has been widely used as a surgical treatment of OSA. Unfortunately, the current methods of diagnostic evaluation have a poor predictive result. A better method of diagnostic evaluation is needed to select which patients would be good candidates for this procedure. Therefore, we sought to establish a prediction model to predict the postoperative apnea-hypopnea index (POST-AHI) for evaluating the outcomes of UPPP surgery.

Materials and methods: Two unique datasets consisting of convenient measurements such as demographic, anthropometric and Polysomnography (PSG) variables was utilized. Model 1 included 271 men and 26 women using demographic and PSG variables as the input which includes sex , age, BMI, neck circumstance, tonsil size, palate position, preoperative AHI, SPINE-AHI REM-AHI, NREM-AHI ,Nadir SpO2 and CT90. Model 2 included 125 men and 12 women using the input of Model 1 plus Computed Tomography (CT) variables which includes area of the rear area, sublingual area, vertical distance between the lower edge of mandible and the lower edge of hyoid and airway length. Machine learning algorithms such as Artificial neural network (ANN), Random forest (RF), Support vector regression (SVR) and K-nearest neighbor algorithm (KNN) were used to train the regression Model 1 and regression Model 2. We randomly shuffle the dataset into three subsets:70% for training, 10% for validation and 20% for testing.

Results: The mean absolute deviation between the true POST-AHI and predictive POST-AHI of Model 1 was 11.40 in ANN, 15.36 in RF, 11.98 in SVR, 12.59 in KNN respectively. The mean absolute deviation of Model 2 was 6.44 in ANN, in 10.92 RF, 7.12 in SVR, 7.35 in KNN respectively.

Conclusions: The Model 2 using ANN has high prediction precision which illustrates the anatomical factors are important predictive factors for estimating the UPPP outcomes. A graphical user interface design of the software is completed, and the software is developed to predict the outcomes of UPPP surgery for OSA patients.

Other
Board #348 : Poster session 2
POOR SLEEP AND CHRONIC PAIN'S EFFECT ON PHYSICAL AND PSYCHOLOGICAL WELL-BEING FROM THE UK BIOBANK DATASET

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Introduction: The comorbidity between poor sleep and chronic pain has consistently been documented. Insomnia is reported by 67-88% of chronic pain patients, while chronic pain is reported by over 50% of people with insomnia. The relationship between poor sleep and chronic pain may be modulated by physical and psychological factors. This project aimed to describe the association between poor sleep, chronic pain and measures of general well-being in the UK biobank (UKBB).

Methods: The associations between sleep phenotypes and Body Mass Index (BMI), Townsend Deprivation Index (TDI), neuroticism and chronic pain were assessed. Out of 502,599 subjects that participated in a baseline visit, 38,088 (7.578%) were selected for analysis because they had a follow-up visit. Subjects were also excluded if their reported sex did not match their genetic sex, and if their reported ethnicity was inconsistent between visits. The final dataset included 36,570 (7.276%) subjects that passed quality control.

Results: At baseline, 73.9% of subjects reported occasional or regular insomnia, and 34.7% reported snoring. Self-reported chronotypes showed that 62.4% of subjects were 'morning' people and 37.6% reported being ´evening´ people. Mean sleep duration was 7.18 hours, with 77% having sleep duration between the 7-9 hours. 39.13% reported having chronic pain for more than 3 months.Insomnia was significantly associated with higher BMI at baseline (p=0.014) and increased neuroticism (p< 0.001). Snoring was significantly associated with higher BMI at baseline and follow-up (both p's < 0.001), decreased TDI (p=0.006), increased neuroticism (p< 0.001). As compared to 'morning' people, being an 'evening' person was significantly associated with higher BMI at baseline and follow-up (both p's < 0.001), increased TDI (p< 0.001), and increased neuroticism (p< 0.001).
As compared to subjects who sleep between 7-9 hours, subjects who sleep outside of this range had a higher BMI at baseline and follow-up (both p's < 0.001), increased TDI (p< 0.001), and increased neuroticism (p< 0.001).
As compared to subjects with no pain, chronic pain subjects had a higher BMI at baseline and follow-up (both p's < 0.001), increased TDI (p< 0.001), increased neuroticism (p< 0.001), and shorter sleep duration at baseline (p< 0.001). Chronic pain subjects with insomnia have higher BMI at baseline and follow-up (both p's < 0.001), increased TDI (p< 0.001), and increased neuroticism (p< 0.001), as compared to subjects who only report one of the two conditions. Insomnia, snoring, being an 'evening' person, and not sleeping 7-9 hours represent a risk for chronic pain (OR=1.68, 1.12, 1.13, 1.40 respectively).

Conclusions: In a large dataset, we showed that insomnia, snoring, being an 'evening' person, and sleeping outside of the 7-9 hours range are associated with elevated BMI, neuroticism and chronic pain. Lower socio-economic status is also reported in all poor sleep phenotypes, except for snoring. Chronic pain is also associated with elevated BMI, TDI, and neuroticism, suggesting that those measures may play a role in the comorbidity of sleep and pain.

NORMATIVE EMG VALUES AND ISOLATED RAPID EYE MOVEMENT SLEEP WITHOUT ATONIA FREQUENCY IN ADULTS WITHOUT REM SLEEP BEHAVIOR DISORDER

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Introduction: Normative REM sleep without atonia (RSWA) values remain unclear. In adults without REM sleep behavior disorder (RBD), older age and male sex are associated with greater RSWA. Isolated elevated RSWA has also been reported as a possible prodromal synucleinopathy parallel to, yet distinct from, REM sleep behavior disorder (RBD). We aimed to describe normative RSWA and characterize isolated elevated RSWA frequency in adult patients without RBD seen in our clinical sleep medicine practice.

Materials and methods: We visually quantified phasic, "any", and tonic RSWA in the submentalis (SM) and anterior tibialis (AT) muscles, and the automated Ferri REM Atonia Index (RAI) during polysomnography in adults without RBD aged 18-88 years old. RSWA percentiles were calculated across sex and age deciles, and RSWA in older ($\geq$ 65) vs. younger (< 65 years old) men and women was compared. Isolated RSWA (exceeding previously determined diagnostic RBD cut-offs, or above 95th percentile) frequency was also determined.

Results: Overall 95th percentile RSWA percentages were: SM phasic, any, tonic=8.6%, 9.1%, 0.99%; AT phasic and "any"=17.0%; combined SM/AT phasic, "any"=22.3%, 25.5%; and RAI=0.85. Most phasic RSWA burst durations were $\leq$ 1.0 second (85th percentiles: SM 1.07, AT 0.86 seconds). Older men had significantly higher AT RSWA than older women and younger patients (all p< 0.04). Twenty-nine (25%, 18 men) had RSWA exceeding the cohort 95th percentile, while 17 (14%, 12 men) fulfilled diagnostic cut-offs for phasic or automated RBD RSWA thresholds.

Conclusions: RSWA levels are highest in older men, mirroring the demographic characteristics of RBD, possibly suggesting altered REM sleep atonia control in older men. These data establish normative adult RSWA values and thresholds for determination of isolated RSWA elevation, potentially aiding RBD diagnosis and discussions concerning incidental RSWA in clinical sleep medicine practice.

ACTIGRAPHY-MEASURED CIRCADIAN REST-ACTIVITY RHYTHM AND SLEEP PATTERN ALTERATIONS IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER AND NEURODEGENERATIVE SYNUCLEINOPATHY DISEASES: A CASE-CONTROL STUDY

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Introduction: Circadian and sleep disturbances are commonly observed at neurodegenerative synucleinopathy diseases. However, whether circadian rhythm and sleep patterns are altered in idiopathic REM sleep behavior disorder (iRBD), a widely accepted prodromal stage of neurodegenerative synucleinopathy diseases, remains unclear. Hence, this case-control study aimed to investigate circadian rest-activity rhythm and sleep characteristics in iRBD by using actigraphy, thereby exploring whether a trajectory of circadian rest-activity rhythm changes exists from iRBD to neurodegenerative synucleinopathy diseases.

Materials and Methods: Three groups of participants were recruited and were assessed by using wrist-worn actigraphy for seven days: I)37 patients with neurodegenerative synucleinopathy diseases (33 PD&4 DLB) converted from iRBD [mean age: 71.7±9.3 years; 4 males (11%)], II)77 age- sex- and BMI-matched patients with iRBD [mean age: 71.1±6.4 years; 12 males (16%)], and III)47 non-RBD controls [mean age: 71.3±7.9; 8 males (17%)]. Circadian rest-activity rhythm (cosinor analysis and nonparametric analyses) and sleep patterns were analyzed. The functional actigraphy analysis was performed to provide 24-hour rest-activity profile. Comorbid conditions, medications and neurocognitive functions were assessed or obtained from the central medical system in Hong Kong. We also conducted sensitivity analysis by comparing the primary circadian and sleep parameters among iRBD patients by separating them with or without hypnotic use.

Results: *I)Rest-activity rhythm:* Across non-RBD control, iRBD and neurodegenerative synucleinopathy diseases groups, the significant differences with decline trend were identified in mesor (166.2 ±48.2 vs. 146.3±47.0 vs. 86.9±43.0, $P< 0.01$; $P_{linear}< 0.01$) and the average activity during the most active 10-hour period (M10) (262.5±81.6 vs. 233.1±77.6 vs. 138.3±71.4, $P< 0.01$; $P_{linear}< 0.01$). *II)Sleep patterns:* During active period, increasing trends were identified from non-RBD control, iRBD and neurodegenerative diseases groups in both sleep percentage (16.1%±8.7% vs. 21.6%±10.3% vs. 38.5%±16.8%, $P< 0.01$; $P_{linear}< 0.01$) and sleep bouts (34.9±12.2 vs. 41.4±15.0 vs. 51.7±14.0, $P< 0.01$; $P_{linear}< 0.01$). *III)Subjective daytime sleepiness:* There was no difference in *Epworth Sleepiness Scale* score (9.2±4.9 vs. 9.0±5.6 vs. 8.6±5.7, $P=0.92$; $P_{linear}< 0.70$) amongst the three groups. *IV)Functional analysis:* Patients with neurodegenerative diseases showed the lowest activity level, followed by patients with iRBD and non-RBD controls. *V)Sensitivity analysis:* iRBD patients with hypnotic use had comparable mesor (159.1±61.1 vs. 139.8±36.9, $P=0.09$), M10 (244.8±99.3 vs. 227.2±64.2, $P=0.35$), and sleep percentage (20.7%±11.6% vs. 22.1%±9.6%, $P=0.57$) and sleep bouts (40.9±18.6 vs. 41.6±13.0, $P=0.84$) during active period with iRBD patients without hypnotic use.

Conclusions: Alterations in circadian rhythm and sleep patterns, characterized by lower daytime activity level (M10) and more objective daytime sleepiness (rather than subjective daytime sleepiness), exist not only in neurodegenerative synucleinopathy diseases but also

in iRBD. These alterations with significant tendencies suggest that they may serve as prodromal markers of α-synuclein neurodegeneration. Longitudinal studies with larger sample size are warranted to further clarify the role of circadian rest-activity rhythm and sleep pattern changes in the progression of neurodegenerative synucleinopathy diseases.

Parasomnia
Board #187 : Poster session 3

THE EFFECT OF CBT FOR ANXIETY DISORDERS ON NIGHTMARES AND SLEEP QUALITY

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Introduction: Nightmares are defined as repeated, extremely dysphoric and well-remembered dreams that lead to awakening. Patients with anxiety disorders very often experience sleep disturbances, including nightmares. According to previous research there is a relationship between anxiety disorders and nightmares, and treating nightmares could lead to decreasing anxiety level. The aim of our study was to examine the influence of CBT for anxiety on sleep difficulties - nightmares and sleep quality.

Materials and methods: 132 patients (female = 85, male = 47, age M = 35.71, SD = 11.45) with anxiety spectrum diagnosis underwent 7 weeks group CBT program aimed to improve strategies for handling anxiety and depression. A battery of following questionnaires was used to measure mood and sleep parameters: Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory II (BDI II), Beck Anxiety Inventory (BAI) in all participants, and Nigthmare Distress Questionnaire (NDQ), Nightmare Effects Survey (NES) and nigthmares frequency questions in those who experienced nightmares at the beginning and at the end of the program.

Results: We found a significant influence of CBT program on several sleep parameters. There was a statistically significant decrease in PSQI Total score ($p < .001$), BDI-II ($p < 0.001$) and BAI ($p < 0.001$) after CBT. There were no differences in NDQ, NES or nightmare frequency. However, we have found positive correlations between changes in BAI and NDQ ($p < 0.05$, $r = 0.26$), BAI and NES ($p < 0.05$, $r = 0.3$), BDI and NES ($p < 0.05$, $r = 0.3$) after CBT. No significant relationship between BDI and NDQ, BDI and nightmare frequency, BAI and nightmare frequency changes was found.

Conclusions: Group CBT for anxiety decreased level of anxiety, depression and improved sleep quality. Despite no changes of frequency, distress or consequences of nightmares after the treatment, a significant relationship was found between changes of anxiety and nightmare consequences and distress change. We have also found relationship between depression change and nightmare consequences change.

RETROSPECTIVE ANALYSIS OF INCIDENCE OF NEURODEGENERATIVE DISORDERS IN JAPANESE PATIENTS WITH IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Objectives: Rapid eye movement sleep behavior disorder (RBD) has close relationship with neurodegenerative disorders, especially α-synucleinopathy. Accumulating reports from around the world have indicated a high risk for neurodegeneration in patients with idiopathic RBD (iRBD). However, the risk among Japanese patients with iRBD has not been well examined so far. We retrospectively analyzed the incidence of neurodegenerative disorders among Japanese patients diagnosed with iRBD.

Methods: This study was conducted as a retrospective chart review. We analyzed the patients who were diagnosed with iRBD based on RWA finding on polysomnography and medical record, and with a follow-up of ≥6 months. We also identified patients who were later diagnosed as neurodegenerative disorders, and we estimated the incidence using the Kaplan-Meier (KM) method. This study was performed with the approval of the ethics committee of Fujita Health University.

Results: We included 57 Japanese patients with iRBD with an average follow-up of four years. Among them, 14 (24.6%) were confirmed to have developed neurodegenerative disorders. The estimated incidence of neurodegenerative disorders was 18.5% at 5 years and 68.1% 10 years using the KM method. Neurodegenerative disorder-free survival curves did not differ significantly as to whether comorbid depression or sleep apnea were present. 12 (85.7%) out of 14 patients with neurodegenerative disorders were diagnosed as α-synucleinopathy.

Conclusions: It was suggested that the risk for neurodegeneration, particularly for α-synucleinopathy, might also be high in Japanese patients with iRBD. The estimated incidence might be slightly lower than that have been reported in studies conducted abroad; this might be due to the limitation of retrospective data collection in this study, or possibly because of ethnicity. Further prospective studies employing standardized evaluation procedures would be warranted in Japan.

Acknowledgments: The authors have no conflict of interests to declare with regard to this study.

REM SLEEP BEHAVIOUR DISORDER : POTENTIAL SLEEP AND DATSCAN CORRELATES

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Introduction: REM Sleep Behaviour Disorder (RBD) is a parasomnia that manifests as vivid, often frightening dreams, with associated abnormal motor behaviours, arising during REM sleep. Several longitudinal studies have revealed that a high proportion of idiopathic RBD patients convert to α-synucleinopathies such as Parkinson´s disease and Dementia with Lewy Body disease with time. Diagnostic modalities such as polysomnography (PSG) and dopamine transporter imaging are commonly used, yet little is known about the potential strength of combining these tools in recognising patients in the early, or even presymptomatic, stages of these disorders. By improving this early recognition, neuroprotective strategies could be commenced more expediently.

Materials and methods: In order to assess the combined potential of these diagnostic modalities, an exploratory, retrospective study of paired PSG recordings and 123I-FP-CIT DAT-SPECT images (DaTSCAN) of patients presenting to a tertiary sleep disorders clinic (Guy's Hospital, London) between 2015 and 2018, with confirmed RBD, was conducted. In addition, PSG data from RBD patients were compared to historical matched controls. This study obtained local ethical approval.

Results: 14 patients with RBD met study inclusion criteria (2 female; mean age ± S.D.: 63.0 ± 7.1) and were compared to 25 age- and gender-matched controls. While no significant differences were observed in sleep macrostructure parameters between patients with RBD and controls, patients with RBD did have a significantly higher periodic limb movement (PLM) index ($P < .012$). 71.4% of RBD patients had abnormal DaTSCAN findings, of which reduction in the left putamen update was present in 35.7% of patients.

Conclusions: Periodic limb movements were found to be more prevalent in patients with RBD. In disorders related to dopaminergic dysfunction such as restless leg syndrome, PLMs are considered to be a symptom of the disease. In other disorders like primary insomnia, the clinical relevance of PLMs is still being controversially discussed. To date there is no consensus if their presence in RBD is similarly related to dopaminergic dysfunction, and further analyses are currently been undertaken to correlate them to the DaTSCAN findings revealed in this study.

SUCCESSFUL TREATMENT OF SOMNAMBULISM WITH OROS-METHYLPHENIDATE

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Introduction: Somnambulism is a non-REM parasomnia with potential for significant injury as well as functional nighttime and daytime impairment. The optimal treatment for somnambulism has not been established. We report the cases of two patients with chronic and disabling somnambulism who were successfully treated with Osmotic Release Oral System methylphenidate (OROS-MPH). To our knowledge, this is the first report of successful treatment of somnambulism using this novel approach, which may shed light on the neurobiological underpinnings of this disorder.

Materials and Methods: The medical records of two adult patients with severe somnambulism treated at our sleep clinic with OROS-MPH were reviewed. The records were assessed for clinical and polysomnographic features, OROS-MPH dosing and its effect on frequency of sleepwalking episodes.

Results: The first patient is a 24-year-old woman who presented with a lifelong history of somnambulism, reporting weekly episodes, occasionally associated with sleep-eating behaviours. She also reported significant daytime sleepiness. Treatment with OROS-MPH was initiated at a dose of 18 mg per day in the morning. The patient reported an immediate remission of her sleepwalking behaviours as well as a reduction in her daytime sleepiness. The dose was subsequently increased to 36 mg after episodes re-emerged four months following treatment initiation. At last follow-up, five years after the initiation of OROS-MPH, the patient reported continued efficacy without side-effects.

The second patient is a 34-year-old woman who presented to our clinic with a lifelong history of sleepwalking with episodes occurring in clusters over several consecutive days every four to eight weeks. The patient was initially treated with clonazepam, but reported frequent residual episodes after a six-month trial. The clonazepam was discontinued and the patient was treated with OROS-MPH at a dose of 18 mg per day, taken in the morning. The patient reported an immediate benefit of the OROS-MPH with no subsequent episodes over the next 6 months. She also reported more consolidated and restorative sleep. Over the next four years, the dose was titrated up to 27 mg and the patient reported continued efficacy at our last follow-up, with rare episodes occurring only after missing doses of OROS-MPH

Conclusion: Our case reports indicate that OROS MPH can result in a significant improvement in sleepwalking. If our findings are confirmed in a larger cohort, OROS MPH could represent an interesting therapeutic option since it seems to reduce both sleepwalking frequency and daytime somnolence in adult sleepwalkers. In addition, the study of the mechanisms by which OROS-MPH improves somnambulism may contribute to our understanding of the disorder's pathophysiology.

SLEEP IMPACTS OF NOCTURIA IN A LONGITUDINAL STUDY

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Introduction: Sleep enuresis, an intermittent incontinence of urine during sleep, has been seldomly studied in adult population. While the problem is frequent in children, between 15% and 20%, it is estimated to be less than 5% in young adults. This study examines the prevalence, incidence and chronicity of sleep enuresis among adults.

Materials and methods: The initial study was carried with 15,929 individualsfrom 15 US States. The longitudinal study was carried on in eight of these states. A total of 12,218 subjects were interviewed by phone during the first wave (W1) and 10,930 at the second wave (W2) three years apart. The analyses were carried on the subjects who participated in both interviews (N=10,930). Sleep enuresis was defined as episodes of involuntary nocturnal miction in the previous year. Frequency of episodes was also assessed as well as duration of the problem.

Results: During the first interview, 4.9% of the sample reported at least 1 episode of sleep enuresis during the previous year: 24.5% of them had sleep enuresis episodes 2 nights or more per week. At the second interview, 5.5% reported at least 1 episode of sleep enuresis in the previous year: 21.6% had several episodes per week. Sleep enuresis was chronic in 18.7% of cases; i.e., 1% of the sample. Incidence was 1.3% per year. In both waves, prevalence of sleep enuresis (at least once per week) was higher in women and significantly increased with age being at least 8 times higher in participants 65 years or older compared to the participants < 25 y.o. Incident enuresis, occurring at least once per month, was predicted by increased age (RR:1.1), a sleep duration > 8hrs at W1 (RR: 1.5), a nonrestorative sleep at W1 (RR: 1.7), difficulties initiating sleep at W1 (RR: 1.7) and presence of a medical condition at W1 (RR; 1.4). On the other hand, chronic sleep enuresis was predicted by increased age (RR: 1.1), difficulties initiating sleep at W1 (RR: 2.3); hypersomnolence at W1 (RR: 3.5) presence of a medical condition at W1 (RR: 3.2) and a sleep duration > 8hrs at W1 (RR: 5.3).

Conclusions: Episodes of sleep enuresis were relatively frequent especially among older people where it affected one on 12 individuals. The presence of medical conditions and a longer sleep were predictive factors of both chronic and incident sleep enuresis.

RISK FACTORS FOR NIGHTMARES IN THE ELDERLY IN A POPULATION-BASED COHORT STUDY

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Introduction: Nightmares are vivid dreams that leads to awakening during sleep with repeated occurrences of dreams, including intense and negative emotions. Previous studies have shown that nightmares are linked to various mental disorders, including depression and suicidal ideation. However, earlier studies were mostly conducted on children and adults, and there are currently very few studies on nightmares in older adults. Based on the population-based cohort study, this study aims to explore the prevalence of nightmare disorders, demographic factors, and nightmare risk factors in an elderly population.

Materials and methods: This cross-sectional study utilized a subsample from the Korean Genome and Epidemiology Study (KoGES). Participants (n=2,940; mean age 63.71 ± 6.73; females 49.3%) completed the Disturbing Dream and Nightmare Severity Index (DDNSI) in addition to self-report questionnaires about depression (Beck Depression Inventory), suicidal ideation (Depressive Symptom Inventory-Suicidality Subscale), sleep quality (Korean version of the Pittsburgh Sleep Quality Index) and stress (Perceived Stress Scale). Depending on data distribution, chi-squared test, Mann-Whitney U test and multivariate logistic regression were conducted to explore demographic and risk factors of nightmares after adjustment for gender, age, insomnia, marital and employment status, and family income.

Results: Among the sample, 399 people (13.6%) reported experiencing nightmares more than once a year, and 79 people (2.7%) were classified as having clinical levels of nightmares in the elderly population, which was classified with DDNSI scores. There were significant differences in gender (64.6% female, $p < 0.01$), marital status(24.1% bereaved, $p < 0.001$), employment status(70.9% unemployed, $p < 0.001$) and age group (46.8% over 70 years, $p < 0.001$) in the nightmare clinical group compared to the normal group. Elderly individuals who had clinically significant nightmares showed significantly shorter total sleep time, longer sleep onset latency, lower sleep efficiency, and higher depression and stress levels ($p < 0.01$) than the normal group. In addition, the clinical group was associated with high suicidal ideation risk after controlling for gender, age, insomnia, marital and employment status, and family income. ($p < 0.01$).

Conclusions: Our results indicate that psychological factors and demographic factors such as age and gender can be a risk factor for nightmares in the elderly population. Furthermore, the population-based cohort study showed the prevalence of nightmares which increased sharply after age 70 which is also associated with increased psychopathology, and this finding suggests the need for further study of nightmares in older populations.

DECREASED FUNCTIONAL CONNECTIVITY IN THE DEFAULT MODE NETWORK IN NIGHTMARE DISORDER PATIENTS COMPARED TO HEALTHY CONTROLS

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Introduction: The default mode network (DMN) is a neural circuitry of specific areas that work when the brain is inactive. DMN shows increased activity when awake and not cognitively demanding tasks. Also, DMN has been associated with psychopathology as well as sleep disorders. The main purpose of this study was to examine the differences in resting-state functional connectivity of the DMN in nightmare disorder patients compared to healthy controls.

Materials and Methods: Twelve female nightmare disorder patients (NG) who experienced trauma based on the DSM-5 definition, and 12 age- and gender-matched healthy controls (HC) participated in the study (mean age 28.25 ± 8.14 years). Individuals who had serious psychosis, had lost consciousness in the past, or met criteria for substance abuse were excluded from the study using a structured interview (Structured Clinical Interview for DSM-Ⅳ Disorders). All participants underwent resting-state functional magnetic resonance imaging (3T) and completed 7-day sleep diaries and self-report questionnaires for nightmares (Disturbing Dream and Nightmare Severity Index), depression (Beck Depression Inventory), anxiety (Beck Anxiety Inventory), post-traumatic stress disorder symptoms (PTSD Checklist for DSM-5), insomnia (Insomnia Severity Index), and suicidal ideation (Depression Symptom Inventory-Suicidality Subscale). FMRI data were head motion corrected, band-pass filtered (0.009-0.08 Hz), spatially smoothed (5-mm FWHM), and several sources of spurious variance were removed (six head motion, signal from CSF, and signal from WM). Functional connectivity maps were created by computing the Pearson's correlation coefficients for the posterior cingulate cortex (PCC) to examine default mode network (DMN). Parametric tests were conducted to analyze group differences for self-report questionnaires.

Results:The NG reported having nightmares on average 1.39 times per week. Compared to the HC group, the NG reported significantly higher levels of nightmares, depression, anxiety, PTSD, insomnia, and suicidal ideation ($ps < .01$) on self-report questionnaires. Sleep diaries revealed longer wake after sleep onset (WASO) and sleep onset latency (SOL) for NG compared to HC (25.60 vs. 4.11 minutes, 84.80 vs. 32.77 minutes, respectively) and sleep efficiency was lower in the NG compared to HC ($ps < .05$). Compared to the HC, NG had decreased functional connectivity in the left superior frontal gyrus ($p < .005$). There was a significant positive correlation between WASO and connectivity with the superior frontal gyrus in NG ($r = .72, p = .018$). No other significant correlation between clinical indices and functional connectivity.

Conclusions: These preliminary results indicate that female nightmare disorder patients with exposure to trauma have a shift in functional connectivity in the DMN, especially in the connectivity between the posterior cingulate cortex and the superior frontal gyrus, which in turn was associated with sleep disturbance, such as increased wake after sleep onset.

CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS IN SEXSOMNIA: A DESCRIPTIVE ANALYSIS

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Introduction: Sexsomnia is a NonREM parasomnia characterized by sexual behaviors during sleep.
In spite of its low frequency, sexsomnia may have severe psychological, psychosocial, physical and legal consequences. Considering that current knowledge mostly comes from case reports and small series, and systematized data about the features of patients with sexsomnia is scarce, we conducted a systematic assessment of clinical and polysomnographic characteristics in patients with sexsomnia

Materials and methods: Our sample consisted of six patients referred to the sleep clinic because of sexual behavior during sleep. Sociodemographic and clinical features were obtained from medical records and interviews. Five patients underwent nocturnal polysomnography.

Results: mean at clinical onset was 22.5 (15-37) year-old, age mean at diagnosis 33.3±10.27 years old. All had psychiatric comorbidity: 4 major depression, 1 psychotic disorder, and 1 cannabis use. Two patients presented with another sleep disorder (Hypersomnia and Shift Work Disorder). Three patients reported sleepwalking in childhood. Clinical assessment showed that all participants had suggestive scores for insomnia; 3 for excessive diurnal sleepiness; all of them had sleep apnea risk according to Berlin questionnaire but just one according to Sleep Apnea Clinical Score.

In all participants, nocturnal sexual behaviors occurred between 1 to 3 am and none had recall of the events the next morning; four subjects reported behaviors 2-3 times/week. Five reported sexual intercourse and fondling to the bed partner; 4 pelvic thrusting, masturbation, self-undressing and groaning; 3 vaginal sex, masturbating sleep partner, undressing sleep partner and self-fondling; 2 anal sex; and 1 oral sex and dirty talk.

The polisomnography showed: mean sleep latency 12.3±5.65min, mean sleep efficiency 85.3±13.77%, N1 mean 10.7±9.46%, N2 43.3±13.95%, N3 16.9±5.4%, REM 14.3±5.65%, mean REM latency 169.8±109.05 min, AHI 0.12±0.13/h, arousal index 9.36±3.08/h, arousals in N1 20.4±11.63, N2 30.6±20.8, N3 3.4±2.88 and REM 6.8±3.83. Hypersynchronic delta waves were observed in four cases.

Conclusions: Our results suggest sexsomnia occurs equally in men and women, its onset is during the adolescence/young adulthood, and the sexual behaviors displayed are multiple. Comorbidity with psychiatry disorders is common and there are no relevant findings in polysomnography.

DEVELOPMENT AND VALIDATION OF THE SEMI-STRUCTURED NIGHTMARE DISORDER INTERVIEW

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Introduction: Nightmare is a dream that causes awakening due to strong emotions, and is distinguished from a bad dream. About 60~66.7% of those who experience trauma have nightmares. Women who are not properly diagnosed and treated for nightmares have increased risk of depression, anxiety disorders, and high suicide rates including PTSD. Thus, appropriate assessment and treatment for nightmare disorders are needed in clinical settings, but it is rare that nightmare disorders are systematically assessed. In this study, we developed and validated the Semi-structured Nightmare Disorder Interviewing tool for the diagnosis of nightmare disorder based on Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).

Materials and Methods: The Semi-structured Nightmare Disorder Interview was developed based on DSM-5 in accordance with the scale development phase proposed by DeVellis (2012). Participants consisted of 90 female adults (mean age = 24.84±6.03). All participants completed the following self-report questionnaires: Disturbing Dream and Nightmare Severity Index (DDNSI), Center for Epidemiologic Studies-Depression Scale (CES-D), State-Trait Anxiety Inventory-State (STAI-S), State-Trait Anxiety Inventory-Trait (STAI-T), Insomnia Severity Index (ISI) and Depressive Symptom Inventory-Suicidality Subscale (DSI-SS). In addition, they participated in the Semi-structured Nightmare Disorder Interview and the Clinician-Administered PTSD Scale for DSM-5(CAPS-5). To assess interrater reliability, two trained examiners independently performed scoring of the Semi-structured Nightmare Disorder Interview. Descriptive statistics, Spearman correlation analysis, two independent samples t-test, and cross tabulation analysis were conducted for data analysis.

Results: Spearman correlation analysis between DDNSI and Semi-structured Nightmare Disorder Interview was significant (r=.682, p< .001) at a moderate level. Inter-rater reliability between the two examiners of the Semi-structured Nightmare Disorder was significant ($kappa$=.659, p< .001). In addition, compared to the non-nightmare group, the nightmare group reported significantly higher levels of CES-D, STAI-S, STAI-T, ISI and DSI-SS (ps< .001) on self-report questionnaires.

Conclusions: The Semi-structured Nightmare Disorder Interview can diagnose nightmare disorder reliably and reasonably in research and clinical settings. Therefore, it is considered to be helpful for proper intervention for the nightmare disorders.

NEUROPHYSIOLOGICAL MECHANISM OF BEHAVIORAL EPISODES IN RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER: A VIDEO-POLYSOMNOGRAPHIC APPROACH

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Introduction: To clarify the direct neurophysiological mechanism of the manifestation of rapid eye movement sleep behavior disorder (RBD) episodes.
Materials and methods: Video-polysomnography (V-PSG) records of thirty-five patients with RBD diagnosed in our laboratory (18 males, 17 females, mean age 70.2 years, range 60-83) were analyzed. RBD was diagnosed according to ICSD-3 criteria. The severity of clinical symptoms of RBDE was classified into three classes: Class 1, elementary movements of extremities; Class 2, intense movement of extremities involving the body, or purposeful movements; Class 3, sitting, standing, or walking. V-PSG findings for 10 seconds just before the onset of RBDE were classified into four types depending on the presence or absence of elevated submental electromyographic (EMG) activity and the appearance of rapid eye movements (REMs): Type 1, EMG ($-$), REMs ($-$); Type 2, EMG ($+$), REMs ($-$); Type 3, EMG ($-$), REMs ($+$); Type 4, EMG ($+$), REMs ($+$).
Results: The appearance rate of type 1-4 in class 1, class 2, and class 3 is shown below. 1) Class 1 : 37%, 17%, 31%, 16% ; 2) Class 2 : 9%, 9%, 33%, 49% ; 3) Class 3 : 0%, 0%, 15% , 85%. As the severity of clinical symptoms of RBDE increased, the incidence of Type 4 became higher. Especially, in Class 3, REMs always appeared during the 10 seconds just before the onset of RBDE in addition to EMG.
Conclusions: Our findings suggest that REMs as well as elevated submental EMG activity play an important role in the manifestation of RBDE.

NIGHTMARE FREQUENCY IN TEENAGERS REPORTING A HISTORY OF SEXUAL ABUSE

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Introduction: Nightmares are among trauma victims' most frequently reported symptoms. Child abuse constitutes one of the better documented chronic traumas, and while several studies have investigated nightmares in adult victims of child abuse, few have done so in adolescent populations. We investigated nightmare frequency in teenagers reporting a history of sexual abuse as compared to teenagers with no such history.
Methods: 402 teenagers (355 girls, 47 boys, mean age = 15.85 ± 0.87 years) reporting a history of sexual abuse and 402 non-victims matched for age and gender were selected from a representative stratified cluster sample of 8194 teenagers as part of a larger investigation on the prevalence of interpersonal violence and associated risk factors and mental health outcomes in the province of Quebec, Canada. Participants reported their nightmare frequency over the past 6 months on a Likert-type scale ranging from 0 (never) to 4 (very often).
Results: 582 (72.4%) of the 804 participants reported experiencing nightmares over the last 6 months: 59% reported having nightmares rarely, 21% sometimes, 8% often and 12% very often. The impact of childhood sexual abuse on nightmare frequency was assessed with a multivariate logistic regression. Nightmare frequency was grouped into two categories (never-rarely and sometimes or more) and included as the outcome variable. Gender, age, sexual abuse victimization, intra-family sexual abuse and number of other traumas were included in one block as predictor variables. The model was significant and explained 20% of the variance of nightmare frequency. The overall percentage of correctly classified participants was 75%. Female gender (OR = 2.36, 1.31-4.27), sexual victimization (OR = 8.36, 5.52-12.64), intra-family sexual abuse (OR = 0.62, 0.40-.098) and number of other interpersonal traumas experienced (OR = 1.19, 1.07-1.31) emerged as significant independent predictors of nightmare frequency, while age was not a significant predictor.
Conclusion: Nightmare frequency in teenagers is associated with female gender, sexual victimization, intra-family victimization and number of traumas.

STRESS, DREAMS AND SLEEP DEPRIVATION AS PRECIPITATING FACTORS FOR SLEEPWALKING

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Introduction: Sleepwalking is a common arousal parasomnia affecting between 2%-4% of the general adult population. Behavioral manifestations with ranging degrees of complexity arise from incomplete awakenings, usually from slow-wave sleep. Although factors that intensify or disrupt sleep have been shown to increase the likelihood and intensity of somnambulism in predisposed individuals, little is known about the factors sleepwalkers themselves view as most likely to precipitate their episodes.

Method: Participants were 165 patients (63 men, 102 women; mean age 32.8 years) referred to our sleep disorders clinic for sleepwalking. Each patient underwent a complete overnight polysomnography to rule out the presence of other major sleep disorders and received a final diagnosis of sleepwalking. Participants completed a questionnaire assessing various aspects of their sleepwalking, including history, nature and frequency of episodes, as well as potential precipitating factors. Precipitating factors were assessed by requiring participants to rate a number of items on a scale from 1 (never) to 5 (always) for the degree to which it contributed to their experiencing episodes.

Results: The factors rated by the greatest proportion of sleepwalkers as "often" (4) or "always" precipitating their episodes were stress (70.9% of all patients), bad dreams and nightmares (47.3%), dreams in general (34.5%), sleep deprivation (32,5%), emotionally charged TV shows or movies (26,5%), sleeping in a new environment (25.5%) and irregular sleep schedules (22.4%). Other self-reported factors included sudden noises (14.6%), bed partner moving suddenly (12.7%) and being touched (8.5%). Surprisingly, substance-related factors (e.g., consumption of caffeine, alcohol) were endorsed by fewer than 10% of sleepwalkers.

Consistent with the literature, sleepwalkers considered stress, sleep deprivation and irregular sleep schedules as significant precipitating factors for their episodes. These factors are known to increase sleep pressure or fragment sleep, two conditions associated with increased sleepwalking in predisposed individuals. The fact that dream-related factors were so frequently endorsed underscores the importance of assessing phenomenological aspects associated with sleepwalking and raises important questions as to the role that phenomenological contents play in how somnambulistic episodes are experienced and unfold. Our results for substance-related factors contrasts with anecdotal reports suggesting that alcohol is important precipitating factors of somnambulism.

Conclusion: Adult sleepwalkers report stress, dreams and sleep deprivation as the most significant precipitating factors for their episodes while alcohol, caffeine and sudden noises are viewed as minor factors.

SUVN-G3031, A HISTAMINE H3 RECEPTOR INVERSE AGONIST FOR THE TREATMENT OF NARCOLEPSY WITH OR WITHOUT CATAPLEXY: A PRECLINICAL CHARACTERIZATION

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Introduction: Narcolepsy is a sleep disorder characterized by excessive sleepiness, sleep paralysis, hallucinations, and in some cases episodes of cataplexy. H3R antagonists/ inverse agonists increase histaminergic neurotransmission and offer a therapeutic option for the treatment of narcolepsy. SUVN-G3031 is a potent H3R inverse agonist in the clinical development for the treatment of narcolepsy with or without cataplexy.
Materials and methods: In-vitro binding, functional activity and phospholipidosis inducing liability were evaluated for SUVN-G3031. Pharmacokinetic properties were evaluated after oral administration in mice, rat and dog. SUVN-G3031 was evaluated in brain microdialysis for neurotransmitter modulation in rats. In vivo functionality was assessed using R-α-methylhistamine induced dipsogenia assay. Tele- methylhistamine modulation was evaluated as a possible clinical biomarker. Long term toxicity studies up to 6 months in rats and 9 months in dogs have been completed along with genotoxicity and fetal development toxicity studies in rats and rabbits.
Results: SUVN-G3031 exhibited no inter-species difference in binding affinity at H3R and displayed inverse agonism in functional GTPgS assay with >100 fold selectivity. SUVN-G3031 has no phospholipidosis inducing liability. SUVN-G3031 exhibited excellent pharmacokinetic properties and brain penetration. A single oral administration of SUVN-G3031 produced significant increase in acetylcholine, histamine, dopamine and norepinephrine levels in the cortex. SUVN-G3031 did not alter dopamine levels of striatum and nucleus accumbens indicating that it may not have addiction liability. SUVN-G3031 blocked R-α-methylhistamine induced water intake and produced dose-dependent increase in *tele*-methylhistamine levels in rat and mice brain and cerebrospinal fluid. Preclinical safety evaluation warrants its clinical development.
Conclusions: SUVN-G3031 is an inverse agonist at H3R and results from the preclinical studies provide a strong evidence for the potential utility of SUVN-G3031 in treatment of narcolepsy and other sleep related disorders.
Acknowledgements: None

CHRONIC TRAZODONE TREATMENT ALTERS REMS STRUCTURE IN A MOUSE MODEL OF TAUOPATHY

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Introduction: Sleep disturbances have been shown to negatively impact the progression of dementia, with disruption of sleep continuity and reduction in rapid eye movement sleep (REMS) described as early predictors of dementia onset and progression of cognitive decline [1]. Chronic treatment with trazodone, a commonly used antidepressant with sleep-promoting effects, has been shown to delay neuropathological progression of tauopathy in a mouse model of frontotemporal dementia (rTg4510) [2]. It is unknown whether the effects of trazodone on sleep structure are a specific and necessary component for a delay in pathology to be observed in these mice. This study aimed to assess the impact of chronic trazodone administration on sleep structure and the electroencephalogram (EEG) of rTg4510 mice.

Materials and Methods: rTg4510 male mice (4-months old at start of the study) received daily intraperitoneal administrations of trazodone (40mg/kg, n=7) or placebo (Methylcellulose 10mg/kg, n=5) at Zeitgeber time 4 (ZT4) over a period of eight consecutive weeks. Mice were kept under 12h:12h light-dark conditions. The EEG and electromyogram (EMG) were continuously recorded to investigate trazodone-induced effects on total sleep continuity, non-REMS (NREMS) structure, REMS structure and the EEG.

Results: Chronic trazodone treatment induced an initial reduction in both REMS bout count and duration (p=0.0475 and p=0.0064 respectively; *Mixed-Model Analyses*) during the 12h-light phase in the first 5 weeks of treatment when compared to placebo. This effect was accompanied by a decrease in relative EEG theta power density during REMS (5.1-9 Hz) after 3-weeks of treatment in both 12h-light and 12h-dark phases (p=0.0009 and p=0.0006 respectively; *Mixed-Model Analyses*). EEG power density in NREMS was not significantly affected. Chronic trazodone administration also showed no consistent effect on total sleep time or NREMS time (p=0.4983 and p=0.4518 respectively; *Mixed-Model Analyses*) in rTg4510 mice when compared to the placebo group.

Conclusions: During this study, trazodone significantly reduced REMS duration in the 12h-light phase and 24h-EEG REM-theta power density but had no significant effect on sleep continuity and NREMS time in rTg4510 mice. These results imply that trazodone selectively impacts REMS structure, therefore warranting further investigation in to how these REM sleep changes may influence disease progression and cognitive impairment in the rTg4510 model.

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A 10-YEAR HISTORY OF USING OF 5-HYDROXYTRYPTOPHAN FOR SEVERE INSOMNIA IN A 15-YEAR-OLD WITH AUTISM, SEIZURES, AND SLEEP APNEA; CAUSE FOR CONCERN?

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Introduction: The body produces 5-Hydroxytryptophan (5-HTP) from the essential amino acid L-tryptophan (LT). 5-HTP is also produced commercially and sold as an over the counter food supplement. 5-HTP is extracted from the seeds of the African plant, *Griffonia simplicifolia.*Typically, 5-HTP is the rate limiting step of conversion of LT to serotonin. Serotonin levels regulate sleep, mood, appetite, temperature, pain, and aggressive or sexual behaviors. 5-HTP is found in many commercial combination products and also used alone for sleep onset, depression, anxiety, and to decrease appetite.

Materials and methods: A 15-year-old male with autism, absence seizures well controlled on Lamotrigine, food and environmental allergies presents to sleep clinic for concerns of loud snoring for several years. His mother reports a lifelong history of severe insomnia and short sleep duration as an infant. Since the age of 5 years she has been treating his insomnia with 5-HTP; the nightly dose is 200mg at 20:30 with no side effects observed. He has a stable sleep schedule but does not awake refreshed after 9 hours of sleep per night. He has nasal congestion with mouth breathing and sleeps with his neck hyperextended. His BMI is 18.9 kg/m2 with normal vital signs. Physical exam was significant for a low-lying palate with normal oropharynx and 2+ tonsils. A sleep study revealed moderate obstructive sleep apnea (OSA) with mild carbon dioxide retention.

Results: Serotonin cannot cross the blood brain barrier and must be made in the central nervous system. Therapeutic use of 5-HTP increases serotonin levels in the brain due to easily crossing the blood brain barrier. Serotonin is a key neurotransmitter in regulating sleep-wake cycles and is converted into melatonin in the presence of darkness. Typical doses of 5-HTP for insomnia are 50-200mg given in the evening. 5-HTP has been shown to increase REM sleep which can cause vivid dreams or nightmares and potentially worsen REM related sleep apnea. There is a risk of serotonin syndrome when used with selective serotonin reuptake inhibitor antidepressants or monoamine oxidase inhibitors. There is also a risk of weight loss due to an appetite depressant effect.

Conclusions: Our patient was treated for his moderate OSA with nasal steroids, Montelukast, and referred to ENT for surgical evaluation of airway obstruction. The mother was counselled to be aware of the risks of 5-HTP including medication interactions, changes in sleep architecture, and appetite reduction. Providers must be aware of mechanism of action, potential medication interactions, and typical dosages of commonly used supplements in order to have an educated discussion with families who turn to over the counter medications to treat sleep problems.

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DISCOVERY OF A NOVEL, ORALLY AVAILABLE OREXIN 2 RECEPTOR-SELECTIVE AGONIST, TAK-994, AS A THERAPEUTIC DRUG FOR NARCOLEPSY

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Introduction: The orexin system is a critical regulator of sleep/wakefulness states, and the deficiency of orexin-producing neurons in the lateral hypothalamus is associated with narcolepsy type 1 (NT1). Orexin peptides act on two G protein-coupled receptors: orexin 1 receptor (OX1R) and orexin 2 receptor (OX2R). OX2R knockout (KO) mice, but not OX1R KO mice, showed clear narcolepsy-like phenotypes, suggesting OX2R plays a more direct role in the pathophysiology of NT1 compared with OX1R. Thus, an OX2R-selective agonist is anticipated to be a promising therapeutic drug for NT1. In this study, we characterized *in vitro* and *in vivo* profiles of a novel, orally available OX2R-selective agonist, TAK-994.

Materials and methods: A calcium influx assay in Chinese hamster ovary (CHO) cells stably expressing human OX2R was used to assess OX2R-agonistic activity. To investigate the activation of OX2R-downstream signals, inositol monophosphate contents, β-arrestin recruitment, and phosphorylation of extracellular signal-regulated kinase 1/2 and cAMP response element-binding protein were measured in CHO cells stably expressing ProLink-tagged human OX2R and β-arrestin2-β-gal-EA fusion protein. Electrophysiological studies were conducted to assess the activation of physiological OX2R on histaminergic neurons in the mouse tuberomammillary nucleus (TMN). Electroencephalogram/electromyogram recordings with wild-type (WT) mice and OX2R KO mice were performed during their sleep phase to evaluate TAK-994 mediated arousal effects.

Results: TAK-994 activated OX2R (EC_{50} value: 19 nM) in the calcium influx assay, and induced OX2R-downstream signaling similar to orexin peptides *in vitro*. In electrophysiological studies, TAK-994 activated physiological OX2R on histaminergic neurons in the mouse TMN *in vitro*. Oral administration of TAK-994 promoted wakefulness in WT mice, but not in OX2R KO mice, during their sleep phase confirming TAK-994 OX2R selectivity *in vivo*.

Conclusions: An orally available TAK-994 may have potential as a new treatment option for patients with NT1 and other hypersomnia disorders with normal orexin levels.

A NOVEL, ORALLY AVAILABLE OREXIN 2 RECEPTOR-SELECTIVE AGONIST, TAK-994, AMELIORATES NARCOLEPSY-LIKE SYMPTOMS IN NARCOLEPSY MOUSE MODELS

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Introduction: Narcolepsy type 1 (NT1) is a severe neurological disorder characterized by symptoms of excessive daytime sleepiness (EDS) and cataplexy. Currently available medications for NT1, including psychostimulants (e.g., modafinil for EDS), antidepressants (e.g., venlafaxine for cataplexy), and sedatives (e.g., sodium oxybate for both EDS and cataplexy), are symptomatic treatments with limited efficacy and adverse effects. Because NT1 results from loss of orexin-producing neurons, replacement therapies with orexin receptor agonists, particularly acting on orexin 2 receptor (OX2R), are considered as promising therapeutic options for NT1. In this study, we assessed the effect of TAK-994, a novel, orally available OX2R-selective agonist, on narcolepsy-like symptoms in two narcolepsy mouse models: orexin/ataxin-3 and orexin-tTA;TetO diphtheria toxin A (DTA) mice.
Materials and methods: TAK-994 was administered orally to mice at zeitgeber time 12, and the sleep/wakefulness states were evaluated *in vivo* based on electroencephalogram/electromyogram measurements. The fragmentation of wakefulness was assessed by the episode number and duration of wakefulness. The number of cataplexy-like episodes was determined by counting the number of episodes of direct transition from wakefulness to rapid eye movement sleep.
Results: In both orexin/ataxin-3 mice and orexin-tTA;TetO DTA mice, oral administration of TAK-994 significantly increased wakefulness time, and ameliorated fragmentation of wakefulness during their active phase. TAK-994 also significantly suppressed cataplexy-like episodes in both narcolepsy mouse models during their active phase.
Conclusions: An orally available TAK-994 could have the potential to treat a broad range of symptoms in NT1, such as EDS and cataplexy.
Acknowledgements: This study was conducted by Takeda Pharmaceutical Company Limited.

SENSITIVITY AND VALIDITY OF ON-THE-ROAD AND SIMULATED DRIVING TEST TO MEASURE IMPAIRED DRIVING BEHAVIOUR: EFFECT OF SLEEP DEPRIVATION

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Introduction: The assessment of potential sedative effects of new drugs is an important part of early-phase drug development. Undesired drowsiness may lead to an increased risk of traffic accidents. Sedation induced by one night of sleep deprivation causes a clinically relevant performance impairment [1, 2, 3]. This study assessed the sensitivity of both simulated and on-the-road driving behaviour as well as a validated psychomotor test battery to sedation induced by sleep deprivation in healthy subjects.

Materials and methods: This two way cross over study included 24 healthy males (age 25.7+/-1.6, BMI 24.3+/-3.4) in possession of a valid driver's license with a minimum mileage of 3000 km per year without a history of sleep disorders. Simulated and on the road driving behaviour as well as psychomotor functions were assessed after a well-rested and after a sleep deprived night. The order of sleep deprivation vs. well-rested was randomized with at least 7 days to recover from the sleep deprivation. Measurements were done in the morning at around the same time (± 1 hour) in the following order: psychomotor tests (including among others: body sway, adaptive tracker, eye movements and visual analogue scale for alertness), simulator driving test and on-the-road highway driving test. The driving simulator was developed by Green Dino BV (Wageningen, the Netherlands), the on-the-road car used a forward facing camera with advanced image recognition (Mobileye Vision Technologies Ltd, Israel). Driving behaviour was examined by using the Standard Deviation of Lateral Position (SDLP).

Results: Sleep deprivation significantly worsened SDLP scores during both simulated and on the road driving, 10cm (33%) (95%CI: 6.7-13.3) and 2.8cm (13%) (95%CI: 1.9-3.7), respectively. Performance on most psychomotor tests showed significant impairment after a night of sleep deprivation: the adaptive tracking score decreased with 6%point (18%) (95%CI: 4.1-7.6), the body sway increased with 37.2mm (18%) (95%CI: 2.3-35.1), the saccadic peak velocity decreased with 40.7deg/s (8%) (95%CI: 28.2-53.3) and the VAS for alertness decreased with 19.2mm (36%) (95%CI: 15.3-23.1).

Conclusions: This study provides a relevant reference for measuring drug-induced sedation for the Green Dino drive simulator and the Mobileye equipped on the road car. A deterioration of adaptive tracking, body sway and VAS for alertness after a night of sleep deprivation confirms previous results [2]. Further analysis will focus on the correlation between the individual tests for more insight in the mechanism of impaired driving behavior.

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Pharmacology
Board #225 : Poster session 2
SAFETY OF ZOLPIDEM AND ZOPICLONE DURING PREGNANCY: A NATIONWIDE RETROSPECTIVE COHORT STUDY OF RISKS OF PRETERM DELIVERY AND LOW BIRTH WEIGHT AT BIRTH AND INTELLECTUAL DISABILITY DURING 7-YEAR FOLLOW-UP

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Introduction: Insomnia is commonly seen among pregnant women. Although non-pharmacological interventions have been recommended as treatment of choice, there are a substantial number of women taking sleep aids during pregnancy. However, the fetal effects of sleep medications have not been well documented. Therefore, this study aims to investigate the safety of Zolpidem and Zopiclone, two commonly used sleep medications, during pregnancy.

Materials and methods: This study utilized data from the Maternal and Child Health Database (MatCHeD) which covers all medical claims of all infants born in 2004-2014 in Taiwan, along with their parents' encrypted personal identification numbers. Mothers' medical claims from 2000 to 2015 were retrieved from Taiwan's National Health Insurance Research Database (NHIRD) to identify the use of Zolpidem or Zopiclone during pregnancy.

Results: 843,369 live-born singleton infants were selected after excluding infants with parents having intellectual disability or major psychiatric disorders and mothers using psychotropic and sleep medications other than Zolpidem and Zopiclone during pregnancy. There were increased risks of preterm delivery, low birth weight and congenital malformations among 7,399 infants in the exposed group (AORs 2.4, 2.3 and 1.4 respectively). After excluding infants with adverse birth outcomes, the AOR of intellectual disability for the exposed group was 1.3 (95% confidence interval (CI): 1.2~1.4) compared to the comparison group during a 7-year follow-up period.

Conclusions: This study demonstrates associations between adverse birth and developmental outcomes and the use of Zolpidem and Zopiclone during pregnancy. The results call for more attention of the safety of sleep medications during pregnancy.

DIFFERENT EFFECTS OF OREXIN RECEPTOR ANTAGONIST AND GABA~A~ AGONIST ON PHYSICAL AND COGNITIVE FUNCTIONS AFTER FORCED AWAKENING

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Introduction: Insomnia is a common symptom in the general population, and a majority of insomnia patients are taking hypnotic agents. Currently, the most commonly prescribed hypnotic agents belong to the class of benzodiazepines and related compounds that enhances the function of the major inhibitory neurotransmitter g-aminobutyric acid (GABA). However, there is a concern about their side effects including tolerance, dependency, rebound insomnia, confusion, amnesia, and increased frequency of falling. In contrast, suvorexant is a recently approved orexin receptor antagonist representing an alternative mechanistic approach to insomnia treatment, which specifically inhibits the orexin-mediated wake-promoting system of the brain. This study aimed to compare pharmacological effects of orexin receptor antagonist and GABA~A~ agonist on physical and cognitive functions upon forced awakening when the drug effect is maximal.

Materials and Methods: The present study was a randomized, double-blind, placebo-controlled, 3-way crossover study. The participants were 30 healthy males, and sleep was recorded polysomnographically. Fifteen min before bedtime, participants took a pill: suvorexant 20 mg, brotizolam 0.25 mg, or placebo. A series of physical and cognitive functions tests were performed 3.5 h before bedtime (pre-test). Ninety min after taking a pill, participants were forced awoken. Participants repeated the same physical and cognitive functions tests (post-test). After woke up in the morning, participants repeated the tests (follow-test). Physical function tasks are body sway (trajectory length of center of foot pressure and rectangular area), agility and dynamic balance test, choice stepping reaction time, and Purdue pegboard test. Cognitive function tasks used Stroop color-word test. Also, the sum of z-score of all of physical and cognitive function tests was calculated.

Results: In post-test, total z-score of physical and cognitive function under brotizolam was also lower than under placebo ($P = 0.001$), while the difference between suvorexant and placebo were not statistically significant ($P = 0.264$). Static balance ability evaluated as rectangular area of center of foot pressure during 30 s as body sway test with eyes opened showed significant effect of time ($P = 0.002$), drug ($P < 0.001$) and interaction ($P < 0.001$). Brotizolam significantly deteriorated static balance ability compared to placebo and suvorexant at post-test. Agility and dynamic balance, and Stroop color-word test showed significant interaction and time effect; score deteriorated in post-test under brotizolam and suvorexant compared to placebo.

Conclusions: Suvorexant did not cause significant deterioration of static balance ability, while brotizolam reduced static balance ability evaluated after forced awakening.

IMPACT OF QUETIAPINE OVER SLEEP ARCHITECTURE- A REVIEW OF CURRENT DATA

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Introduction: Quetiapine is recommended quite frequently by clinicians for the treatment of insomnia associated to different psychiatric disorders and even for primary insomnia, although clear recommendations for its use in these cases are lacking from specific guidelines. If the anti-histaminic properties of low-dose quetiapine are confirmed by basic pharmacological studies, one should consider both beneficial effects and adverse effects that could arise from this pharmacodynamic profile.

Materials and methods: A search of main electronic databases (PubMed, Cochrane, CINAHL, Embase, Thomson Reuters/Web of Science) was performed using as paradigm „quetiapine" OR „quetiapine XR" AND „sleep architecture", „REM sleep", „non-REM sleep", „insomnia" OR „sleep disorders". All papers published between 2000 and 2018 were collected and filtered out non-significant citations based on pre-defined inclusion/exclusion criteria. No limitations regarding the language of published papers, age, primary diagnosis or specific comorbidities were formulated.

Results: Quetiapine and other atypical antipsychotics as augmentation therapy or monotherapy to unipolar and bipolar disorder patients have been shown to improve sleep continuity and sleep architecture. Quetiapine showed in polysomnographic studies in patients diagnosed with schizophrenia that it can increase the sleep latency, wake time after sleep onset, and REM sleep latency, while increasing total sleep time and sleep latency in healthy subjects. A randomized clinical trial showed that under acoustic stress quetiapine increased total sleep time by half an hour and reduced the number of awakenings by 35-40% compared to placebo and similar to mirtazapine. In the same trial, low doses of quetiapine specifically increased the duration of non-rapid eye movement sleep (N2) and induced daytime sleepiness and lessened sustained attention in patients with transient insomnia. In alcohol-dependent patients with insomnia quetiapine had no effect on sleep efficiency, but reduced awakenings after sleep onset and increased non-significantly sleep onset latency and stage 2 sleep time. Quetiapine XR improved sleep quality in elderly patients with major depressive disorder, and in midlife women with the same disorder. Quetiapine XR also improved sleep quality in patients with generalised anxiety disorder (monotherapy) and in those diagnosed with fibromyalgia (as add-on therapy).

Conclusions: Quetiapine had positive effects over insomnia associated with major depressive disorder, bipolar disorder, fibromyalgia, generalised anxiety disorder, schizophrenia, but larger, better-designed trials using polysomnography should be realised in order to confirmed the impact of this antipsychotic over sleep architecture in both primary and secondary insomnia. The risk for daytime sleepiness and metabolic adverse effects should be considered whenever this antipsychotic is recommended.

Pharmacology
Board #226 : Poster session 2

TRAZODONE AS ADD-ON FOR RESIDUAL INSOMNIA ASSOCIATED TO SEVERE MAJOR DEPRESSIVE DISORDER IN ELDERLY PATIENTS

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Introduction: Residual symptoms of severe major depressive disorder are important predictors for relapse and they are associated with poorer quality of life, lower functionality, and risk for contracting new psychiatric disorders (e.g., alcohol or benzodiazepine dependence). Insomnia is one of the most frequently reported residual symptom in major depression, and this phenomenon has attracted complex pharmacological and psychotherapeutical-oriented interventions, which have been associated with various degrees of success.

Materials and methods: Five patients, mean age 71.5 years, diagnosed with major depressive disorder have been treated during their last episode (severe, without psychotic features) with either a serotonin selective reuptake inhibitor (sertraline, fluoxetine or escitalopram), or a serotonin and norepinephrine reuptake inhibitor (venlafaxine or duloxetine). All these patients were evaluated after 4, 8, 12, 16, 20 and 24 weeks since the treatment onset and both their global clinical status and their Geriatric Depression Scale (GDS-30) improved significantly after 24 weeks. Also, their overall functionality, evaluated through Global Assessment of Functionality Scale (GAF) improved considerably (+65% to baseline). However, all these patients accused the persistence of difficulties in falling asleep, combined with multiple awakenings during the night, observed for the majority of nights within a normal week. The self-rated disconfort associated with sleep problems was evaluated as moderate to severe (6.8 on a 10-point visual analogic scale- VAS). A clinical thoroughly examination was performed and other organic or toxic causes for sleep problems were excluded. A flexible dose of trazodone (25-100 mg QD) was recommended as add-on to their current treatment, in order to manage residual insomnia.

Results: Patients reported improved quality of sleep and the VAS score declined to a mean value of 4.6 after 7 days. This improvement persisted after 14 and 28 days, without significant fluctuations on GAF, GDS-30, or CGI-S. Two patients discontinued treatment with trazodone after 28 days, but in the other 3 cases, trazodone was administered as add-on for the remaining of the antidepressant treatment. In one case trazodone daily dose was increased up to 200 mg. No significant adverse events were reported during the treatment.

Conclusions: Continuous monitoring of the sleep quality and quantity should be initiated by the treating physician in cases of major depression in elderly patients, even if the mood and other core symptoms of depression are considered in remission. Adding trazodone is granted if residual insomnia is detected, but individual responsivity may request dose adjustment during the entire duration of the antidepressant treatment.

SEVOFLURANE DEPRESSES NEURONS IN THE MEDIAL PARABRACHIAL NUCLEUS BY POTENTIATING POSTSYNAPTIC GABA$_A$ RECEPTORS AND BACKGROUND POTASSIUM CHANNELS

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Introduction: Despite persistent clinical use for over 170 years, the neuronal mechanisms by which general anesthetics produce hypnosis remain unclear. Previous studies suggest that anesthetics exert hypnotic effects by acting on endogenous arousal circuits. Recently, it has been shown that the medial parabrachial nucleus (MPB) is a novel wake-promoting component in the dorsolateral pons. However, it is not known whether and how the MPB contributes to anesthetic-induced hypnosis.

Materials and methods: The actions of sevoflurane, a widely used volatile anesthetic agent that best represents the drug class of halogenated ethers, were investigated in mice. The calcium signals of MPB neurons were examined using *in vivo* fiber photometry during sevoflurane exposure. The action potential firing, the membrane potential, the membrane input resistance, and the inhibitory postsynaptic currents mediated by GABA$_A$ receptors were recorded from MPB neurons using *in vitro* whole-cell patch-clamp recordings during infusion of sevoflurane.

Results: The population activities of MPB neurons were inhibited during sevoflurane anesthesia. Sevoflurane suppressed the firing rate of MPB neurons in a concentration-dependent and reversible manner. At a concentration of 0.22 mM, sevoflurane potentiated synaptic GABA$_A$ receptor-mediated inhibition, and the inhibitory effect of sevoflurane on the firing rate of MPB neurons was completely abolished by picrotoxin (100 µM), a selective GABA$_A$ receptor antagonist. At a concentration of 0.44 mM, sevoflurane directly hyperpolarized MPB neurons and induced a significant decrease in membrane input resistance by increasing a basal potassium conductance.

Conclusions: Sevoflurane inhibits neurons in the MPB through postsynaptic GABA$_A$ receptors and background potassium channels, suggesting that the MPB is involved in sevoflurane-induced hypnosis.

MIDBRAIN DOPAMINERGIC NEURONS MEDIATE MODAFINIL INDUCED AROUSAL

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Introduction: 2-[(Diphenylmethyl) sulfinyl] acetamide (modafinil), a widely used wake-promoting agent, prescribed principally to treat narcolepsy with low propensity for abuse. Modafinil weakly interacts with the dopamine transporter, however, it isn't completely clear it acts on which parts of dopaminergic neurons. Here, we investigated the modafinil action on identified dopaminergic neurons in the midbrain, to understand the precise mechanism of modafinil.

Materials and methods: Firstly, we abolished dopaminergic neurons in ventral tegmental area (VTA) and substantia nigra (SN). Next, we employed calcium signal detections to discern the neuronal activities in VTA treated with raclopride, apomorphine, modafinil and caffeine. Then, we used an intensity-based genetically encoded dopamine indicator, dLight1.1, to track the projected area nucleus accumbens (NAC) dopamine (DA) levels across the spontaneous sleep-wake cycle and the dopaminergic response to modafinil and caffeine.

Results: When we abolished dopaminergic neurons in VTA and SN, the robust wake-promoting effects caused by modafinil were totally blocked even at a high dose (180 mg/kg). However, only lesion of SN resulted in a reduction of arousal by 1 h, while VTA was partially blocked. In calcium signal detections in VTA, we found that intraperitoneal modafinil inducing calcium signals diminished at a dose-dependent manner, which inhibited the population activities of VTA dopaminergic neurons. While pretreatment with D2 receptors (D2R) antagonist raclopride (2 mg/kg), the 40% diminishment of calcium signals caused by modafinil (90 mg/kg) were decreased to 20% and lasting time reduced from 4 h to 2 h. Similarly, D2R agonist apomorphine (0.5 mg/kg) also inhibited the population activities of VTA dopaminergic neurons decreasing 30% signal and lasting for 2 h. Dopamine release in NAC were detected by dLight1.1across the spontaneous sleep-wake cycle and the dopaminergic response to modafinil and caffeine. The results showed that modafinil increased the dLight1.1 signal exhibiting dose-dependent manner while caffeine did not. Finally, we used D2R shRNA to silence the dopamine D2R expressed in VTA dopaminergic neurons, which exert a negative feedback regulation that reduces the firing of neurons, DA synthesis and release.

Conclusions: The results indicated that the inhibitory effects of modafinil on VTA dopaminergic neurons was antagonized, which may block the negative feedback regulation for reducing firing, DA synthesis and release. Our findings demonstrated that midbrain dopaminergic neurons mediate modafinil induced arousal.

ASSOCIATION OF REM CHARACTERISTICS AS A STATE MARKER OF DEPRESSION AMONG IRANIAN PATIENTS: A CASE-CONTROL STUDY

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Introduction: Alteration in Rapid Eye Movement (REM) as a sleep phase has been related to depression in clinical researches, it depends to some factors such as age, sex and race. There is limited evidence regarding the association of REM changes and depressed mood among Iranian patients So far.
Materials and methods: Current study was conducted among 48 patients referred to Baharloo sleep center for polysomnography. Twenty-three participants were assigned to case group (Depressed) and control group (non-depressed) based on their BDI (Beck depression Inventory II) score. We assessed REM latency, 1st duration of REM phase, total duration of REM cycles and REM density by administrating polysomnography for one night.
Results: Longer duration of REM phase (p: 0.026) the last REM period density (p: 0.057) were related to depression after age-sex adjustment and more REM periods number in depressed(p: 0.009).
Conclusions: Our study suggests that rapid eye movement density could be a polysomnographic marker of depression.

ADJUNCTIVE LIGHT TREATMENT IN MAJOR DEPRESSIVE DISORDER PATIENTS WITH EVENING CHRONOTYPE - A RANDOMIZED CONTROLLED TRIAL

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Introduction: The current study aimed to conduct a randomized controlled trial to evaluate the efficacy of bright light therapy (BLT group) with gradual advance, as compared to dim red light (DRL group), with the same gradual advancement protocol, in patients with unipolar non-seasonal depression and evening-chronotype.

Materials and methods: The current study was a randomized, assessor and prescriber-blind, home-based trial for patients with unipolar non-seasonal depression and evening-chronotype. Recruited patients were randomly allocated to either five weeks of combined bright light therapy with gradual advance (BLT group) or to dim red light with the same advancement protocol (DRL group), subjects were followed up weekly during the five-week intervention phase, at one-week, one months, two months and five months after treatment. Primary outcomes included i) remission rate (as defined by the Hamilton Rating Scale for Depression 17-item (HRSD-17) component via the Structured Interview Guide for the Hamilton Depression Rating Scale with Atypical Depression Supplement (SIGH-ADS) score of 7 or less) and ii) the score of HRSD-17.

Results: A total of 112 patients (46.5 ± 11.7 years old, 79.6% female) with moderate unipolar depression and evening chronotype were recruited. Twelve patients who achieved spontaneous remission of depression and nine patients who dropped out before treatment were excluded from the analysis. Ninety-one patients were included into the statistical analyses by using the modified intention-to-treat method and imputation by last observation carried forward (LOCF) for missing data. The differences in the change of clinical measures between the two groups, including HRSD 17, HAMA, YMRS, ISI, HADS, BSSI, MEQ, CFS and SF-36, were not statistically significant (p > 0.05) by repeated-measures ANOVA across the 5 months. Nonetheless, the BLT group achieved a higher remission rate of depression than the DRL group starting from week 2 of treatment. Kaplan-Meier curve analyses showed a faster remission and a higher cumulative remission rate (66.0% and 45.7%) for the BLT group as compared to the DRL group (Log Rank Test, p=0.045).

Conclusions: The use of bright light therapy with gradual advance brought about a faster onset of remission and a higher remission rate at week 2 as compared to dim red light group. Our findings supported the use of adjunctive bright light therapy for patients with moderate unipolar depression and evening chronotype.

POOR SUBJECTIVE SLEEP QUALITY DURING PREGNANCY IS ASSOCIATED WITH POSTPARTUM DEPRESSION

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Introduction: Sleep disturbances, characterized by insomnia symptoms, reduced sleep quantity and quality, or disrupted regularity, are highly prevalent in pregnancy. Sleep problems during pregnancy have been associated with later sleep disturbance as well as increased depressive symptomatology. The present study aimed to characterize prenatal sleep disturbance and further examine its associations with persistent sleep problems and mood disorder during postpartum period.

Materials and methods: The sample included 211 pregnant women (29.91 ± 5.33 years old at delivery), who were enrolled in a longitudinal study since their first trimester of pregnancy. Sleep and mood were assessed with self-report questionnaires, including the Pittsburgh Sleep Quality Index (PSQI), the Center for Epidemiologic Studies Depression Scale Short Form (CES-D-SF), and the Edinburgh Postnatal Depression Scale (EPDS), during 5 prenatal and 2 postnatal visits. Mixed model repeated measure analyses were conducted to examine differences in sleep and mood across time. Logistic regression controlling for age, years of education, and baseline depression was performed to estimate the association between poor sleep quality during pregnancy and presence of postpartum sleep and depressive symptomatology.

Results: At 15 weeks pregnancy, 42.1% of participants had a PSQI score indicative of poor sleep quality. Women reported significant deteriorations in sleep quality during second and third trimesters, followed by a gradual improvement over postpartum period (all ps < .001). The prevalence rate of postpartum depression was 8.5% and 8.9% at 3 and 6 months after delivery, respectively. PSQI scores at 25 weeks and 36 weeks pregnancy were associated with increased odds of (1) having persistent poor sleep postpartum (OR 1.64, 95% CI=1.07-2.51; and OR 1.91, 95% CI=1.04-3.50, respectively), and (2) having postpartum depressive symptoms at 3 months (OR 1.37, 95% CI = 1.03-1.83; and OR = 1.35; 95% CI = 1.06-1.73, respectively), controlling for maternal age, education and baseline depressive symptoms (CES-D-SF).

Conclusions: Women experienced marked sleep disturbances across pregnancy and postpartum. Poorer subjective sleep quality during pregnancy contributed to development and extent of clinical postpartum depression. Maternal sleep concerns during pregnancy may be an important premorbid clinical indicator of postpartum mood disorders. Our findings suggest that screening for sleep problems during pregnancy may be of clinical significance for postpartum psychiatric risk.

DANCE TO ANOTHER RHYTHM - CHRONOBIOLOGY AND SLEEP IN ADHD CHILDREN

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Introduction: The research on circadian rhythmicity, combining ClockGenes with behavioral and endocrine outcomes increasingly enriches the fields of neuroscience, psychopharmacology and adult psychiatry. In recent years, For Attention Deficit Hyperactivity Disorder (ADHD) a disturbance of circadian rhythm is described. In their review of 2017 on adults Coogan and McGowan characterized a delayed circadian phase, evening preference, and sleep onset insomnia as phenomena typical for ADHD. Based on the results of our study, we discuss the connections and interactions of motor activity, light consumption, expression of the two clock genes (BMAL1 and PER2), secretion of melatonin and cortisol with psychometric properties in ADHD children.

Materials and methods: Juvenile patients (8-12 years) suffering from ADHD were recruited from the department for child and adolescent psychiatry of Rostock University Medical Center (n = 12) and age-matched to healthy controls (n = 11). Each participant was assessed with a structured clinical interview and specific ADHD questionnaires. Participants of both groups were drug-naive. Sleep habits were assessed with the pediatric sleep questionnaire (PSQ). Participants wore aktimeters on the non-dominant wrist for at least 7 days to evaluate motor activity and light consumption. Salvia was collected every 4 hours (8, 12, 16, 20, 24, 4, 8 h) for cortisol plus one sample (22 h) for melatonin. Buccal mucosal membrane was collected every 4 hours to determine expression of BMAL1 and PER2 at the same time points as saliva samples.
Hormone and genetic data was analyzed with the Cosinor method. Between-group comparisons and correlation analysis of chronometric and questionnaire data were conducted.

Results: As expected, groups differed for measures of ADHD, but less so for sleep disturbances measured by the PSQ. However, groups differed in the expression of ClockGenes and hormone levels, but not in movement and light consumption.

Conclusions: ADHD children show disturbed circadian rhythmicity only on the genetic and endocrine level, but not in sleeping behavior. This disturbance seems to be independent from movement and light consumption. These results differ from the findings on adults, which lead us to the hypothesis that ADHD in children may rest upon slightly different circadian disturbances.

EFFECT OF GROUP COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN OUTPATIENTS WITH MAJOR DEPRESSION SUMMARY

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Introduction: Ninety percent of patients with Major Depressive Disorder suffer from insomnia symptoms. Insomnia increases the risk of developing depression, suicidal ideation, non-remission and relapse.. Research supports the effect of Cognitive Behavioral Therapy for insomnia in the depressed, but the effect on comorbid outcome seems modest. Samples have been heterogeneous according to coexisting medical conditions and severity of depression making it difficult to assess if patients with a clinical diagnosis of depression benefit from Cognitive Behavioral Therapy-Insomnia.
The aim of our randomized controlled trial was to examine the effect of group cognitive behavioral therapy for insomnia in patients with moderate to severe levels of depression in an outpatient comorbid sample.
Materials and methods: Forty-seven participants were randomized to receive 6 weekly sessions of Cognitive-behavioral therapy for insomnia or treatment as usual (TAU). Outcome measures were Sleep diary, Insomnia Severity Index, Dysfunctional Beliefs and Attitudes about Sleep Questionnaire, Hamilton Depression Rating Scale and WHO 5 questionnaire for Quality of Life. The measures were obtained before and after the intervention.
Results: As compared to TAU group cognitive behavioral therapy reduced insomnia symptoms with a medium effect size on most sleep variables. Furthermore, results showed a medium to large effect size on depressive symptoms. Dysfunctional beliefs about sleep and quality of life improved compared to scores in the treatment as usual condition.
Conclusion: In conclusion group, cognitive behavioral therapy was efficient for treating insomnia in patients with major depression in an outpatient clinic but replication with a larger sample is recommended.
Acknowledgements: Authors want to thank neurologist and Ph.D, Marit Otto for support on polysomnographic data.

SLEEP, MEMORY, AND EMOTION PROCESSING IN YOUTH WITH AND WITHOUT PTSD

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Introduction: Sleep disturbance and emotion processing abnormalities are core features of pediatric post-traumatic stress disorder (pPTSD). A wealth of multidisciplinary evidence indicates that sleep is crucial for optimal cognitive and emotional function. For example, impaired sleep quality is associated with amplified responsivity to aversive stimuli as well as diminished emotion regulation capacity. Emerging evidence also indicates that sleep plays a crucial role not only in consolidating the content of emotional experience, but also in reducing its affective potency. Despite these data, the contributions of sleep to emotion processing in pPTSD have received remarkably little attention. No studies to date have objectively measured sleep in pPTSD using electroencephalography (EEG), and none have examined the direct relationship between sleep and emotion processing.

Materials and methods: Ten participants with PTSD and ten age- and sex-matched controls between the ages of 11-17 years completed two counterbalanced overnight sleep studies using high-density EEG (256-channel). Prior to sleep on one night, participants rated 70 neutral and 70 negative scenes from the International Affective Picture System (IAPS) with respect to subjective arousal on a scale of 1-9. The following morning, youth again rated subjective arousal to 200 negative and neutral images, half of which were new, and were asked to report whether images were remembered from the previous night.

Results: PTSD and TD groups showed marked differences in patterns of arousal ratings given for negative images. TD ratings were near-normally distributed, with a most frequent rating of 8 at night and of 4 in the morning, whereas PTSD ratings were most frequently given as 1 or 9. Memory did not differ significantly between groups. However, as arousal increased, mixed-effects linear regression models revealed that PTSD, but not TD, youth were more likely to identify both novel (p=.018) and repeated (p=.046) images as having been seen the night before. Significant group differences were also identified in the change in arousal from pre to post-sleep for previously viewed negative material. Specifically, TD youth *decreased* subjective arousal to negative imagery, while PTSD youth slightly increased ratings of arousal (change in arousal TD, -1.89 ±0.97; PTSD +0.14 ±1.0; p=0.007). Analyses of sleep slow-wave activity (SWA) in non-rapid eye-movement (NREM) sleep revealed a robust, global *decrease* in SWA power in youth with PTSD on the task night relative to their baseline night of sleep (mean SWA change -36.76%±.053). In contrast, SWA power did not change in TD youth on task night relative to baseline sleep (mean SWA change +.095%±.005). The average change in SWA from baseline to task night was robustly correlated with the change in emotional reactivity across all subjects (Pearson's rank correlation *p*-.58, p=.008).

Conclusions: Our results indicate that SWA plays a role in emotional habituation in TD and PTSD youth. They furthermore suggest a distinction between the ways in which PTSD and TD youth respond to negative stimuli, with PTSD youth ratings of negative images indicative of an all-or-nothing reaction. PTSD youth also appear more likely than TD youth to identify more negative stimuli as familiar.

SLEEP ARCHITECTURE AND COMORBID SLEEP DISORDERS IN PATIENTS WITH BIPOLAR AFFECTIVE DISORDER AND RECURRENT DEPRESSIVE DISORDER

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Introduction: Bidirectional relationship between sleep disturbances and affective disorders (e.g. Bipolar Affective Disorder (BPAD and Recurrent Depressive Disorder (RDD) is increasingly recognised. However, the underlying neuromechanisms are far from clear, and whilst majority of studies to date report on the sleep macrostructure of RDD, very little is available to delineate or compare it to the sleep architecture of BPAD. In order to address the current gap in the knowledge of potential underlying pathophysiology, a retrospective study of polysomnographic recordings of patients presenting to a tertiary sleep disorders clinic with affective disorders was conducted.

Materials and methods: A retrospective observational study of medical records and polysomnographic recordings of all patients with BPAD, and of age- and gender-matched patients with RDD, who were investigated between 2015 and 2018 at a large tertiary Sleep Disorders Centre (Guy's Hospital, London, United Kingdom), was conducted. The study obtained required ethical approval (Project No 9496, GSTT NHS).

Results: We studied sixty three BPAD patients (33 female; mean age ± S.D.: 41.8 ± 12.4) and 126 age- and gender-matched RDD patients (62 female; 41.5 ± 12.8). Whilst no significant differences were observed in the sleep macrostructure parameters between BPAD and RDD patients, the major differences were observed in the comorbid sleep and physical disorders. Two most prevalent sleep disorders, namely obstructive sleep apnoea (OSA) (BPAD 54.0% *vs RDD* 21.4%, $P< .001$) and insomnia (BPAD 34.9% *vs* RDD 15.0%, $P< .005$) were found to be strongly linked with BPAD. Similarly, investigated BPAD patients were reported significantly more morbidly obese (52.4% *vs* 31.0%, $P=.007$) and with more prevalent diagnoses of diabetes (14.3% *vs* 3.2%, $P=.011$) and hypothyroidism (14.3% *vs* 2.4%, $P=.003$). Mood stabilisers (e.g. lamotrigine, valproate and lithium) and atypical antipsychotics (e.g. aripiprazole and olanzapine) were more frequently prescribed to patients with BPAD, while prescription of antidepressants (e.g. citalopram and sertraline) was more frequently noted in patients with RDD.

Conclusions: OSA and insomnia, two most prevalent sleep disorders, were found significantly more prevalent in patients with BPAD, by comparison to RDD patients, in our study. Whilst some differences can be attributed to differential treatment regimes, we believe our striking findings merit further investigation.

POOR SLEEP MARKERS IN CHILDREN AND ADOLESCENTS REFERRED FOR A NEUROPSYCHOLOGICAL EVALUATION

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Introduction: Even though sleep and daytime functioning are closely related, the sleep of children and adolescents referred for a neuropsychological evaluation is rarely assessed and this was the aim of the present story. We further explored the frequency of poor sleep according to specific neurodevelopmental disorder (NDD) diagnoses. Our hypothesis was that children and adolescents diagnosed with a NDD would report more markers of poor sleep compared to their non-affected peers.

Materials and methods: 56 children (5-12 years old) and 17 adolescents (13-16 years old) were recruited from the database of a private neuropsychology clinic. Sleep data came from the clinic's own questionnaire and NDD diagnoses were DSM-5 compliant. Markers of poor sleep were defined as: (1) sleep latency ≥30 minutes; (2) sleep duration significantly shorter than age-specific norms; (3) significant differences between weekdays and weekends sleep schedules. Chi-squared tests compared the proportion of participants with poor sleep to that expected in the general population of children and adolescents. Descriptive statistics were used to characterize sleep according to NDD diagnoses, namely: Attention-Deficit /Hyperactivity Disorder (ADHD: n=38), Autism Spectrum Disorder (ASD: n=5), Tourette Syndrome (TS: n=4), Dysexecutive Syndrome (n=1), Language Disorder (n=5), Learning Disorder (n=2), Anxiety Disorder (n=5), NDD-non specified (NDD-NS: n=9) and Typically Developing (TD: n=4).

Results: There were more adolescents referred to neuropsychology who reported poor sleep (82.4%) compared to the general adolescent population (20%) ($\chi 2(1) = 41.3$, $p < 0.001$). The difference between children referred to neuropsychology (46.4%) and the general population of children (37.0%) was not significant ($\chi 2(1) = 2.1$, $p = 0.17$). More adolescents referred to neuropsychology reported poor sleep (82.4%) compared to children of the same group (46.4%) ($\chi 2(1) = 6.8$, $p < 0.05$). Results of poor sleep across diagnoses were ADHD: 20/38 (52.6%), ASD: 4/5 (80%), TS: 3/4 (75%), Dysexecutive syndrome: 1/1 (100%), Language Disorder: 2/5 (40%), Learning Disorder: 2/2 (100%), Anxiety Disorder: 2/5 (40%), NDD-NS: 4/9 (44%) and TD: 2/4 (50%).

Conclusions: Adolescents referred for a neuropsychological evaluation seem to be at a higher risk of reporting markers of poor sleep compared to adolescents in the general population and to children of the present study. We hypothesize that additional risk factors associated with adolescence contribute to this higher number of poor sleep markers in adolescents with NDD. Further studies with more participants are needed to test this hypothesis across a numerically more representative sample.

THE ROLE OF SLEEP DISTURBANCES AND NEGATIVE EMOTIONALITY IN NICOTINE DEPENDENCE

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Introduction: Sleep disturbances are among the negative consequences of nicotine withdrawal but their role in nicotine dependence remains largely unknown. This study aimed to systematically investigate the association between nicotine dependence, sleep disturbances, and negative emotionality.

Materials and methods: The participants of this study were young adults aged 18-28, with 15 of them being regular smokers and 20 non-smokers. Smokers were compared to non-smokers on subjective and objective measures of sleep, nicotine dependency, stress and anxiety. Participants completed the Pittsburgh Sleep Quality Index, the Fagerstrom Test for Nicotine Dependence, the Personal Stress Scale, and the State-Trait Anxiety Inventory, and provided salivary samples for detecting levels of two important biomarkers of stress: cortisol, reflecting hypothalamus-pituitary-adrenal axis activity and alpha amylase, reflecting sympathetic activity. Participant´s sleep was continuously monitored for 1 week with a wrist actigraph. Subsequently, smokers began 5 days of abstinence from nicotine during which sleep was continuously monitored with a wrist actigraph. Saliva samples were collected, and all questionnaires completed, at 4 time points: 0, 2, 3 and 5 days into abstinence.

Results: Compared to non-smokers, smokers experienced increased activity during sleep that was correlated with their urge to smoke. Moreover, abstinence from smoking induced a sharp decline in sleep quality, reflected by reduced sleep efficiency, increased latency to sleep onset, and increased activity during sleep. This decline in sleep quality was associated with increased anxiety, somatic and emotional withdrawal symptoms, and in the urge to smoke.

Conclusions: Nicotine addiction involves substantial sleep disturbances that are related to heightened stress and anxiety, supporting the pathological motivation to seek nicotine.

DIAGNOSTIC RELEVANCE AND THERAPEUTIC EFFICIENCY OF A SYSTEMIC PROCEDURE OF SLEEP (RESPIRATORY AND ARCHITECTURE) DISORDERS CARE IN A 100 CONSECUTIVE DEPRESSIVE HOSPITALIZED PATIENTS COHORT INTO A PSYCHIATRIC DEPARTMENT

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Depressive syndrome induces sleep disorders. Sleep fragmentation induces and worses depressive syndrome.
Restauration of respiratory sleep disorders is a marker of therapeutic efficacy.
Some psychotropic agents worse sleep obstructive (NLP) and central (BZD) respiratory events.
We conduct a prospective work who the aim was in front of a patient allocated for obstructive sleep apnoeas syndrome (OSA) selected through the Berlin Questionnaire (BsQ) in course of hospitalization in the psychiatric department after the control of the acute phase, does exist an OSA.
The second objective was the view of efficiency (efficacy and adherence) of a CPAP treatment in these a priori versatile patients.
Patients and methods : BSQ and Pichot's Scale for all patients, if positive (BsQ > 2 clusters, and Pichot < 20 points) PSG in the sleep department (standard, CidLx, Cidelec, France). Ventilation criteriae AHI > 20 plus clinical symptoms (fatigue, sleepiness, nycturia, sleep disruption).
Results : 106 patients in intention to treat (BsQ >2, AHI > 20/hr)), OSAS (auto-PAP pts, PRISMA 20A, WeinMann® ; ICON, F&P®) : 68 patients (64%). Lost of care 12 pts, AHI (mean, SD) = 35,5 +/- 29,1/hr, age (men, SD) = 55,2 ± 12,9 y.o , 32 ♂ (30,1%), 74 ♀ (69,9%).
Adherent patients (> 4hr30:night), 48 = 75%. Sleep lab. comparative 6 months C-A-PAP adherence: pts from cardiology 55%, DM Steinert 33%, co-actuarial Pneumology cohort 75%.
Conclusions : 64% pré-selected pats through a BsQ in a psychiatric department suffer from OSA eligible for CPAP treatment (and not only because of an AHI SdB. It exist an inversion of the usual sex ratio (75% ♀). These patients are adherents, 75% as usual pneumologic pts. 48/106 patients (45%) suffer from post tobalogic COPD (SPLF criteriae:
Aknowledgement S. Saint-Pierre, Weinmann, France ; J. Safont, SOS Oxygène-Centre, France

SLEEP QUALITY AND PRESCRIPTION OPIOID MISUSE: THE POTENTIAL MEDIATING ROLE OF PAIN INTENSITY, NEGATIVE AFFECT, AND OPIOID CRAVING

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Introduction: Chronic pain is a major health problem that affects up to 20% of the adult population, and opioids are among the most frequently prescribed medications for the management of patients with chronic pain. Despite the potential benefits of opioid therapy, studies have revealed alarmingly high rates of opioid misuse among patients with chronic pain, being up to 20-30% in primary and tertiary care clinic settings, respectively. Opioid misuse (e.g., the use of opioids differently from how they were prescribed) may cause deleterious health problems and may result in fatal opioid overdose. In past research, elevated rates of opioid misuse have been observed among patients experiencing high levels of pain intensity, negative affect, and craving. However, these factors cannot fully account for opioid misuse behaviours observed among patients with chronic pain. There is reason to believe that sleep problems might also contribute to opioid misuse, but this has yet to be examined. The co-occurrence of sleep problems and chronic pain is well-documented, as research indicates that clinically significant sleep problems are reported by up to 72% of chronic pain patients. In previous research, poorer sleep has been found to be associated with heightened pain intensity, negative affect, and craving, suggesting that these variables could possibly mediate the association between sleep quality and prescription opioid misuse. The first objective of this study was to examine the association between sleep quality and opioid misuse in patients with chronic pain being prescribed long-term opioid therapy. We also examined whether pain intensity, negative affect, or opioid craving mediated the association between sleep quality and opioid misuse.
Methods: In this longitudinal study, 89 chronic pain patients prescribed opioid therapy were recruited from primary and tertiary care settings. Patients underwent a baseline assessment and then completed diary measures of sleep quality, pain intensity, negative affect, and opioid craving for 14 consecutive days using numeric rating scales (NRS). Opioid misuse behaviours were also assessed using a self-report instrument validated for patients prescribed opioids.
Results: Poorer sleep quality was associated with elevated rates of opioid misuse ($p < .01$) as well as with heightened levels of pain intensity ($p < .001$), negative affect ($p < .001$), and opioid craving ($p < .001$). A regression analysis revealed that poorer sleep quality remained significantly associated with opioid misuse even after controlling for pain intensity, negative affect, and opioid craving (all p's $< .05$). A subsequent bootstrapped mediation analysis revealed that the association between sleep quality and opioid misuse was not significantly mediated by any of these variables (all p's $> .05$).
Conclusions: Our findings provide new insights into the potential deleterious influence of sleep problems on opioid misuse among patients with chronic pain. Importantly, our findings suggest that sleep problems might contribute to opioid misuse over and above other well-known risk factors such as pain intensity, negative affect, and opioid craving. From a clinical standpoint, our findings indicate that treatment interventions designed to improve sleep quality might contribute to reducing prescription opioid misuse among patients with chronic pain.

Psychiatric Disorders Affecting Sleep/Wake
Board #233 : Poster session 2

CIRCANNUAL FLUCTUATION OF INTERMITTENCY OF DAILY LOCOMOTOR ACTIVITY, AND ITS RELATIONSHIP TO SUBJECTIVE MOOD, PHYSICAL ACTIVITY, AND CHRONOTYPE: TWO-YEAR FOLLOWING-UP OF A CASE WITH DEPRESSION

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Objectives: Mood disorders have close relationship to biological rhythms. We recently found that cumulative distributions of resting period durations of locomotor acitivy measuered by actigraphy take a power-law distribution form, and their scaling exponent significantly decreased in major depressive disorder (MDD) and circadian rhythm sleep-wake disorder. In this study, we examined longitudinal changes of distribution statistics of resting periods in a patient with MDD, and thier relationship to subjective mood, physical activity, and chronotype.

Methods and materials: A female patient with MDD in her 30s participated in this study. Her rest-activity was continuously evaluated from actigraphy data for 48 months, and clinical assessments including Beck Depression Inventory (BDI), International Physical Activity Questionnaire (IPAQ), and Morningness-Eveningness Questionnaire (MEQ) were administered biweekly or monthly during the observation period. The parameter γ , defined as a scaling exponent of the resting period duration, was calculated for weekly data of actigraphic rest-activity, based on the analysis proposed in our previous studies. This study was approved by the Ethics Committee of the Fujita Health University, and the patient provided prior verbal and written informed consent.

Results: The values of parameter γ were ranged between 0.61 and 1.1 (mean 0.88 ± 0.10), which was lower than those of healthy controls previously reported, meaning systematic increase of resting period durations. The parameter values also showed circannual fluctuation dipping in winter seasons. As for clinical aspects, there were not apparent seasonal changes of depressive symptoms or related events which could affect her mood or behaviors during winters. The BDI scores presented the gradual decrease, whereas the IPAQ and MEQ scores showed the gradual increase, indicating the increasing trend of physical activity levels and the shift to morning chronotype; the changes of these scores were not corresponded to the fluctuation of the parameter γ .

Conclusion: The decrease of the parameter γ in the patient with MDD was consistently observed over the long experimental period , with showing circannual fluctuations. Although it would be hard to discuss the existence of "seasonal" changes in intermittent parameter of γ only from two years' observation of one patient, but it would suggest that the parameter γ might not change parallelly with subjective mood, physical activity levels, and chronotype. To interpret clinical meaning of the decrease γ , further long-term studies with many subjects would be warranted.

Psychiatric Disorders Affecting Sleep/Wake
Board #209 : Poster session 1

IMPACT OF STRESS-COPING STRATEGY ON SLEEP QUALITY IN GENERAL POPULATION

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Introduction: Association of perceived stress with sleep quality has been shown in several studies. However, little is known about the influence of stress-coping strategy on the sleep quality in general population. Therefore, we aimed to reveal the association of stress-coping strategy with sleep quality in general population.

Materials and methods: All employers who were belonged to Suwon city hall, Suwon-si, Gyeonggi-do, South Korea were requested to complete self-rating questionnaire through intra-network of Suwon city hall. Questionnaires included demographic characteristics, Pittsburgh sleep quality index (PSQI), Perceived stress scale-10 (PSS-10), Korean Brief COPE inventory (Brief COPE). Items of Brief COPE were categorized to three subgroups; problem-centered coping, emotion-centered coping, dysfunction coping. Responds were recruited and analyzed to delineate the relationship of perceived stress and sleep quality and impact of stress-coping strategy on sleep quality.

Results: 808 subjects (19.8%) complete their questionnaires and the mean age of respondents was 40.21 ± 10.32 years. BMI of participants was 22.55 ± 3.64 kg/m^2 and 36.0 % of subjects were male. Total score of PSQI was shown as 7.30 ± 7.94 and 69.7% of respondents reported their PSQI score was more than 5, the indicator of poor sleep quality. The total score of PSS-10 was 17.89 ± 6.07 and the proportion of group having a significant level of stress (PSS-10 >17) was 49.9%. Participants were using problem-centered coping mostly, followed by emotion-centered coping and dysfunctional coping. The total score of PSQI was correlated with that of PSS-10 (Pearson correlation coefficient, 0.544; $p< 0.001$). And participants reporting their poor sleep quality (PSQI>5) were using dysfunctional coping that participants not having poor sleep quality (21.08 ± 4.93 vs 23.85 ± 5.12, $p< 0.001$). However, sleep duration and habitual sleep efficiency were not significantly associated with stress-coping strategy.

Conclusions: It was shown that subjects with higher perceived stress were suffering with poorer sleep quality. And stress-coping strategy influences the relationship of perceived stress and sleep quality among general population.

A TRANSDIAGNOSTIC SLEEP AND CIRCADIAN TREATMENT FOR INPATIENTS WITH AFFECTIVE DISORDERS, A MIXED METHODS PILOT STUDY

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Introduction: Sleep problems are highly prevalent for inpatients with bipolar affective disorder and unipolar depression. Cognitive behavioral therapy for insomnia (CBT-I) presents a promising treatment for patients with depression and comorbid insomnia. Further, a transdiagnostic approach developed by Harvey and Buysse treating sleep disturbances in patients with mental disorders has proven efficient. However, only few studies have investigated the feasibility and effect of these treatments for patients admitted in mental health wards for affective disorders. Therefore, the aim of this pilot study was to investigate the feasibility of a transdiagnostic sleep and circadian intervention for inpatients with sleep problems comorbid to bipolar affective disorder or unipolar depression. The study was conducted in order to inform a potential future lager scale randomized controlled study (RCT) investigating the effect.

Materials and methods: A mixed model design was applied, comprising a six week prospective follow-up study and semi-structured individual interviews by the end of the intervention. Adult inpatients (>18 years) with unipolar depression or affective bipolar disorder (neutral or depressive phase) comorbid to a sleep problem (>1 month) were eligible for inclusion. Exclusion criteria were; manic symptoms, other known sleep disorders, involuntary admission, severe physical disease(s) or an active substance abuse problem, suicidal risk, or pregnancy. The study was conducted in 3 acute wards during autumn 2018. The intervention consisted of 6 individual sessions based on a Transdiagnostic manual for treating sleeping problems by Harvey and Buysse. The intervention was delivered by a sleep medicine educated nurses supervised by a CBT-I trained psychologist. Primary outcomes were reduction in Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI). Pre-post tests using t-test was preformed. The interview data was analyzed using thematic analysis.

Results: Ten patients, 5 men and 5 women were included. They had mean age of 37 years, 6 had unipolar depression and 4 bipolar affective disorder. Of the 10 included patients 5 completed the 6-week intervention, whereas one dropped out after 5 weeks and 4 dropped out in the first study week. For the completers mean ISI score decreased from 20.4 at baseline to 12 at endpoint (p=0,03) and the PSQI score from 17,6 to 13.2 (p=0.06). The qualitative analysis revealed 2 themes. One called "New insights" representing the positive outcomes of the intervention on patients sleep and how it affected their recovery process in a positive direction. Another called "Conflicting interests" representing the patients` challenges having to fill out sleep diaries and change sleep habits while being admitted with a depression. For some patients this was too difficult, and they dropped out of the study.

Conclusions: The patients' sleep problems were significantly reduced and patients were in general positive regarding the intervention. However as the dropout rate in the study was high (50%) it is relevant to consider whether a 6-week sleep intervention is suitable in an inpatient setting. Based on the preliminary results we have decided to review the study design and setting before initiating a RCT.

RESILIENT - AN ONLINE MULTIDIMENSIONAL TREATMENT TO PROMOTE RESILIENCE AND BETTER SLEEP: A RANDOMIZED CONTROLLED TRIAL

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Introduction: The wildfires on May 1, 2016 in Fort McMurray, Alberta (Canada), destroyed approximately 2,400 homes and buildings and led to massive displacement of approximately 88,000 people. Many individuals faced direct or potential threat to their life or health, or significant losses. Alberta Health Services estimated that mental health referrals were up 1,500% in 2016. The overarching aim of this project is to widely disseminate evidence-based tools to promote resilience and better sleep. This paper presents the results of a randomized controlled study assessing the efficacy of an online self-help intervention targeting post-traumatic resilience on specific symptoms (post-traumatic stress, insomnia, depression).

Materials and methods: 1,510 phone surveys have been conducted in May 2017 to assess the prevalence of PTSD, insomnia and depression in the evacuees from the Fort McMurray wildfires (T0). After the survey, 697 participants expressed interest to participate in the longitudinal arm of the study, which included four assessments with online questionnaires (T1 to T4). After completion of T2 (pre-treatment) in May 2018, participants with significant post-traumatic stress, insomnia or depressive symptoms (n = 136) were randomised either to a treatment condition (n = 69) or to a waitlist control condition (n = 67). Participants were on average 45 years old, and mostly women (76%). Seven percent identified as members of a First Nation. Age, gender, membership in a First Nation and pre-treatment post-traumatic stress, insomnia and depression symptom severity did not differ between the treatment and waitlist conditions (all $p > .05$). Participants completed T3 (post-treatment) in November 2018.

Treatment Description. The treatment is a therapist-assisted self-help online cognitive-behaviour therapy focusing on post-traumatic stress, sleep and mood. It includes 12 sessions of evidence-based psychotherapeutic components, such as psychoeducation about PTSD, sleep and depression; prolonged exposure to avoided situations and memories and sleep management strategies (restriction of time in bed, stimulus control, sleep hygiene education). Participants completed self-assessment measures and journals within the platform, such as the sleep diary. Supervised graduate psychology students provided brief regular weekly contacts by videochat or phone, according to the participant's preference.

Results: Participants in the treatment group completed an average of 5 sessions (+/- 5.26) and 17 completed at least half of the treatment. Mixed model ANOVAs revealed significant Assessment Time X Treatment Condition interactions on post-traumatic stress, insomnia and depression symptom severity, showing improvements of symptoms in the treatment condition.

Conclusions: These results demonstrate the effectiveness of the RESILIENT online treatment platform to decrease post-traumatic stress, insomnia and depression symptoms in evacuees from the 2016 Fort McMurray, Alberta wildfires. This computerized psychotherapeutic tool was successful to provide access to specialized evidence-based mental health care to promote resilience and better sleep after a disaster in a remote population. Future research will focus on verifying the implantability and usability of the platform among Fort McMurray health professionals. The assessment of the platform´s

potential for adaptation to respond to the needs of diverse populations (e.g., sexually abused women, members of First Nations, Inuit and Métis) is also underway.

ASSOCIATIONS OF SLEEP AND CIRCADIAN RHYTHM DISORDERS WITH BIPOLAR DISORDER: A CASE-CONTROL STUDY

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Introduction: Sleep and circadian rhythm are closely related to mood regulation in both healthy individuals and patients with mood disorders, especially bipolar disorder. Subjective reports of sleep problems are common among patients with bipolar disorder. However, the associations of bipolar disorder with various sleep disorders have not been systematically evaluated. The current study aimed to determine the magnitude of the associations of bipolar disorder with various sleep and circadian rhythm disorders based on a structured clinical interview.

Materials and Methods: A total of 128 patients with bipolar disorder [87 female (68.0%); mean age: 46.54±9.59] and 167 age/sex-matched control subjects [96 female (57.5%); mean age: 46.85±5.35] were recruited as the parents of an on-going bipolar offspring study. All participants were recruited from Hong Kong. The Mini-International Neuropsychiatric Interview and the Diagnostic Interview for Sleep Patterns and Disorders were conducted by trained researchers to confirm the diagnoses of psychiatric disorders and sleep and circadian rhythm disorders. Excessive daytime sleepiness was defined as a score of self-reported Epworth Sleepiness Scale ≥ 14. Generalized Estimating Equations, a method to take possible correlation between individuals within a family into account, was used to estimate the associations of bipolar disorder with sleep and circadian rhythm disorders.

Results: Patients with bipolar disorder had higher rates of delayed sleep phase disorder (10.2% vs. 2.4%; p=.005), insomnia disorder (32.0% vs. 18.0%; p=.005), non-REM parasomnia disorder (7.0% vs. 1.8%; p =.024), nightmare (16.4% vs. 4.2%; p =.000) and excessive daytime sleepiness (13.6% vs. 5.4%; p =.015) but comparable rates of obstructive sleep apnea-hypopnea syndrome, restless legs syndrome, periodic limb movements disorder, bruxism and probable REM sleep behavior disorder, when compared with controls. After adjusting age and sex, the associations of bipolar disorder with delayed sleep phase disorder [OR (95%CI) : 4.36 (1.39-13.71); p =.012], insomnia disorder [OR (95%CI) : 2.03(1.18-3.48); p =.011], non-REM parasomnia disorder [OR (95%CI) : 3.82 (1.01-14.50); p =.049], nightmare [OR (95%CI) : 4.33(1.78-10.56); p =.001], and excessive daytime sleepiness [OR (95%CI) : 2.76 (1.20-6.32); p =.017] remained statistical significance.

Conclusion: Bipolar disorder is associated with a wide range of comorbid sleep and circadian rhythm disorders. Future studies are warranted to determine the impact of these disorders on the long-term outcomes of bipolar disorder. In addition, future analyses of the age of onset of the sleep and circadian rhythm disorders in high-risk offspring in the current bipolar family cohort may further validate whether these comorbid sleep and circadian rhythm disorders at patients with bipolar disorder would occur prior (as prodromal features) or during (as comorbidities) the occurrence of bipolar disorder.

TRANSDIAGNOSTIC SLEEP AND CIRCADIAN RHYTHM DISTURBANCE IN SCHIZOPHRENIA AND BIPOLAR DISORDER: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Despite being a common cause of distress and disability in individuals with schizophrenia and bipolar disorder, sleep and circadian rhythm disruption remains poorly characterised. We aimed to define and compare the magnitude and variability of actigraphic sleep-circadian alterations in these disorders.
Materials and methods: In this systematic review and meta-analysis, EMBASE, Medline, and PsycINFO were searched to November 2018 for case-control actigraphy studies reporting sleep-circadian parameters in remitted schizophrenia or bipolar disorder. Summary-level means and standard deviations were extracted from published reports. Using random-effects meta-analysis, standardised mean-differences (SMD) between patients and controls were quantified using Hedges-g, and patient-control differences in variability were quantified using the mean-scaled coefficient of variation ratio (CVR). A wald-type test compared effect-sizes between disorders.
Results: Thirty studies reporting on 967 patients and 803 controls were included. Compared to controls, both schizophrenia and bipolar groups had significantly longer total sleep time (SMD [95%CI] = 1.26 [0.73,1.79] and 0.46 [0.32,0.60] respectively) but also greater sleep latency (0.74 [0.34,1.14] and 0.24 [0.04, 0.44], wake after sleep onset (0.90 [0.15,1.66] and 0.24 [0.10, 0.37]) and reduced daytime mean motor activity (-1.04 [-1.38, -0.69]) and -0.75 [-1.20,-0.29]. Magnitude of effect-sizes were higher in schizophrenia compared to bipolar disorder for total sleep time (z = 3.45, P < .001), sleep latency (z = 2.32, P=.02), and wake after sleep onset (z = 3.05, P = .002). CVR was significantly elevated in schizophrenia and bipolar disorder for total sleep time (CVR = 1.43 [1.08, 1.90] and 1.37 [1.15, 1.64]), time in bed (1.34 [1.09, 1.65] and 1.41 [1.16, 1.71), and relative amplitude (1.57 [1.10, 2.25] and 1.35 [1.17, 1.57]).
Conclusions: Common patterns of sleep-circadian disturbance were found across both populations, implicating shared mechanisms of sleep-related dysfunction. Elevated variability in sleep duration parameters in patients suggests there may exist a subgroup of patients in which sleep is affected, and who would particularly benefit from intervention, as opposed to it being a universal phenomena. Although there some was evidence for a more severe disturbance in schizophrenia, these findings argue against disorder-specific sleep-circadian patterns, and advocate for the development of transdiagnostic interventions targeting sleep.

DEPRESSION SYMPTOMS ARE ASSOCIATED WITH SLEEP QUALITY IN LATINX CHILDREN

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Introduction: Psychological distress is associated with poor sleep, with most research focused on depression and anxiety and fewer studies showing relationships with stress. Further, these explorations are less frequently investigated among Latinx children. We hypothesized that anxiety, depression and perceived stress would be associated with lower sleep quality and shorter sleep duration in Latinx children.

Materials and methods: A southern California community sample of 100 Latinx children (10-12 years old) completed surveys and wore Actiwatches (Philips-Respironics) for seven days. Total nighttime sleep duration was derived from actigraphy. Sleep quality was derived using three items that assessed problems with falling asleep, staying asleep, and overall rating of sleep quality. Anxiety and depression symptoms were measured by the Revised Children's Anxiety and Depression Scale. Stress scores were determined using the 10-item version of the Perceived Stress Scale. Hierarchical multiple linear regression models, adjusting for gender and pubertal development, tested cross-sectional associations between psychological factors and sleep variables. Regression models fit data well and met statistical assumptions.

Results: Of the total sample, 83 participants had complete data on all variables of interest. Children (mean age=10.9±0.8 years) were 47% male with the largest proportion (41%) in pubertal Tanner stage 3. There were no significant associations with objectively-measured sleep duration. The model accounted for 18.1% of variation in sleep quality score ($F(5,77)=3.39$, p=.008, R^2=.181). Anxiety symptoms (p=.39) and perceived stress (p=.41) were not related to sleep quality score, nor were gender (p=.58) or pubertal stage (p=.45).A one-point increase in depression symptoms score (range: 0-1.90) was associated with a 0.66-point increase in sleep quality score (range: 0-2.67; B=0.66, p=.010, 95%CI: 0.16, 1.17).

Conclusions: Among a community sample of Latinx children, depression symptoms were related to sleep quality but not sleep duration. Findings align with extant literature showing strong associations between clinical depression and insomnia in adults and youth (although less research has been conducted in pediatric populations). Existing research indicates a bidirectional relationship, which this cross-sectional study cannot rule out. Associations should be replicated using longitudinal designs to elucidate temporality of relationships. Results may indicate that reducing depression symptoms could potentially enhance sleep quality in Latinx children. Additional research is needed to further elucidate the differential results for sleep quality vs. sleep duration.

CANNABIS USE AND QUANTIFIED SLEEP EEG IN INDIVIDUALS WITH DEPRESSION

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Introduction: There is a high prevalence of sleep irregularities among people with depression and it is believed that this may play a role in its onset and maintenance. There are also indications that some people self-medicate with cannabis to improve their sleep and mood. Inconsistencies in this field of research are apparent in healthy populations, and even less is known in regard to the impact of cannabis use on sleep in people with depression. This study investigated the spectral composition of NREM sleep EEG in individuals with depression who consumed cannabis on the day of the sleep recording.
Materials and methods: Polysomnography recordings were gathered for 42 individuals with a documented history of depression who were referred to the sleep clinic of a mental health care facility as part of a larger retrospective study. The sample selected contained 21 (38.8 ±16.6 years old, 70% female) individuals who reported consuming cannabis on the day of the recording, and 21 (39.1 ±16.2 years old, 70% female), age and gender matched, who did not. Spectral analysis was done on C3 for each NREM sleep stage separately and submitted to a mixed ANOVA with 2 groups (cannabis vs non-cannabis) and one repeated measure (sleep stages: NREM1, NREM2, NREM3).
Results: Significant group by sleep stage interactions were found for the 4-8Hz ($F(1.2,44) = 4.1$, $p = .042$) and 16-24Hz ($F(1.7, 59.4) = 5.1$, $p = .014$) frequency bands. Interaction trends were found for 1-4Hz ($F(1.2, 42.8) = 3.3$, $p = .068$) and 12-16Hz ($F(1.3, 45.6) = 3.2$, $p = .072$). As compared to the non-cannabis group, the cannabis group, had an overall increased spectral power only in NREM1 for the frequencies spanning across 4 to 24Hz ($t \geq 2.2$, $p \leq .032$). A similar trend was found for the 1-4Hz band ($t(40) = 1.9$, $p = .067$). There was no significant interaction or main effect of group for the 8-12Hz band.
Conclusions: These preliminary outcomes indicate a widespread elevation in power across the most part of the EEG spectrum, specific to NREM1, in people with a history of depression who consumed cannabis. While the functional significance of this finding remains unclear, no alteration in NREM2 or deep sleep were observed, suggesting that cannabis use did not have adverse effects on quantified EEG measures during most of the sleep episode. Future randomized placebo-controlled studies are needed to control for dosage, route, cannabis compound, and timing of administration in order to adequately address the remaining questions revolving around the potential interactions between cannabis and sleep disturbances linked to depression.

EXCESSIVE INTERNET USE AND SLEEP

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Introduction: In 2017, it was estimated that 84% of the US households was getting some type of internet service at home. This proportion is even higher in the student population since nowadays, internet is not solely for entertainment but it is also used for educational purposes and management. On campuses, internet access is granted to all the students. Pathological or compulsive use of the internet, a pattern of symptomatic behaviors, has been reported to affect between 0.3% to 8.1% of the US population. One of the possible consequences is the impacts on sleep quantity and quality as well as daytime sleepiness and fatigue. This study investigated these aspects among students living on a campus.
Materials and methods: Undergraduate and graduate students living on the campus of Stanford University were interviewed using the Sleep-EVAL system during the 2014-2015 academic year. The total sample included 1,871 undergraduate and 1,113 graduate students (2,984 in total). The mean age was 22.9 (+/- 5.7) y.o. and 57.9% of the sample was male. The phone interviews took place in the dorms all over the campus. In addition of the detailed sleep questionnaire, a section was added to tackle excessive internet and/or computer use for recreational purposes. Students were considered with an internet/electronic device addiction if they were spending at least 15 hours per week on the device and displayed at least 5 addiction-related symptoms.
Results: A total of 39.4% of the students spent at least 15 hours per week on electronic devices for recreational purposes; 5.3% had 5 or more addiction symptoms. Difficulties initiating sleep (13.0% vs. 5.7%), unrefreshing sleep (22.0% vs. 5.6%), daytime sleepiness (44.0% vs. 24.2%) and excessive fatigue (50.4% vs. 19.5%) were significantly higher in the addiction group (>= 5 symptoms) compared to the no addiction group (0-2 symptoms). Nighttime sleep duration was comparable between the groups but the addiction group at a tardier bedtime and wake-up time than the no addiction group. Students in the addiction group had also a greater proportion of suicidal thoughts (16.9% vs. 6.6%), suicide attempts (9.7% vs. 3.3%), major depressive disorder (9.7% vs. 3.0%) and social anxiety disorder (24.8% vs. 8.5%) than the no addiction group.
Conclusions: Internet/electronic device addiction is highly prevalent in this student population, affecting one on 20 students. The addiction was associated with a variety of sleeping problems and psychiatric disorders that are cause for concerns.

DISSOCIATIVE SUBTYPE OF POST-TRAUMATIC STRESS DISORDER: PRELIMINARY RESULTS EXAMINING SLEEP ARCHITECTURE

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Introduction: The latest edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*-5) introduced a new specifier identifying a dissociative subtype of Post-traumatic Stress Disorder (PTSD). Dissociation is characterized by two main factors: depersonalization, an out of body experience, which creates a sense of disconnection between the mind and body, and derealization, when one's surrounding environment is perceived as distant or distorted. Overall, dissociation reflects a detachment from physical and emotional experiences to consciousness. A few studies in non-clinical populations showed that dissociative symptoms correlate with poor subjective sleep quality and can be worsened by acute sleep deprivation. Sleep disturbances are common in both PTSD and dissociative disorders, but little is known about the sleep profile of the dissociative PTSD subtype. The combination of sleep disturbances linked to PTSD and dissociation may possibly have additive effects. In the present study, we evaluated objective sleep measures in a clinical sample of people with PTSD based on dissociative subtype classification.
Materials and methods: Fourteen combat exposed veterans with PTSD (5 females and 8 males; mean age (±SD) = 49.3(±9.3) years) were administered the *Clinician-Administered PTSD Scale for DSM-5* and the *Dissociative Subtype of PTSD Scale* (DSPS). They underwent two nights of polysomnography. The first night was used as an adaptation night. Sleep architecture variables from the second night were compared across participants with and without the dissociative subtype using analyses of variance controlling for sex.
Results: Six participants (42%) met criteria for the dissociative subtype. Compared to the non-dissociative subgroup, the dissociative subgroup had significantly shorter total sleep time ($F(1,11)=7.2$, $p=.021$), longer sleep onset latency ($F(1,11)=6.6$, $p=.026$), poorer sleep efficiency ($F(1,11)=8.6$, $p=.013$), and a lower amount of NREM 2 sleep ($F(1,11)=9.6$, $p=.010$). There was no other significant group difference in sleep architecture. Across the entire sample, after controlling for sex, lower amount ($r=-.71$, $p=.005$) and percentage ($r=-68$, $p=.007$) of NREM 2 sleep correlated with worse depersonalization symptoms severity. Higher percentage of REM sleep also correlated with worse depersonalization symptoms severity ($r=.55$, $p=.043$).
Conclusions: In this preliminary study, worse sleep abnormalities were observed in people with the dissociative PTSD subtype compared to those with non-dissociative PTSD. This included more difficulties falling asleep, more fragmented sleep, and shorter sleep durations. Furthermore, increased REM sleep at the expanse of NREM2 was linked to an increase in the severity of depersonalization. Since sleep deprivation may actively worsen dissociative symptoms, sleep abnormalities linked to PTSD could possibly play a role in the severity of dissociative symptoms, and in turn, engender greater distress.Further work is required to examine finer sleep features in larger samples of people with the dissociative PTSD subtype. This could highlight biological features supporting differences in PTSD subtypes, and enable the development of better tailored sleep interventions for people with PTSD.

ADHD SYMPTOMS AND GREATER BRAIN-BEHAVIOR VULNERABILITY TO SLEEP LOSS IN CHILDREN: LINKING REDUCED RESTING-STATE BRAIN CONNECTIVITY TO MORE SEVERE PERFORMANCE DEFICITS

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Introduction: Sleep problems common in children with attention-deficit/hyperactivity-disorder (ADHD), yet it is unknown whether ADHD symptoms affect a child´s resilience to sleep loss. We combined fMRI with a behavioral response-inhibition task in a within-subjects partial sleep restriction study to test whether ADHD symptoms are associated with greater vulnerability to brain and behavioral consequences of short sleep in children.

Materials and methods: 13 children (7F; 11.7±1.3 years) characterized for ADHD symptoms (Conners-3 T-scores) slept at home for 1 week (9.5h in bed) and two consecutive nights in the lab: baseline (9.5h in bed) and partial sleep deprivation (4h in bed). A fMRI session each morning involved a go/no-go task and a resting-state scan to assess brain connectivity. A behavioral metric of response-time variability (tau) in this task was derived by an ex-gaussian fit of reaction times for go-trials. A whole-brain index of network-connectivity (modularity) was derived from resting-state analyses. Regression assessed independent associations for ADHD symptoms, brain modularity, and response-time variability following sleep loss. Sobel-Goodman mediation tested whether neural changes after sleep loss explain associations between ADHD and response-time variability after short sleep.

Results: Whole-brain modularity was reduced after sleep loss (t(12)=-2.79, p=.016); more severe ADHD symptoms were associated with progressively greater decreases in modularity (b=-.0036, p=.008). Greater behavioral response-time variability after sleep loss was associated with ADHD symptoms (b=3.25, p=.038) and the degree of modularity reduction (b=-839.0, p=.002). Decreased modularity fully mediated (89.9%; z=2.001; p=.045) the association between ADHD symptoms and response-time variability.

Conclusions: These data indicate an ADHD symptom-brain-behavior axis of vulnerability following sleep loss in children. More severe ADHD symptoms were associated with a greater reduction in resting-state brain connectivity following sleep loss, and in turn greater behavioral performance deficits during cognitive testing. The ability of resting-state connectivity to mediate the association between ADHD symptoms and sleep loss's impact on performance indicates resting brain imaging may provide a novel tool for assessing sensitivity to sleep loss in ADHD. More generally, these preliminary results underscore the need to better understand sleep-dependent brain function in children, both in typical development, and in prevalent conditions such as ADHD.

IRON DEFICIENCY AND SLEEP - A SCOPING REVIEW

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Introduction: Iron deficiency (ID) is associated with restless legs syndrome (RLS) induced insomnia, but standardized assessment of iron status in diagnostic work up and supplementation as treatment have not been considered in clinical practice. In this review, we investigated 1) the effects of ID on symptom type and severity of sleep disorders, and 2) whether iron supplementation improves symptoms.
Methods: Scoping review of 93 studies using the terms "iron deficiency anemia" and "sleep" on biomedical database search engines.
Results: RLS was investigated in 74 articles, periodic limb movements in sleep (PLMs) in eight, sleep disordered breathing (SDB) in three, and general sleep disturbances (GSD) in eight. In association studies, a positive association with ID was found in 29/42 RLS, 3/8 PLMs, 2/2 SDB, and 5/6 GSD studies. In treatment studies, iron supplementation was beneficial in 1/1 SDB, 2/2 GSD, and 29/30 RLS studies, of which five were RCTs. For studies investigating pediatric populations, 1/1 RLS, 1/1 SDB, 2/5 PLMs, and 4/5 GSD association studies found positive associations, while 6/6 RLS and 2/2 GSD treatment studies demonstrated a benefit with iron supplementation.
Conclusion: Iron investigation and supplementation should be considered in patients presenting with sleep disorders utilizing novel higher level study design.

EVOLUTION OF OBJECTIVE WAKEFULNESS AND SLEEP PRESSURE BUILDUP DURING CONTROLLED EXTENDED WAKEFULNESS IN SLEEPY ADULT ADHD PATIENTS

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Introduction: Attention Deficit Hyperactivity Disorder (ADHD) is a childhood-onset disorder and can persist into adulthood. ADHD can affect individuals´ social and occupational functioning. A proportion of adult ADHD patients exhibits an objective excessive daytime sleepiness assessed by Maintenance of Wakefulness Test (MWT). The aim of this study was to determine if this daytime sleepiness was related with a modification of the kinetics of sleep pressure buildup.

Materials and methods: 8 drug-free sleepy adult ADHD patients (mean age = 39.8 ± 11 years, 2 males) and 7 matched (in sex, age and chronotype) healthy volunteers have been recruited. To be included in the study, sleepy ADHD patients should have a mean sleep latency 4*40 minutes MWT < 20 mn. For four days prior to the study, participants were asked to maintain regular bedtimes and wake-up times according to their individual usual preferences (checked by actimetry and PSG). All volunteers underwent a 36-h of extended wakefulness in ''constant routine'' protocol. Karolinska drowsiness test (KDT) and MWT were repeated every 4hr. Sleep pressure was evaluated by theta-alpha (6-9Hz) band of EEG during KDT. Frontal power theta-alpha frequency (PTAF) was calculated after an automatic artifact rejection. Kinetics of sleep pressure buildup was defined by asymptote and time constant assessed by saturating exponential function. A mixed linear model taking into account age, gender and score of Morning/Evening questionnaire of Hörne and Ostberg was used to compare MWT sleep latency in both groups over time. The same model was used to compare the asymptote and the time constant.

Results: Total sleep time did not differ between the two groups before the CR at the actimetry and at the PSG. At the first MWT measurement, ADHD patients presented a significantly lower sleep latency than healthy controls (p=0.012). This difference remained constant over the 9 measurements. No significant difference was found between groups for time constant and asymptote.

Conclusions: While MWT sleep latencies during the extended wakefulness are shorter in ADHD patients than healthy subjects, the kinetics of sleep pressure buildup is not different. The difficulty to remain awake during soporific circumstances in some ADHD patients is not explained by an alteration of homeostatic sleep process. This difficulty to remain awake may be related to a reduction of wake promoting signal and/or a primary disorder of vigilance/tonic alertness

THE SPECTRAL FINGERPRINT OF SLEEP PROBLEMS IN POST-TRAUMATIC STRESS DISORDER

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Background: Sleep problems are a core feature of post-traumatic stress disorder (PTSD). However, a robust objective measure for the sleep disturbance in patients has yet to be found.

Methods: The current study assessed EEG power across a wide frequency range and multiple scalp locations, in matched trauma-exposed individuals with and without PTSD, during rapid eye movement (REM) and non-REM (NREM) sleep. In addition, a full polysomnographical evaluation was performed, including sleep staging and assessment of respiratory function, limb movements and heart rate. The occurrence of sleep disorders was also assessed.

Results: In PTSD patients, NREM sleep shows a substantial loss of slow oscillation power and increased higher frequency activity compared to controls. The change is most pronounced in right-frontal brain areas and correlates with insomnia. PTSD REM sleep shows a large power shift in the opposite direction, with increased slow oscillation power in occipital areas, which is strongly related to nightmare activity and to lesser extent with insomnia. These pronounced spectral changes occur in the context of severe subjective sleep problems, increased occurrence of various sleep disorders and modest changes in sleep macrostructure.

Conclusions: This is the first study to show pronounced changes in EEG spectral topologies during both NREM and REM sleep in PTSD. Importantly, the observed power changes reflect the hallmarks of PTSD sleep problems: insomnia and nightmares and may thus be specific for PTSD. A spectral index derived from these data distinguishes patients from controls with high effect size, bearing promise as a candidate biomarker.

CPAP IN THE TREATMENT OF MAJOR DEPRESSION COMPLICATED WITH OSAHS: A CASE REPORT

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Depression and Obstructive sleep apnea (OSA) are the major associated comorbidities and is one of the reasons for poor antidepressant efficacy. Therefore, early identification and treatment of OSAHS is of great significance for antidepressant treatment. In this case report, the patient suffered from depression, pessimism, over-thinking, loss of interest, low self-evaluation, irritability, unwillingness to communicate with others, poor sleep, accompanied by snoring, increased nocturnal urine, dry mouth in the morning, with fatigue and no sense of recovery, dizziness and sleepiness during the day. Routine antidepressant therapy is not effective. OSAHS was diagnosed by clinical symptoms, scale evaluation and polysomnography. On the basis of routine antidepressant therapy, noninvasive continuous positive pressure ventilation (CPAP) was given. Apnea hypopnea index was controlled in the normal range, and depressive symptoms and scale scores were significantly improved. The diagnosis and treatment process of this patient suggests that we should pay attention to the effect of OSAHS on antidepressant treatment. When significant snoring and daytime sleepiness are observed in patients with major depression, we should actively find the reasons.

Psychiatric Disorders Affecting Sleep/Wake
Board #218 : Poster session 1

WHO IS SEEKING HELP FOR SLEEP? A CLINICAL PROFILE OF PATIENTS IN A SLEEP PSYCHOLOGY CLINIC

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Introduction: Sleep disturbances are known to be related to several psychiatric conditions and medical conditions. Some studies have already reported patient clinical profile from the primary care settings but, to our knowledge, there are no clinical profiles of patients from a psychological sleep clinic available. The present study outlines a clinical profile of an ecologically valid population consulting for sleep difficulties at the Sleep psychology clinic of Université Laval.
Materials and methods: Patients self-reported to the sleep clinic or were referred by general practitioner or pulmonologist. After a phone screening interview, patients presented to the clinic for a semi-structured clinical interview for sleep and psychopathology, which was conducted by psychologists and doctorate students in psychology. A chart review of patients (56% female, Mage=43.6yrs) was performed (between 2015 and 2018) to record diagnosed sleep disorders, mental disorders, and medical conditions.
Results: There was a high level of comorbidity with an average of 2.85 diagnoses per patient (SD=1.76) and 27% of the patients had 4 diagnoses or more. Patients presented at least one comorbid psychiatric disorder (58.5%), a medical comorbidity (27.5%) or another sleep disorder alongside their primary sleep concern (39.5%). Insomnia was the main sleep disorder (76%). Anxiety (77.8%) and depression (53.8%) were the predominant psychiatric disorders, while fibromyalgia (10.9%), hypertension (10.9%), and head trauma (9.1%) were the main medical conditions. Of patients with 5 diagnoses and more, 77.8% were taking on average 3.2 different types of medications.
Conclusions: This clinical profile emphasizes the reality of multiple morbidities, which may have implications for clinical decisions. Future research is needed to evaluate transdiagnostic approach for the sleep disorder patient with multiple morbidities.

SLEEP ASSESSMENT IN OBSESSIVE-COMPULSIVE DISORDER TREATED WITH DEEP BRAIN STIMULATION - DOUBLE CASE REPORT OF MORNING AND EVENING CHRONOTYPE PATIENTS

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Introduction: Two patients with severe treatment-resistant obsessive-compulsive disorder (OCD) treated with Deep Brain Stimulation (DBS), pharmacotherapy and cognitive-behavioural therapy (CBT) are presented.

Materials and methods: Two 28-year-old Caucasian male patients with severe treatment-resistant OCD underwent bilateral implantation of electrodes into nucleus accumbens (NAc) and ventral part of the anterior limb of internal capsule (vALIC) and Medtronic Activa SC single-channel non-rechargeable stimulators. DBS was commenced 2 weeks after the surgery. Mental state and sleep assessment have been performed in 2 weeks periods for first 6 months of stimulation, then once a month. During the treatment blinded to patient and raters turn-off trial was performed. Following tools were used: Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), Social and Occupational Functioning Assessment Scale (SOFAS), Athens Insomnia Scale (AIS), Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), SLEEP-50 Questionnaire, Morningness-Eveningness Questionnaire for Self-Assessment (MEQ-SA). Pharmacotherapy was continued from pre-operative period: Case A - valproates, fluoxetine and trazodone (periodically), Case B - sertraline, clomipramine, risperidone and lamotrygine.

Results: Case A in pre-operative period reported low sleep quality (SQ) (PSQI=12), increased daytime sleepiness (DS) (ESS=11), confirmed by SLEEP-50 (100 points total, increased scores in insomnia, daytime activity and circadian rhythm domains). 31 points in MEQ-SA confirmed evening chronotype. During first year of DBS treatment, OCD (Y-BOCS down from 28 to 8) and functioning (SOFAS up from 45 to 55) improvement was observed. SQ (PSQI=8) improved and the patient reported higher normal DS (ESS=8-10), some insomnia symptoms (AIS=9) and cessation of frequent nightmares. Trazodone (75 mg) was administered and further amelioration (6 months of follow-up) was observed (PSQI=4, AIS=4, ESS=5) along with OCD symptom reduction (Y-BOCS=5, SOFAS=70). Turn-off trial did not affect sleep significantly, but OCD symptoms exacerbated.

Case B in pre-operative period reported slightly lower SQ (PSQI=6), higher normal DS (ESS=7), though SLEEP-50 showed no major problems in sleep (61 points, no domains significantly increased). MEQ-SA (score=59) confirmed traits of morning chronotype. During first year of DBS treatment, significant improvement in OCD symptoms (Y-BOCS down from 28 to 5) and functioning (SOFAS up from 40 to 87). After turning on DBS, patient presented hypomaniac symptoms for few hours and did not sleep for the whole night. The next day he slept normally. During 1-year observation improvement in SQ (PSQI=3) and DS (ESS=4) was observed, though the patient decreased night sleep time (5,5-6 hours/day) with rare naps during the day (2-3/week). Turn-off trial lasted for 3 days - severe deterioration of mental state with poorer sleep quality (difficulties in maintaining sleep, frequent nightmares) was observed. DBS was restored, patient again presented hypomaniac symptoms and could not sleep for one night.

Conclusions: DBS along with pharmacotherapy and CBT significantly increased SQ and DS in an evening chronotype case. Improvement in OCD symptoms and functioning could have contributed to better sleep hygiene. In morning chronotype case baseline SQ and DS were better than case A, still the combined treatment contributed to improvement, although the patient significantly reduced sleep time. Side effect of one-day sleep deprivation after DBS

turn-on was observed.

DIAGNOSTIC SIGNIFICANCE OF ALL-NIGHT VIDEO-POLYSOMNOGRAPHY IN ELDERLY-ONSET TEMPORAL LOBE EPILEPSY

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Introduction: We investigated the diagnostic significance of all-night video-polysomnography with full-montage EEG (PSG) in elderly-onset temporal lobe epilepsy (EOTLE).

Materials and methods: On the basis of the PSG results, an analysis of 17 patients with temporal lobe epilepsy (estimated age at onset 50 and above) was conducted as to whether they developed Interictal Epileptiform Discharges (IED) or Clinical Seizures (Sz). Epilepsies and epileptic seizures were classified according to the International League Against Epilepsy criteria which were devised in 1989 and 1981, respectively. Sleep stages were determined on the basis of the American Academy of Sleep Medicine criteria which were devised in 2012. Sleep disorders were determined according to the International Classification of Sleep Disorders-Third Edition, which was devised in 2014.

Results: IED appeared in 17/17 patients (100%) during the first night: 16/17 patients (94%) were in stage W, 14/15 patients (93%) were in stage N1, 15/15 patients (100%) were in stage N2, 5/6 patients (83%) were in stage N3, and 13/15 patients (87%) were in stage R. Sz appeared in 12/17 patients (71%) and all 12 patients presented with simple/complex partial seizures without secondarily generalized tonic/clonic seizures in the hospital: 10/17 patients (59%) were in stage W, 4/17 patients (24%) were in stage N1, 4/17 patients (24%) were in stage N2, and 1/17 patients (6%) were in stage N3, 1/17 patient (6%) was in stage R.

Conclusions: IED and Sz were observed with high frequency during PSG in patients with EOTLE. Given the present study, PSG would improve the diagnosis of EOTLE.

VASOPRESSIN MEDIATES ANXIETY-LIKE BEHAVIOR, GLUTAMATERGIC NEURON ENGAGES INSOMNIA CIRCUIT IN THE PARAVENTRICULAR HYPOTHALAMIC NUCLEUS (PVH)

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Introduction: Sleep disturbances are common in stress-related psychological disorders, yet the underlying brain circuitry is not understood. Do stress-related psychological disorders engage natural sleep pathways? It is usually assumed that stress-related psychological disorders and sleep disturbances arise by influencing the same circuitry to lesser or greater extents. The paraventricular nucleus of hypothalamus (PVH) is a key structure in the hypothalamic-pituitary-adrenal (HPA) axis, which been known to play prominent roles in mediating the stress response. However, the role and circuitry underlying PVH control over stress-related mental disorders, such as anxiety-related behaviors and sleep disturbances has remained obscure. PVH contains a large amount of glutamatergic neurons, which have wide and extensive connections with other hypothalamic and brainstem structures, that engages wake promoting, suggested PVH glutamatergic neurons might have a more important role in sleep-wake regulation. AVP that released from the PVH is essential for mediating stress response, suggested PVH vasopressin neurons may involve in mental disorders.

Materials and methods: Utilizing DREADDs (Designer Receptors Exclusively Activated by Designer Drugs) and Optogenetic approaches, gene manipulations that perturb normal PVH avp or PVH Vglut2 neuron function, as well as a specific fiber photometry of neuronal Ca2+ signals.

Results: Activate PVH ^{Vglut2}neurons induce potent wake promoting effect. PVH^{Vglut2}neurons also engages in insomina during stress environment. Furthermore, PVH ^{Vglut2}→parabrachial complex (PB) neurons efferent circuit is sufficient to mediated wake and insomnia in stress response. However, PVH ^{Vglut2} did not involve in mental disorders, such as anxiety and depression behaviors. These results reveal that PVH ^{Vglut2}→PB projections essentially governing wake and PVH vasopressin engages anxiety behavior.

Conclusions: We identified that PVH ^{AVP}neurons mediate acute anxiety behavioral changes and REM rebounds, but PVH ^{AVP}neurons did not show obvious acute depression behaviors but induce potent wake promoting effect.

CHANGES IN FRONTAL PERFUSION OVER TIME IN REM SLEEP BEHAVIOR DISORDER

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Introduction: REM sleep behavior disorder (RBD) is a parasomnia characterized by an increased risk of neurodegenerative diseases such as Parkinson's disease and dementia with Lewy bodies. Therefore, investigating the temporal evolution of cerebral activity in people with idiopathic (iRBD) might further our understanding of how phenoconversion occurs. Indeed, although previous studies have shown that iRBD patients present altered cerebral regional cerebral blood flow (rCBF), a marker of cerebral activity, progression of those changes over time still needs to be characterized. We have studied longitudinal changes of rCBF in patients with iRBD during wakeful rest, which we measured with high-resolution single-photon emission computed tomography (SPECT).

Materials and methods: Thirty-seven patients with iRBD (age: 67.4 ± 6.9 years, 82% men) and 27 healthy controls (age: 65.8 ± 8.6 years, 76% men) were evaluated during wakeful rest with baseline SPECT acquisition. After an average of 17 months (16.6 ± 7.1), patients with iRBD were reevaluated with a second SPECT acquisition. We compared rCBF between: 1) iRBD patients and controls at baseline, 2) iRBD patients at baseline and follow-up, and 3) iRBD patients at follow-up and controls. Findings were considered significant at $P < 0.05$ (false discovery rate (FDR) corrected).

Results: At baseline, iRBD patients showed reduced rCBF in the bilateral orbitofrontal and lateral temporal cortex, and in the left lateral parietal cortex as compared to controls. Over time, iRBD patients showed increased rCBF in the bilateral orbitofrontal cortex when comparing to baseline scans. When comparing iRBD patients at follow-up to controls, no significant differences were observed, suggesting that iRBD patients progressively re-normalize their brain activity. However, we observed that this re-normalization of rCBF values was only observed in subjects who did not show phenoconvert, as the normalization over time was not observed in the 8 participants who converted later on (1 to 4 years) after the second SPECT acquisition.

Conclusion: Although iRBD patients show widespread regions of hypoperfusion, they developed frontal increases in rCBF over an average of 17 months. Frontal perfusion reached control levels, and was specifically observed in those who did not phenoconvert to a neurodegenerative disease. Perfusion normalization over time in iRBD patients may represent an attempt at compensation in the affected frontal regions: a compensatory mechanism that may become deficient in patients as they phenoconvert. Further studies with longer follow-up and regular SPECT acquisitions should investigate whether frontal perfusion normalization in iRBD patients is associated with a lower risk of phenoconversion to neurodegenerative diseases.

A MOUSE MODEL OF RBD: INDUCING SYNUCLEINOPATHY IN GABA/GLYCINE NEURONS IN THE VENTRAL MEDULLA

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Introduction: REM sleep behavior disorder (RBD) is characterized by periods of REM sleep without atonia and excessive muscle twitches that result in motor behaviours in REM sleep. Alarmingly, 80-90% of RBD cases convert into synucleinopathies within 10-15 years. Synucleinopathies, such as Parkinson's disease, are characterized by aggregates of α-synuclein (αSyn; Lewy pathology) that cause neuronal dysfunction and degeneration. RBD is also associated with the presence of αSyn aggregates and neurodegeneration in brain areas thought to play a role in generating REM sleep muscle atonia, such as the ventral medulla (vM). This suggests that the RBD cases that precede synucleinopathy may be the result of αSyn pathology in areas that generate REM sleep atonia. GABA/glycinergic neurons of the vM generate REM sleep muscle atonia by directly silencing motoneurons. Therefore, our objective is to induce αSyn pathology selectively in the GABA/glycine neurons of the vM to determine if synucleinopathy can cause neurodegeneration and cell loss in this neuronal sub-population and cause an RBD-like behavioural phenotype.

Materials and methods: We used a Cre-dependent adeno-associated viral vector (AAV) to selectively over-express αSyn in the GABA/glycine vM neurons of mice. Mice expressing tdTomato fluorescence in GABA/glycinergic neurons were used to confirm that the Cre-dependent AAV drives αSyn over-expression selectively in these neuronal populations. We performed histology for phosphorylated αSyn, a marker for αSyn aggregates, to confirm that αSyn over-expression induces Lewy pathology characteristic of synucleinopathies. Electrophysiology and video recordings were used to monitor motor activity during REM sleep.

Results: We found that 91.28 +/- 2.08% of vM neurons over-expressing αSyn also expressed tdTomato fluorescence, confirming that the AAV selectively drives αSyn over-expression in GABA/glycine neurons (n=5). Histology for phosphorylated αSyn revealed that many of the vM neurons over-expressing αSyn also contained aggregated αSyn (n=4); a marker of Lewy pathology. We also found the Lewy pathology of vM neurons induced elevated motor activity during REM sleep by increasing both basal muscle tone and increasing phasic motor activity (n=9; t-test, p< 0.05).

Conclusions: Our results indicate that Cre-dependent AAVs are an effective tool for selectively inducing Lewy pathology in GABA/glycine vM neurons that play a role in generating REM sleep atonia and that Lewy pathology in vM neurons triggers elevated motor activity during REM sleep. We propose that this mouse model is useful for studying the link between RBD and synucleinopathy and could be used to develop drug interventions to prevent synucleinopathic-mediated neurodegeneration in REM sleep circuitry.

AGE OF ONSET OF IDIOPATHIC RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER: A 5-YEAR LONGITUDINAL STUDY

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Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is a parasomnia characterized by repetitive episodes of dream enactment behaviors (DEBs) and loss of atonia during REM sleep. Idiopathic RBD (iRBD) is regarded as a herald of α-synucleinopathies, such as Parkinson's disease (PD), dementia with Lewy Bodies (DLB). Previous studies suggested that there were differences in daytime impairment and cognitive functions between the early and late onset PD. However, there were limited data on iRBD especially with regard to their age onset and associated clinical features. Therefore, we aimed to compare the early- and late-onset of iRBD with regard to their demographic data, severity of RBD, polysomnographic parameters, and neurodegenerative biomarkers and diseases.

Materials and methods: iRBD patients attending sleep clinic between 1997 and 2016 who were confirmed with video-polysomnography (video-PSG) were consecutively recruited in this study. The diagnosis of iRBD was based on International Classification of Sleep Disorder (ICSD) criteria. Neurocognitive function was evaluated by the Olfactory Identification Test and the Farnsworth-Munsell 100 Hue test. Motor function was evaluated by trained neurologist according to the Movement Unified Parkinson's Disease Rating Scale part III (UPDRS-III). In addition, all iRBD patients were followed up at sleep clinic in Hong Kong. A majority of them (96.5%) visited the specialist outpatient clinic within a year from the last visit and the diagnoses of parkinsonism and dementia syndromes were ascertained by the specialists.

Results: A total of 220 patients (male, 77.3%) with iRBD were consecutively recruited. There was a group of late onset of iRBD at age 70's years old and suggested a bimodal distribution. The patients with late-onset iRBD was ostensibly older than early-onset iRBD when they underwent PSG assessment (mean age±SD: 76.7±4.5 vs. 63.8±5.7, p< 0.001) and have later age onset (72.3±3.8 vs 58.8±4.9). Patients with late-onset iRBD had lower RBDQ-HK total score (38.1±15.1 vs. 46.2±14.7, p=0.04), which was mainly related to a lower behavioral factor score (25.3±9.8 vs. 32.0±11.2, p=0.001). They also had poorer cognitive functioning such as lower MMSE score (26.0±4.2 vs. 28.0±2.0, p=0.001), lower olfactory identification score (1.5±1.6 vs. 2.1±1.6, p=0.03), higher color vision error score (251.5±87.0 vs. 188.7±80.7, p=0.001), and higher UPDRS-III score (4.9±6.3 vs. 2.2±2.8, p=0.04). In addition, patients with late-onset iRBD more likely converted to dementia (20.0% vs. 8.9%, p=0.03) when compared to early-onset iRBD .

Conclusions: The findings suggested that there was a bimodal distribution of age onset of iRBD which there was a late onset peak at early 70's. These two groups differed in the clinical profiles at which patients with late-onset iRBD had less severe RBD symptoms. However, they had poorer neurocognitive and motor function than patients with early-onset iRBD. In addition, patients with late-onset iRBD were more likely converted to neurodegenerative diseases, especially dementia. The results also has a great implication in delineating the clinical profiles of early- and late-onset iRBD as well as their relevant neurodegenerative progression.

NEW STRATEGIES TO MANAGE REM BEHAVIOR DISORDER: A MULTICENTER STUDY

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Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is a unique parasomnia characterized by loss of REM sleep atonia and dream enactment behavior, diagnosed through clinical history and polysomnography (PSG), but it is only rarely captured during in-laboratory polysomnography. Polysomnography and Clonazepam have been the traditional diagnostic test and drug of choice for RBD, respecively, but other alternatives should be considered.

Methods: We studied 36 patients (30 men) diagnosed with RBD in 3 differents hospitals, based on clinical and polysomnographic features, and treated over the last 25 years.
We analyzed medical records and clinical scale scores, sex, type of drug, doses and regarding symptoms. We tried to use the same clinical criteria and similar diagnostic and therapeutic procedures in all the patients, confirming RBD with PSG and using firstly alternative treatments to clonazepam, mostly in monotherapy, changing or adding other medications if they presented side effects or didn´t decrease symptoms. We measured vestibular myogenic evoked-potentials (VEMPs) in some of these patients, once they presented sleep-related injurious or potentially injurious disruptive behaviors by history and compared with controls and with those whose RBD diagnosis was confirmed later.

Results: Mean RBD onset symptoms age was 64.7 years old. Mean lag time between RBD onset and diagnosis and between RBD onset and start treatment were 4.8 and 10.5 years,respectively. Frequent comorbidities were Parkinson disease (15), sleep apnea (12),cognitive and psychiatric disorders(5), Willis-Ekbom disease (3), and hypersomnia (1).: Gabapentin: 18 patients (300-800 mg, effective in 14, changed in 4); Pregabalin: 5 patients (75-150 mg,effective in 3, changed in 2); Melatonin (sustained-release):10 patients (2 mg, effective in 7, mostly associated); and non-clonazepam benzodiazepines: 3 patient (0.5-2 mg, effective).
According to VEMPs, they were abolished in all RBD patients and no significant changes were observed whatever if was their treatment option or their clinical evolution.

Conclusions: Based on our results, VEMPS could be a very useful diagnostic test to detect earlier RBD, easier and less costly than PSG.Besides, there are better medications than clonacepam as first-choice treatment like melatonin, gabapentin, pregabalin,and sustained-release melatonin because they have excellent pharmacokinetics, low pharmacological tolerance, and less side effects.
Both facts represent new strategies to diagnose and treat RBD, but we need further studies to confirm our results and develope better alternatives to optimize the management of RBD patients.

Acknowledgements: To all the people who have participated and made it possible

REM Behavior Disorders
Board #226 : Poster session 3

REM SLEEP BEHAVIOR DISORDER CHANGES IN THE PROGRESSION OF PARKINSON'S DISEASE: A LONGITUDINAL STUDY

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Introduction: REM sleep behavior disorder (RBD) in Parkinson's Disease(PD) seems to be associated with a malignant phenotype characterized by a rapid decline in both motor and non-motor domains, and by an increased risk of dementia.(1)However, an improvement or remission of RBD symptoms is occasionally reported by PD patients over time. Despite its prognostic value, little is known about the evolution of RBD in PD, concerning both its clinical and neurophysiological features. In the present study, we aimed to longitudinally assess clinical and neurophysiological features of RBD, including quantified REM Sleep Without Atonia (RSWA) in PD patients with RBD (PDRBD) at baseline and after 3-years-follow-up, in order to ascertain whether or not RBD is a stable feature in PD. Moreover, we aim to assess whether the changes of RSWA parallel the clinical progression of PD, including cognitive functions.
Materials and methods: Twenty-two (17M, mean age 64.0±6.9years) moderate-to-advanced PD patients (mean PD duration at baseline: 7.6±4.8years) with RBD, underwent one-night video-polysomnographic recording and an extensive clinical and neuropsychological assessment at baseline and after 3-years. RSWA was quantified according to two visual scoring method, namely the Montreal and SINBAR scoring methods.(2,3)RSWA changes were correlated (Pearson or Spearman) to the evolution of clinical and neuropsychological data.
Results: At follow-up, the self-reported frequency of RBD episodes increased in 6 patients, decreased in 6 and remained stable in 10, while all RSWA measures significantly increased in all subjects. Patients also had worse Hoehn and Yahr stages (p=0.02), higher dopaminergic doses (p=0.05) and they performed significantly worse in phonetic and semantic fluency tests (p=0.02;p=0.04). Changes in RSWA correlated significantly with the increase in dyskinesia (r=0.61,p=0.05) and motor fluctuation (r:0.54,p=0.03) scores, and with the worsening of executive functions (r0.78,p=0.001) and visuo-spatial perception (r=-0.57, p=0.04).
Conclusions: Despite the subjective improvement of RBD symptoms in one-fourth of PD patients, all RSWA measures increased significantly at follow up, and their change correlated with the clinical evolution of both motor and non-motor symptoms of PD. In conclusion, RBD may represent a long-lasting feature in PD and RSWA may be a marker of the disease's progression.In light of the stability of RBD and its prognostic implication in PD, early PDRBD patients may represent ideal candidates for neuroprotective and disease-modifying trials, when they will be hopefully available.

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THE RELATION BETWEEN MOTOR-BEHAVIORAL EPISODES AND PHASIC EVENTS DURING REM SLEEP IN REM SLEEP BEHAVIOR DISORDER

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Introduction: The rapid eye movement (REM) sleep behavior disorder (RBD) is a parasomnia characterized by dream-enacting behavior related to the loss of the normal generalized skeletal muscle atonia during REM sleep, and shows REM sleep without atonia (RWA) during polysomnography (PSG).
Previous studies reported that motor behavioral episodes in RBD were associated with phasic EMG activity and rapid eye movements (REMs).
Materials and methods: Twenty-one patients with RBD (21 men, 67.1±6.5 years) who were diagnosed in our center between August to November 2012 were enrolled. PSG were scored according to AASM manual for scoring 2.5. Phasic EMG activity was scored from mentalis and anterior tibialis EMG recording as the percentage of 3 seconds mini epochs containing phasic EMG events. Phasic EMG activity was defined as any bursts of EMG activity lasting 0.1-5 seconds with an amplitude exceeding four times the background EMG activity during REM sleep. We analyzed their PSG and synchronized video recordings and detected motor-behavioral episodes during REM sleep. Motor-behavioral episodes were classified as vocalization only, primitive movements, and complex movements. We examined whether or not phasic EMG activity and REMs occurred in 9 seconds before the onset of motor behavioral episodes.
Results: total of 770 motor -behavioral episodes in 21 patients during REM sleep periods were analyzed. Of those episodes, 89 episodes consisted of vocalization only, and the other 681 episodes showed combinations of movements and vocalizations. Phasic EMG activity and REMs appeared frequently just before all motor-behavioral episodes. In vocalization only, REMs were observed more frequently than in complex movements.
Conclusions: Phasic EMG activity and REMs are involved in behavioral manifestation in RBD. It is possible to be neurophysiological indicator Further studies are necessary to confirm which kind of motor -behavioral episodes with / without phasic activities is a marker of neurodegenerative diseases in isolated RBD.

"RESPIRATORY REM SLEEP BENEFIT" IN REM SLEEP BEHAVIOR DISORDER

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Introduction: Rapid eye movement sleep behavior disorder (RBD) is a parasomnia characterized by dream-enactment behaviors that emerge during a loss of REM sleep atonia. In patients with RBD, OSA syndrome (OSAS) can occur frequently as comorbid entity. It has been reported that the presence of muscle tone during REM could play a protective role in patients with OSAS RBD (Huang J. et al. Sleep 2011). During OSAS recurrent episodes of complete or partial collapse of the upper airway occurred during, both, NREM and REM sleep, but during REM sleep the withdrawal of excitatory noradrenergic and serotoninergic inputs to upper airway motor neurons deeply reduces the pharyngeal muscle activity, increasing the propensity for upper airway collapse. This is the first study comparing the protective role in the impact of OSAS in RBD patients ("REM sleep benefit") with a particular population of OSAS patients, the OSAS REM group, in the search of an adequate model to compare future therapeutic strategies.

Materials and methods: We evaluated retrospectively 25 patients with RBD and coexisting OSA (OSAS RBD) and 26 patients with REM-predominant OSA and REM-isolated OSA. All subjects were ≥ 50 years old and underwent one-night polisomnography (PSG) or video polisomnography (vPSG). Diagnoses of RBD and OSA were made according to standard criteria (ICSD-3 and Haba-Rubio J. et al. Chest. 2005). We excluded patients with cardiac disease, dementia, signs of parkinsonian-plus disorders or any additional neurodegenerative diseases.The results were express in x$\pm$ SE, ANOVA and nonparametric test (Mann-Whitney U test) were used to analyze our results and a $p < 0.05$ was considered significant.

Results: There were no statistical differences between groups with regard to age, body mass index, sleep architecture and sleep continuity parameters. The ratio male/female was higher in the group of OSAS RBD. In regard to respiratory variables, there were no significant differences in AHI, AHI NREM and REM between groups with significative differences between AHI NREM and AHI REM in the OSAS REM group ($p< 0.042$). Mean SpO2 was similar between groups but we found a significative lower O_2 saturation nadir values in the OSAS RBD group (OSAS REM 73.1±7.7, OSAS RBD 79.6±8.8, $p< 0.0037$).

Conclusions: Our study found a significant reduction of the nadir of oximetry values in OSAS RBD patients in comparison with OSAS REM group. This reduction, named by us "the respiratory REM sleep benefit", is in accordance with the reduction of the nadir of oximetry values observed in patients with Parkinson's Disease (PD) with or without RBD and/or OSAS (Bugalho P. et al. Sleep Med 2017; Huang JY et al. Chin Med J 2018;131:899-906).Could this group integrated by the OSAS REM patients become a useful model to compare the "REM sleep benefit" observed in patients with RBD and, in some reports, in patients with PD? This is a question that arises in face of the evidence from different drugs, particularly, cannabinoids, that reduce both, sleep apnea and RBD clinical features.

STRIATAL DOPAMINE TRANSMISSION IN INDIVIDUALS WITH ISOLATED RAPID EYE MOVEMENT SLEEP WITHOUT ATONIA (RSWA): A SEARCH FOR PRECURSOR BIOMARKER FOR NEURODEGENERATION

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Introduction: Isolated REM sleep without atonia (RSWA) is characterized by increased phasic or/and tonic muscle activity during REM sleep without dream enactment behaviors. In previous studies, isolated RSWA may represent decreased striatal dopamine transporters and reflect an early presentation of neurodegenerative diseases. However, the relationship between isolated RSWA and striatal dopamine transmission in high risk population of idiopathic REM sleep behavior disorder (iRBD), such as first degree relatives (FDRs) of iRBD, has still not been clarified. In this study, we aimed to investigate the striatal dopamine transmission between individuals with RSWA and individuals without RSWA from FDRs of patients with iRBD and healthy controls.

Materials and methods: This is a case-control study including 6 FDRs of iRBD with isolated RSWA (mean age 58.8 ± 9.3 years), 29 FDRs of iRBD without isolated RSWA (mean age 59.5 ± 9.0 years), and 11 community-based health controls without isolated RSWA (mean age 57.1 ± 8.7 years). All individuals underwent video-polysomnography and two-day triple-tracer PET/CT neuroimaging protocol (^{18}F-DOPA, ^{11}C-raclopride, and ^{18}F-FDG-PET neuroimaging). RSWA was defined by at least 10% of excessive EMG activity during REM sleep in the mentalis muscle.

Results: RSWA percentage was significantly higher in FDRs of iRBD with isolated RSWA (14.1 ± 4.6 %) compared with FDRs without RSWA group (4.4 ± 2.2 %) and healthy control group (2.8 ± 4.1%). FDRs of iRBD with RSWA had significantly lower ^{18}F-FDG-PET in the putamen (FDRs with RSWA: 1.31 ± 0.06 vs FDRs without RSWA: 1.44 ± 0.10 vs Control: 1.43 ± 0.11, P = 0.018) and caudate (FDRs with RSWA: 1.06 ± 0.05 vs FDRs without RSWA: 1.16 ± 0.08 vs Control: 1.15 ± 0.12, P = 0.038). There were no significant differences in the ^{11}C-raclopride and ^{18}F-DOPA uptake at 60 minutes among groups.

Conclusions: Individuals with isolated RSWA had decreased glucose metabolism in the putamen and caudate than controls. This suggests individuals with isolated RSWA may carry a higher risk of neurodegenerative diseases. Isolated RSWA may serve as an emergent prodromal marker of PD.

Acknowledgements: Study participants and the staff of the Sleep Assessment Unit, Shatin Hospital, and the Department of Nuclear Medicine &PET, Hong Kong Sanatorium & Hospital.

SLOW OSCILLATION ACTIVITY DURING NON-REM SLEEP IN PATIENTS WITH IDIOPATHIC REM SLEEP BEHAVIOR DISORDER (RBD)

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Introduction: Slow oscillation (SO, < 1 Hz) is the hallmark of slow-wave sleep (SWS) characterized by the cyclic alternation of the neuronal membrane potential between a depolarized down-state and a hyperpolarized up-state. Growing evidence suggests that alterations in SWS have been observed in rapid-eye movement (REM) sleep behavior disorder (RBD), and caused by dysfunction of the nigrostriatal dopaminergic system. However, their neuropsychological mechanisms remain unidentified. We hypothesized that SO activity is disrupted in RBD, and this dysfunction may support the pathological hallmark of neurodegenerative diseases. To address this issue, we investigated the characteristics of SO in RBD from electroencephalograms (EEGs) during a non-REM sleep.

Materials and methods: Thirteen idiopathic RBD patients and 10 healthy controls participated in the study. Single overnight polysomnography (PSG) data were collected from all participants. Twenty-one channel EEGs were recorded during sleep. An automated SO detection algorithm was used for extracting SO event. The algorithm referred to manually scored hypnograms to extract SO during stage N3. The quantitative characteristics of SO activity including density, duration, and amplitude were obtained. SO parameters were correlated with PSG and clinical variables using Pearson's correlation.

Results: Sleep structures were not significant different between the groups. There was no significant difference in SO density between the groups (t=0.120, p=0.906). However, SO amplitude was smaller and SO duration was longer in the RBD group than in the control group (t=2.637, p=0.015; t=-3.958, p=0.001). For both the groups, SO amplitude negatively correlated with SWS (%) (r=-0.701, p=0.024 for control; r=-0.712, p=0.006 for RBD). No significant correlation was found between SO characteristics and other clinical scores.

Conclusions: There has a lack of studies on SOs in RBD, although growing evidences support that SWS contributes to progression of neurodegenerative diseases. We provided novel evidence suggesting that larger SO amplitude and longer SO duration might be associated with dysfunction of cortical and thalamic networks in RBD patients. SO activity is disrupted in RBD, and this dysfunction may support the neural correlates of progression marker in neurodegenerative diseases.

REM Behavior Disorders
Board #245 : Poster session 2

ALPHA-SYNUCLEIN PATHOLOGY IN THE REM SLEEP CIRCUIT TRIGGERS REM SLEEP BEHAVIOUR DISORDER IN MICE

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Introduction: REM sleep behaviour disorder (RBD) is a neurological condition caused by a pathological loss of muscle atonia during REM sleep. This releases violent dream enactment behaviours during REM sleep, which routinely cause patient or bed-partner injuries. However, the most clinically concerning aspect of RBD is that 80-90% of patients eventually develop a synucleopathic neurodegenerative disease. The tight association between RBD and the synucleopathies suggests that RBD itself could result from alpha-synuclein mediated degeneration of the neural circuits that normally control REM sleep atonia. Despite multiple lines of basic science and clinical evidence that support a link between RBD and the synucleopathies, the precise mechanism behind RBD remains largely unknown. Here, we test the longstanding, but experimentally untested hypothesis that alpha-synuclein pathology in the REM sleep atonia circuit will induce RBD symptoms in mice.
Materials and methods: We used an AAV vector-based approach to over-express human alpha-synuclein in the ventromedial medulla (vmM) of wild-type mice, which is at the core of the REM sleep atonia circuit. 10-12 weeks later we assessed if this intervention 1) induced Lewy pathology in these cells; and 2) if it affected motor activity during REM sleep. Sleep-wake behaviours and motor activity were assessed by EEG and EMG recordings as well as real-time video monitoring.
Results: First, we revealed using immunohistochemical analysis that the viral delivery of alpha-synuclein caused Lewy body-like pathology within vmM cells. This was characterized by an accumulation of pathogenic aggregates comprised of phosphorylated alpha-synuclein in these cells. Second, we found that Lewy pathology in vmM cells increased phasic motor activity during REM sleep (t-test; n=8, p=0.0072), but more importantly it prevented the expression of REM sleep atonia (t-test; n=8; p=0.0385). Third, we found that Lewy pathology in vmM cells had no significant effect on overall amounts of sleep or wakefulness (multiple t-tests; n=8; p>0.05).
Conclusions: Our preliminary findings suggest that alpha-synuclein pathology in the REM sleep atonia circuit induces an RBD phenotype in otherwise healthy mice, which suggests that RBD in humans could also result from a synucleopathic mechanism.

EXECUTIVE AND AUTONOMIC DYSFUNCTION IN REM SLEEP BEHAVIOR DISORDER

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Introduction: To examine the cognitive and autonomic function of REM sleep behavior disorder (RBD).
Materials and methods: A total of ninety people were recruited, including 30 RBD diagnosed by polysomnography(17idiopathic RBD and 13 RBD with Parkinson's disease), 30 other sleep disorders(13 obstructive sleep apnea (OSA) and 17 others) and 30 healthy controls, from 2015 to 2018 in Shanghai Ruijin hospital. Demographic features were collected and different scales were used to evaluate sleep,cognitive and autonomic function.
Results: RBD performed worst in Trail Making Test-B tests (TMT-B) among three groups. RBD patients also demonstrated impairments in autonomic function and anxiety mood. In subgroup analysis, iRBD showed worse performance in Auditory Verbal Learning Test (AVLT) than OSA.
Conclusions: RBD showed executive dysfunction and autonomic dysfunction.

PROBABLE RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER PREDICTS PARKINSONISM IN URBAN AND RURAL POPULATION: RESULTS FROM TWO INDEPENDENT COMMUNITY-BASED COHORTS

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Introduction: Many studies have identified a strong association between RBD and synucleinopathies. One important limitation of these studies is that samples were mostly collected from sleep clinics and a control group without RBD was not included. Only one study was conducted to assess population-based risk of neurodegenerative disease so far and found that pRBD$^+$ subjects were at 2.2-fold increased risk for developing mild cognitive impairment (MCI)/PD in about 4 years. However, in that study, the sample size was relatively small (44 pRBD$^+$ subjects and 607 pRBD$^-$ subjects) and subjects (70-89 years) were relatively old. Therefore, in this study we aimed to estimate the risk for developing Parknsonism among probable RBD (pRBD) in a large cohort of community population after approximately 4 years of follow-up.

Materials and methods: Subjects without cognitive impairment, aged 50 years or above, were recruited from Wuliiqiao (urban) and Malu (rural). pRBD was determined by RBD screening questionnaire (RBDSQ) and RBD questionnaire-Hong Kong (RBDQ-HK), respectively. Cox proportional hazard model was used to assess disease risk among subjects with and without pRBD, as well as risk factors for conversion in pRBD$^+$ subjects among subjects with pRBD at baseline.

Results: A total of 2331 out of 3539 subjects (69.5±9.9 years, 753 males) were followed for 47.7 ± 2.9 months in Wuliqiao community (response rate 65.9%), and 1054 out of 1225 subjects (67.9±8.6 years, 438 males) were followed for 45.4 ± 8.0 months in Malu community (response rate 86.0%). After full adjustment for potential confounders, subjects with pRBD had a higher risk (8.06% vs. 1.15%, hazard ratio [HR] (95% confidence interval [CI]) =6.70 (2.55, 17.64) and 4.22% vs. 1.13%, HR (95% CI) =4.78 (1.80, 12.72)) of developing Parkinsonism in Wuliqiao cohort and Malu cohort, respectively. Among those subjects with pRBD at baseline, the conversion of parkinsonism was associated with male (HR (95% CI) =5.42 (1.47, 20.04)), hypertension (HR (95% CI) = 6.22 (1.36, 28.41)) and Mini-Mental State Examination score (MMSE) (HR (95%CI) = 0.72 (0.58, 0.89)). However, there was no significant predictive value of advanced age, farmer, depression, coffee, smoking, alcohol, and SSRI taking at baseline.

Conclusions: The risk of Parkinsonism for pRBD is much stronger than previous report, which was also adopted in the MDS criteria for prodromal Parkinson's disease in both urban and rural population. Some risk factors of conversion to parkinsonism among pRBD$^+$ subjects were found, which may have implication for preventive strategy development in a community setting.

REM Behavior Disorders
Board #230 : Poster session 3
DIAGNOSTIC YIELD OF REM SLEEP MUSCLE ACTIVITY FOR PRESUMED SYNUCLEINOPATHY NEURODEGENERATION

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Introduction: Neurodegenerative disease arises primarily secondary to two proteinopathies; alpha-synuclein (Parkinson disease (PD), multiple system atrophy (MSA), dementia with Lewy bodies (DLB)); and non-alpha-synuclein, most commonly, tau (Alzheimer's dementia (AD), frontotemporal dementia (FTD), progressive supranuclear palsy (PSP) or corticobasal syndrome (CBS). Symptom overlap complicates accurate antemortem diagnosis and additional diagnostic tools are needed for prognostication as well as enrollment in clinical trials for disease targeted therapy. We aimed to determine whether polysomnographic REM sleep without atonia (RSWA) distinguishes between probable synucleinopathy (SYN) and non-synucleinopathy (NSYN) etiologies of cognitive impairment and/or parkinsonism.
Materials and methods: We analyzed quantitative RSWA in 138 patients; 73 with probable SYN etiology (33 PD, 20 MSA, 20 DLB), 50 probable NSYN etiology (15 AD, 11 FTD, 17 PSP, 7 CBS), and 15 primary snoring controls. Phasic, tonic, and "any" muscle activity percentages and phasic burst durations were calculated in the submentalis (SM) and anterior tibialis (AT) muscles. The automated REM atonia index was also determined in SM. Statistical group comparisons and regression were performed, and receiver operating characteristic (ROC) curves used to determine RSWA cutoffs that distinguished SYN from NSYN.
Results: All RSWA measures were significantly greater in SYN patients. SM cutoffs with AUC >0.9 (sensitivity, specificity) were: "any" 11.5% (75%, 96%); phasic 10.8% (75%, 98%); phasic burst duration 0.61 seconds (74%, 94%). In contrast, AT discrimination was poor with AT "any" cutoff of 23.3% being 62% sensitive and 72% specific for SYN (AUC 0.67). Cutoffs were similar irrespective of clinical dream enactment behavior. Subgroup analysis showed greatest SM RSWA in patients with MSA, elevated but similar RSWA between PD and DLB patients, and RSWA similar to controls in AD, FTD, PSP and CBS patients.
Conclusions: Quantitative submentalis REM sleep muscle activity accurately distinguished presumed SYN etiology, even without clinical dream enactment, implying selective vulnerability toward synuclein accumulation of specific brainstem nuclei such as the pontine sublaterodorsal/subcoeruleus (SubC) and medullary magnocellularis and that these structures are relatively spared by non-synuclein neurodegeneration Polysomnographic RSWA appears to be a useful diagnostic tool for presumed SYN etiologies in patients with parkinsonism and/or cognitive impairment with the added benefit of polysomnographic identification of comorbid sleep disorders that may worsen underlying neurologic symptoms in this patient population.

SUDOMOTOR ABNORMALITIES IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: Several publications have demonstrated post-ganglionic sudomotor impairment and small fiber neuropathy (SFN) in patients with Parkinson's disease (PD), suggesting that epidermal denervation may be an early feature of PD. More recently, idiopathic REM sleep behavior disorder (iRBD) has also been associated sudomotor abnormalities, however data are limited. We now report on the prevalence of post-ganglionic sudomotor impairment in a cohort of patients with iRBD.

Materials and methods: We performed a retrospective chart review of all patients seen in the Stanford autonomic clinic from 2013-2019 who underwent sudomotor testing with the quantitative sudomotor axon reflex test (QSART). We identified three groups for analysis: 1.) iRBD, 2.) PD with RBD, and 3.) PD without RBD. Patients with iRBD were diagnosed by a sleep specialist and all patients had video polysomnography (vPSG) confirmation of this diagnosis. Exclusion criteria included a diagnosis of peripheral neuropathy, diabetes mellitus, alcoholism, chemotherapy, or other systemic disorder associated with SFN.

Results: iRBD patients (n = 20) were of similar age and gender to PD with RBD (n = 17) and PD without RBD (n = 21). The PD with RBD group demonstrated the most sudomotor abnormalities (sudomotor CASS 1.285 ± 1.23), followed by iRBD (0.294± 0.58, and PD without RBD (0.55± 0.944, p= 0.007). Most patients demonstrated a non-length dependent pattern of sweat loss.

Conclusions: QSART abnormalities are common in patients with iRBD, and intermediate between those of PD with RBD and PD without RBD. These findings support the concept that cutaneous neuropathy occurs early in the course of the alpha-synucleinopathies, and may reflect a peripheral deposition of alpha-synuclein that occurs in tandem with deposition in the central nervous system.

SLEEP QUALITY AND REM SLEEP BEHAVIOR DISORDER IN ADULTS WITH AND WITHOUT PARKINSON'S DISEASE

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Introduction: Parkinson's disease (PD) is a degenerative central nervous system disorder that belongs to a group of conditions known as movement disorders. However, it presents a series of non-motor symptoms such as depression, anxiety, pain, lack of impulse control and sleep disturbances, which contribute to the alteration of the patient's quality of life with PD.
Objective: To compare the sleep quality and the symptoms of REM Sleep Behavior Disorder among adults with and without PD.
Method: We included 60 adults with an average age at M= 66 (SD= 8) of which 38% were women. Half of the participants already had a PD diagnosis. There were no differences found for sex and age between the groups with and without PD (P £ .05). Instruments applied were the Pittsburgh Sleep Quality Inventory (PSQI), The Epworth Sleepiness Scale (ESS) and the REM Sleep Behavioral Disorder Questionnaire, designed for this study based on the international classification of sleep disorders
Results: In relation to the sleep habits the group with PD reported less hours of sleep than the group without PD, both in weekends (M= 6:21, SD= 2.28 vs. M= 7:12, SD=1:49), as on week days (M=5:59, SD= 1:53 vs. M=6:48, SD= 1:19) and they lay down in a later time to sleep (M=23:04, SD=1:36 vs. M=21:49, SD=2:41). Likewise, the differences in sleep quality (M= 9.9, SD=4.47 vs. M= 7.23, SD= 4.71, t= 2.25, p= .028) and the symptoms of REM Sleep Behavior Disorder (M=3.17 , SD=3.09 vs. M=1.57 , SD=2.51 , t= 2.20 , p=.032) were also found.
Conclusion: Patients with PD present a decrease in sleep quality and quantity also an increase in the symptoms of REM Sleep Behavior Disorder. More attention in sleep is required for the patients with PD in comparison to the general population of adults.

REM SLEEP BEHAVIOR DISORDER IN PATIENTS WITH ALZHEIMER'S DISEASE

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Introduction: Rapid eye movement sleep behavior disorder (RBD) is well known as a prodromal symptom of neurodegenerative disease, especially a-synucleinopathy. In the previous literature, development of RBD in Alzheimer's disease (AD) is known to be rare. However, there are reports that RBD may occur in AD patients because AD also shares the lewy body pathology.
The objective of this study was determine the occurrence of RBD among patients with AD using The REM Sleep Behavior Disorder Screening Questionnaire-Korean Version (RBDQ-KR)
Materials and Methods: We enrolled 54 patients with clinically probable AD patients who identified AD pathology in [^{18}F] flutemetamol PET scan. RBD was evaluated with RBDQ-KR, which validated RBDQ as Korean version to confirm RBD. Detailed neuropsychological tests were measured using the Seoul Neuropsychological Screening Battery (SNSB)
Results: We analyzed RBDQ-KR data recorded by 55 AD patients. AD dementia was 66.7% (36 patients) and MCI due to AD was 18 (33.3%). AD with RBD was 15 (27.8%), among these, AD dementia with RBD was 13 (36.1%), and MCI due to AD with RBD was 2 (11.1%). AD without RBD group showed better results on CDR than AD with RBD group. There were no significant differences in the neuropsychological test except for the SVLT and COWAT items.
Conclusions: Since AD patients share lewy body pathology, it would be possible that RBD in AD may be more frequent than previous reports, therefore RBD should be observed clinically more carefully.
Keywords: REM sleep behavior disorder; Alzheimer's disease

REM SLEEP BEHAVIOR DISORDER CAUSES SYMPTOM FLUCTUATIONS IN PARKINSON´S DISEASE

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Introduction: REM sleep behavior disorder (RBD), which is frequently associated with Parkinson´s disease (PD), represents a sleep stage under the strong circadian influences. Our study sought to determine if RBD could change circadian rhythms in PD.
Materials and methods: Eighteen patients with PD were divided into PD patients with RBD (PD+RBD, n=8) and PD patients without RBD (PD-RBD, n=10). All participants underwent 24 hours of actigraphy and assessed the motor symptoms using Unified Parkinson´s Disease Rating Scale (UPDRS) III score at zero, six, twelve and eighteen o´clock. We evaluated nonmotor symptom (anxiety, depressive mood, sleepiness, fatigue, excessive sweating, sialorrhea, dizziness and pain) fluctuations absent or present for every hour in one day.
Results: Age, sex, PD duration and levodopa equivalent dose were not different. PD+RBD patients had higher flattening of diurnal activity rhythms and reduced quiescence during night than PD-RBD patients from actigraphy. Moreover, PD+RBD patients had higher UPDRS III score than PD-RBD patients at six o´clock, while no difference was observed in other times. Compared to PD+RBD patients, nonmotor symptom fluctuations were less frequent in PD-RBD patients. Anxiety and depressive mood were more common in the morning. Sleepiness and fatigue more likely appeared in the period from 12 a.m. to 15 p.m. Pain often happened an hour before bed. We found no evidence for fluctuations of excessive sweating, sialorrhea and dizziness.
Conclusions: Our results suggest that RBD could be associated with fluctuating motor and nonmotor symptoms in PD. Thus, we argue that RBD results in circadian and sleep regulation in PD.

REM Behavior Disorders
Board #233 : Poster session 3

FREQUENCY AND CHARACTERISTICS OF PATIENTS WITH ISOLATED REM SLEEP WITHOUT ATONIA: A COMMUNITY BASED STUDY

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Introduction: Polysomnographic REM sleep without atonia (RSWA) is the neurophysiologic signature of REM sleep behavior disorder (RBD), which is strongly associated with synucleinopathy neurodegenerative diseases. However, less is known about isolated RSWA in patients without dream enactment. RSWA is most often diagnosed qualitatively by visual inspection in clinical practice. It remains unclear whether such patients have sufficiently abnormal REM atonia control to fulfill quantitative RSWA diagnostic RBD thresholds, and therefore be considered to have isolated RSWA (iRSWA). We aimed to determine the frequency of iRSWA in our large community cohort, and also analyzed controls lacking reported qualitative RSWA.

Materials and methods: We identified all consecutive patients from Olmsted and surrounding counties in Minnesota who underwent polysomnography (PSG) at Mayo Clinic from January 1, 1998 to July 1, 2017. We then analyzed those with qualitatively reported iRSWA (lacking dream enactment behaviors following a standardized clinical interview and video-PSG interpreted by a Mayo Clinic sleep medicine physician), and also analyzed controls without reported visual RSWA, history of neurodegenerative disease, or antidepressant use, matched for age, sex, and apnea-hypopnea index. We also reviewed the demographics and clinical characteristics for all patients. RSWA phasic, tonic, and "any" muscle activity was then visually/manually and automatically analyzed according to our established methods for all patients. We considered patients having quantitative RSWA levels that exceeded previously defined RBD diagnostic thresholds to have a diagnosis of iRSWA.

Results: 142 of 21,110 (0.67%) patients had visually identified RSWA reported; of these, 111 had available PSGs for analysis. Mean RAI was lower, and all mean RSWA phasic muscle activity was higher in RSWA patients than controls (p< 0.01). Sixty-eight (61.3%) RSWA patients vs. 28 (19.7%) controls met at least one RBD diagnostic threshold, including RAI (p< 0.01), thereby fulfilling our diagnostic criteria for iRSWA. Seven (4.9%) iRSWA patients had a neurodegenerative disease at time of PSG, and 88 (62%) were on antidepressants. iRSWA patients were significantly more likely than controls to have restless legs syndrome (p=0.025), insomnia (p< 0.01), and hypersomnia (p< 0.01). Mean ESS was 10.0 for iRSWA patients vs. 8.92 for controls (p=0.079). Three (2.1%) iRSWA patients vs. 2 (1.4%) controls subsequently developed a neurodegenerative disease. Two (4.9%) of 41 iRSWA patients (average follow-up 3.25 years) vs. 0 of 95 controls (average follow-up 3.87 years) developed RBD (p=0.16).

Conclusions: 61% of qualitatively reported RSWA patients had iRSWA, and qualitative RSWA interpretation alone missed iRSWA diagnosis in 19.7% of controls, suggesting superiority of quantitative REM sleep muscle activity analysis over visual qualitative analysis for accurate iRSWA identification. 62% of our iRSWA patients received antidepressants. We also found formative evidence that iRSWA represents prodromal RBD in 4.9%, meriting longitudinal neurological follow-up for these patients. iRSWA patients also trended toward being sleepier, and were significantly more likely to have RLS, insomnia, and hypersomnia, yet infrequent neurodegenerative disease diagnoses at or subsequent to PSG during short term follow-up. Prospective cohort studies are necessary to further characterize the natural history and clinical characteristics of iRSWA patients.

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Board #234 : Poster session 3
CONGITION AND OLFACTION IN FIRST DEGREE RELATIVE OF RBD: A 2-YEAR PROSPECTIVE CASE CONTROL STUDY

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Introduction: REM sleep behavior disorder (RBD) is a parasomnia characterized by dream enactment behaviors which was enabled by disruption of physiological muscle atonia during REM sleep. It has been suggested that RBD is a preclinical stage of synucleinopathy including Parkninson's disease and dementia with Lewy body. Our previous study showed that there is a significant familial aggregation of RBD, suggesting a possibility that first degree relatives (FDR) of RBD cases may harbor a higher risk of neurodegenerative diseases. According to Braak staging hypothesis of synuncleinopathy, neurocognitive and olfactory deficits were often associated with neurodegenerative disease. Thus, in this study, we aim to explore the differences in olfactory and cognitive functioning between RBD-FDR and the FDR of healthy control using a prospective study design.

Materials and methods: This is an ongoing family-based prospective study. RBD cases were recruited from outpatient clinic in Hong Kong and diagnosed according to the International Classification of Sleep Disorder and confirmed by overnight polysomnography, while healthy controls were recruited from the community. All FDRs who have attended baseline were invited to repeat assessment two years later. At follow up, all FDRs were invited to attend face-to-face clinical assessment to assess for any potential sleep disorders, olfactory identification test (OIT) and Monteral Cognitive Assessment (MOCA).

Results: At the moment of the current preliminary report, 73 FDR [50 FDR of RBD case (mean age: 54.2 ± 8.9 and male: 42%), 23 FDR of healthy control (54.8 ± 9.1 and male: 58%)) attended follow up assessment (mean follow up period: 2.5 yrs $\pm$ 0.8). There were no significant differences between age, gender, baseline OIT performance (No of correct items, RBD-FDR vs control-FDR: 4.4 ± 1.6 vs 4.4 ± 1.7) and MOCA (RBD-FDR vs control-FDR: 26.7 ± 2.4 vs 26.4 ± 2.8) between two groups (all $p > 0.05$). Bland and Altman plots indicated that there was no systematic trend found between the difference and mean of MOCA. Repeated measure ANOVA demonstrated no significant time * group interaction effect in both MOCA (baseline vs follow up: RBD-FDR: 26.9 ± 2.6 vs 27.2 ± 1.9; Control-FDR: 26.6 ± 2.6 vs 27.0 ± 2.0; $p > 0.05$) and OIT performance (RBD-FDR: 4.4 ± 1.7 vs 4.1 ± 1.5; Control-FDR: 4.3 ± 1.6 vs 4.0 ± 1.4, $p>0.05$).

Conclusion: The result suggested that there is no significant difference in olfactory and cognitive functioning between RBD-FDR and the FDR of healthy control over 2 years period. This might possible be due to the relatively young age and short follow up duration, at which the neurodegenerative changes might not yet fully emerge. The ongoing recruitment of the FDR subjects will allow a larger sample size and longer follow up period to further examine the possible familial risk of neurocognitive performance among the at-risk FDR subjects of FDR.

REM Behavior Disorders
Board #249 : Poster session 2

USING THE JAPANESE VERSION OF THE BRIEF ASSESSMENT OF COGNITION IN SCHIZOPHRENIA (BACS-J) TO ASSESS COGNITIVE FUNCTION IN PATIENTS WITH REM SLEEP BEHAVIOR DISORDER

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Introduction: Rapid eye movement sleep behavior disorder (RBD) is known to be a prodromal symptom of neurodegenerative diseases such as dementia with Lewy bodies (DLB). In RBD patients, it is known that cognitive function tends to decline along with the progression of the disease. Indeed, it has been shown that mild cognitive impairment (MCI) is already present in RBD patients (Julayanont & Nasreddine, 2017).
However, the cognitive decline profiles specific to RBD patients have not been well established. The Japanese version of the Brief Assessment of Cognition in Schizophrenia (BACS-J) was developed to assess cognitive function in patients with schizophrenia, the disease with altered dopamine function similar to DLB. BACS is composed of six cognitive domains and is also useful to assess cognition with mood disorders other than schizophrenia (Terachi, 2017).
In this study, we examined cognitive function in RBD patients using BACS-J.
Materials and methods: Medical records of RBD patients, who visited the Sleep Clinic in Shiga University of Medical Science during March 1, 2016 to January 14, 2019, were reviewed and 20 patient records fulfilling following assessments were included in this study. For cognitive assessment, Japanese version of Montreal Cognitive Assessment (MoCA-J) and BACS-J were conducted. MoCA-J was used as the standard method to detect MCI. In BACS-J, cognitive functions were separately assessed based on following domains: verbal memory, working memory, executive function, attention and processing speed, motor speed, and verbal fluency. For each domain score and composite total score, Z scores were calculated based on the Japanese elderly healthy controls dataset (Kaneda et al., 2013).
Results: Twenty patients (2 female) were included analysis, with a mean (SD) age of 73.2 (6.8) years, education of 13.1 (2.17) years, and disease duration of 9.15 (5.54) years. Mean (SD) MoCA-J score was 24.0 (2.66). Mean (SD, Z score) of BACS-J domain scores were as follows : verbal memory was 32.85 (8.76, Z = -.53), digit sequencing was 18.20 (4.25, Z = -.39), token motor was 45.80 (12.19, Z = -.61), verbal fluency was 40.15 (9.48, Z = -.37), symbol coding was 41.75 (11.67, Z = -.31) and tower of London was 15.2 (3.72, Z = -.08). Additional one sample t-test showed some subscales in RBD patients were significantly lower in RBD than control; verbal memory score (t (19) = -2.199, p = .04), token motor score (t (19) = -2.974, p = .008), verbal fluency score (t (19) = -2.472, p = .023). Composite Z score was also significantly lower (t (19) = -2.210, p = .04).
Conclusions: In this study, results of BACS-J showed that RBD patients had cognitive decline, which was not detected by MoCA-J. The decline was specific to some of the cognitive domains. These includes verbal memory, token motor, and verbal fluency which may represent RBD-specific cognitive decline.
Future study should clarify if these domains specific decline of cognitive function could help differential diagnosis of MCI as well as prediction of disease progression.
Acknowledgements: We appreciate Sachiko Sawada and Taeko Toyoda´s effort for administrative assistance.

AUTOMATIC SCREENING OF PLMS PATIENT BASED ON DEEP LEARNING MODEL USING AN ELECTROCARDIOGRAM

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Introduction: Periodic limb movement syndrome (PLMS) is a common sleep disorder affecting approximately one third of adults over the age of 60 years. PLMS can affects the sleep effiency, sleep fregmentation, and daytime sleepiness. In this study, we proposed a novel method for automatic screening of PLMS patient based on deep learning model using a single-lead ECG signal.

Materials and methods: Convolutional neural network (CNN) was used as a deep learning model which consists of 5-layer CNN model including three convolutional layers and two fully connected layers. Designed CNN model analyzed the morphology of the ECG segments to discriminate between the PLMS patients and control subjects. For this study, 14 subjects' PSG recordings were used. The subjects composed of the seven controls (4 male, 3 female, Age:50±6.0, BMI:22±2.0) and seven PLMS patients (4 male, 3 female, Age: 49±5.8, BMI:22±1.8). The PLMS index of the patient group was 23±6 per hour. The single-lead ECG signal was collected during PSG, and it was normalized, segmented at the duration of 10 s. After segmentation, the 37,906 segments were obtained, it was divided into the training set (30,324 segments), and the test set (7,582 segments).

Results: We obtained the performance of the automatic screening with an accuracy of 93.0%, F1-score of 94.1% for the test sets, respectively.

Conclusions: We proposed a novel method for automatic screening of PLMS patient based on CNN model using a single-lead ECG signal. Our results demonstrated the possibility of the automatic screening of PLMS patients based on deep learning model using the single-lead ECG signal. In a further study, it should be covered by more subjects and clinically validated.

FAMILY HISTORY OF REM SLEEP BEHAVIOR DISORDER AND NEURODEGENERATION IN REM SLEEP BEHAVIOR DISORDER COMORBID WITH PSYCHIATRIC DISORDERS: PRELIMINARY FINDINGS FROM A CASE-CONTROL FAMILY STUDY

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Introduction: Whether the essence of REM sleep behavior disorder (RBD) symptoms presented in psychiatric population (psy-RBD) is merely a drug side effect or a variant of idiopathic RBD (iRBD) associated with alpha-synucleinopathy has been controversial. Previous study confirmed that iRBD aggregates in family and relatives of iRBD carry higher risk of alpha-synucleinopathy. The current study aimed to investigate the prevalence of neurodegeneration and possible RBD among the first-degree relatives (FDRs) of psy-RBD, as compared with those in FDRs of psychiatric- and normal-control.

Materials and methods: By using a combination of family study method (face-to-face interview) and family history method (proxy report), a total of 231 FDRs of 59 polysomnography-confirmed psy-RBD probands, 141 FDRs of 28 psychiatric control probands, and 188 FDRs of 55 normal control probands has been recruited. The rate of possible RBD, disease history of Parkinson disease and dementia, and other prodromal symptoms of Parkinson disease were compared among three groups of FDRs

Results: Psy-RBD-FDRs were more likely to have possible RBD symptom (32[13.9%] vs 13[9.2%] and 15[8.0%], p=0.13) , higher rate of Parkinson disease history (7[3.0%] vs 0[0%] and 1[0.5%], p=0.03) and dementia (11[4.8%] vs 3[2.1%] and 2[1.1%], p=0.07) as compared to FDRs of psychiatric- and healthy-control, respectively. This trend of difference in possible RBD symptoms and Parkinson disease history among three groups seemed to be more obvious in parents (psy-RBD-parents vs psy-control-parents vs normal-control-parents: possible RBD symptom, 19[20.7%] vs 2[4.1%] vs 3[7.5%], p=0.01; Parkinson disease history, 5[5.4%] vs 0[0%] vs 0[0%], p=0.08) . The rate of depression was found highest in FDRs of psy-control (psy-control-FDRs vs psy-RBD-FDRs and normal-control-FDRs: 26[18.4%] vs 23[10.0%] and 11[5.9%],p=0.001), while other prodromal symptoms such as hand/head tremors, instability of gait, memory deficit, constipation, olfactory deficit or loss and excessive daytime somnolence were not different among groups.

Conclusions: : RBD symptoms emerging in psychiatric population seems related to positive family history of possible RBD symptoms, Parkinson disease and dementia, which suggest that psy-RBD may be a variant of iRBD with shared predisposition in family.

A NEW DIAGNOSTIC APPROACH TO IDENTIFY ISOLATED REM SLEEP BEHAVIOR DISORDER (IRBD): 3D VIDEO ANALYSIS

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Introduction: Isolated REM sleep behavior disorder (iRBD) has been recognized as an early stage of α-synucleinopathy and thus represents an opportunity for potentially disease-modifying intervention. The certain diagnosis of iRBD and its distinction from mimics (i.e., other sleep disorders with motor manifestations during sleep) requires the analysis of video-polysomnography (vPSG) by trained sleep experts. Home-based and automatic systems for RBD diagnosis would drastically simplify this process. Therefore, we evaluated 3D video analysis of lower limb movements during REM sleep as a new diagnostic tool for iRBD and compared it with the gold standard vPSG.

Materials and methods: A total of 104 participants were recruited among patients undergoing 8-hours vPSG at the Sleep Laboratory, Department of Neurology, of the Medical University of Innsbruck: 40 patients (6 females, age 65.1±9.7) with iRBD and 64 patients with other sleep disorders known to go along with motor manifestations during sleep (19 females, age 56.4±12.9). This latter group (AHI 20.4±22.8, PLMS index 26.7±33.2) included sleep apnea (n=11), PLMS (n=4), sleep apnea with PLMS (n=44) and other (n=5). Sleep stages and PLMS were scored according to the American Academy of Sleep Medicine 2012 criteria. 3D videos of the sleeping subjects were recorded by a camera mounted to the ceiling above the bed. Movements of the lower extremities were automatically detected using software based on algorithms developed by the Austrian Institute of Technology and the Medical University of Innsbruck, allowing the contactless detection of even minor motor activities. Breathing-related movements were automatically excluded. Group differences were evaluated by Mann-Whitney U-tests and logistic regression. Analysis of the area under the ROC curve was used to determine the accuracy of our approach.

Results: Group differences regarding sex (p=0.962) and REM duration (p=0.657) were not significant. There was, however, a significant difference of age (p< 0.001), which was therefore introduced as covariate into our analyses. We observed 1.43 ±0.807 leg movements per minute as determined from 3D video processing in subjects with iRBD and 0.343±0.309 in subjects with other sleep disorders with motor manifestations. Logistic regression with age as covariate showed highly significant results (p< 0.001). ROC curve analysis demonstrated that - based on the leg movement frequency - the two patient groups were identified with an accuracy of 0.904 (sensitivity 0.875, specificity 0.922, false positive rate 0.078, false negative rate 0.125). The area under the ROC curve was thereby 0.954. Among the 5 falsely negative classified iRBD patients, two were treated with clonazepam and all of them exhibited excessive fragmentary myoclonus during sleep.

Conclusions: Using a novel approach, we demonstrated the potential of 3D video processing for contactless and automated identification of iRBD. In a sleep laboratory sample of 104 patients with different sleep disorders causing motor manifestations, analysis of 3D leg movements could identify patients with iRBD with an accuracy of 0.904, which might further improve by including upper limb or other body movements.

REM Behavior Disorders
Board #251 : Poster session 2

IS TRAUMA-ASSOCIATED SLEEP DISORDER A SUB-FORM REM SLEEP BEHAVIOR DISORDER? A CANADIAN LONGITUDINAL STUDY ON AGING COHORT STUDY

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Introduction: To assess the differences between post traumatic stress disorder (PTSD)-associated sleep disorder (TSD), which may also trigger dream enactment during REM sleep, and possible idiopathic REM sleep behavior disorder (pRBD) in a 30,097-person national cohort.

Materials and methods: Participants, aged 45-85 years in Canada, were sampled by geographical density and recruited in the Canadian Longitudinal Study on Aging. Those self-reporting dementia or Parkinson's disease were excluded. Since TSD is commonly associated with PTSD, in the CLSA cohort, we defined TSD as dream enactment behavior among PTSD participants with nightmare/flashback symptoms. TSD was defined as:

1) Screen positive on Primary Care PTSD screen (PC-PTSD) questionnaire (cut-off ≥ 3), 2) Endorsing nightmares/recurrent thoughts of a traumatic experience

3) Screen positive on the RBD1Q

Results were compared to PTSD participants whithout TSD, and possible RBD patients without PTSD. A series of global health features, motor and sleep assessments, cognitive tasks and mental health variables were analysed cross-sectionally, adjusted by age and sex.

Results: 304 screened positive for TSD, 1,122 PTSD without TSD, and 857 with pRBD. TSD (56.58%; OR_{RBD}=1.82[1.39,2.38]) was more common among women. The mean of age was also slightly younger among the TSD (59±9) and the PTSD (60±9) than the pRBD (63±11). Compared to those with pRBD, TSD participants were more likely to report memory decline (9.24% vs. 1.73%, OR_{RBD}=6.09[3.2,12.27[RP1]]), impairment in daily motor functions (1.20±1.56 vs. 0.60±1.08, OR_{RBD}=1.57[1.4,1.8]), and daytime sleepiness (26.1% vs. 11.7%, OR_{RBD}=3.0[2.1,4.3]) and endorse psychological distress (20.64±7.29 vs. 14.68±4.76, OR_{RBD}=3.08[2.04,4.61]). However, no difference in objective motor performance was found in between TSD and pRBD; both TSD (28.83 seconds, OR_{RBD}=1.03[1.02,1.05]) and PTSD (27.33 seconds, $OR_{RBD=}$1.02[1.01,1.03]) participants showed slight psychomotor slowing than pRBD (27.07 seconds). TSD performed slightly poorer than the pRBD on the Stroop task (2.07 vs. 1.71, OR_{RBD}=1.09[1.03,1.15]).

Conclusions: Our study suggests that although TSD is relatively more similar to PTSD as a psychiatric disorder, it may share similar motor phenotype as pRBD.

PRODROMAL MARKERS OF α-SYNUCLEINOPATHY NEURODEGENERATION IN 'ISOLATED' RECURRENT DREAM ENACTMENT BEHAVIORS AMONG FIRST DEGREE RELATIVES OF PATIENTS WITH REM SLEEP BEHAVIOR DISORDER - PRELIMINARY VALIDATION OF PRODROMAL RBD CONCEPT

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Introduction: REM sleep behavior disorder (RBD) is a novel and distinct parasomnia characterized by recurrent dream enactment behaviors (DEBs) and REM sleep without atonia (RSWA) during polysomnographic (PSG) assessment. Epidemiological studies have found that some participants from community present with only RSWA or DEBs (but without sufficient RSWA), which may not meet the diagnostic criteria for RBD. Emerging evidences have implied a link between isolated RSWA (RSWA without DEBs) and markers of α-synucleinopathy-related neurodegeneration, and more recently, isolated RSWA was suggested as a prodromal stage of RBD. However, it is still unclear whether recurrent DEBs without sufficient RSWA (isolated DEBs) is related to α-synucleinopathy. Moreover, conditions mimicking RBD symptoms (pseudo-RBD), such as severe obstructive sleep apnea and periodic limb movements, should be assessed and ruled out by PSG. In this regard, the novel concept of 'isolated' recurrent DEBs and the spectrum of prodromal RBD requires a further validation by clinical feature and neurodegenerative prodromal markers perspectives.
Materials and methods: This is a further analysis on a family study of RBD. A total of 97 first degree relatives (FDRs) underwent overnight video-polysomnographic assessment were included. A series of prodromal markers of Parkinson disease, including constipation, neurocognitive test, and motor function, were measured.
Results: Among the FDRs, 31 subjects were found to have DEBs but not sufficient RSWA (DEBs+), while 48 subjects have neither DEBs nor sufficient RSWA (DEBs-). No age and sex differences were found between DEBs+ and DEBs-. FDRs with DEBs had a higher score on Pegboard test (1.13 ± 0.23 vs. 1.05 ± 0.16 min, P = 0.03), higher Diastolic blood pressure drop (-5.8 ± 5.4 vs. -3.2 ± 8.5 mm Hg, P = 0.04), and a higher level of log-transformed MDS likelihood ratio of prodromal PD (0.38 ± 0.50 vs. 0.21 ± 0.35, P = 0.009) than FDRs without DEBs. However, there were no differences in other MDS prodromal markers, such as depression, excessive daytime somnolence (ESS) and constipation.
Conclusions: FDRs of patients with RBD presenting with DEBs had a higher level of some prodromal markers of PD when compared with those FDRs without DEBs. Further prospective study and community-based study are needed to substantiate the prodromal RBD concept.

USING PICTOGRAMS TO MAKE 'STRUCTURED BEHAVIOURAL OBSERVATIONS' OF YOUTH WITH RESTLESS LEGS SYNDROME REPRODUCIBLE

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Introduction: Restless Legs syndrome (RLS) is characterized by an urge-to-move feeling, which worsens during rest — usually towards the evening — and may also cause insomnia. Clinical history taking is influenced by a patient´s own explanatory models and lifestyle, ability to communicate symptoms, as well as professionals' understanding of RLS. The diagnosis of RLS in children and youth with neuropsychiatric/-developmental disorders (NPDDs) is challenging due to variability in their verbalization skills; in addition, some of the behavioural patterns may also be seen as characteristic to the underlying condition (e.g. ADHD). Our clinical observation has been that patients with NPDDs present not only with 'urge-to-move behaviours' but also individual 'self-soothing movement behaviours'.
In order to explore RLS-associated discomfort, we adapted the lab-based Suggested Immobilization Test (SIT), for clinical practice. The formal Suggested Clinical Immobilization Test (SCIT) asks participants to remove their socks/shoes, stand up, stretch & shake out, sit relaxed in a height-wise appropriately sized chair for up to 5-minutes, and describe their sensations. In cases where the formal SCIT cannot be administered (e.g., due to lack of comprehension, behavioural compliance or motor ability) the patient is observed using the informal SCIT, which involves unstructured observations of patients while moving around, coming to a rest, and at the initiation of movements. In this study, we are introducing pictograms to visualize individual 'self-soothing movement behaviours' in a reproducible way.
Methods: We analyzed the symptoms of 26 patients with NPDDs diagnosed with intractable chronic insomnia due to familial RLS and: (a) identified common characteristic movement patterns from clinical assessment reports of sitting/laying behaviours (b) created two checklists: one description-based version (19 items), and one pictogram-based version to helps identify the characteristic individual movement patterns.
Results: The SCIT-checklist has been published [Ipsiroglu et al, 2016] and is used for semi-structured exploration of movement patterns during the formal/informal SCIT. For making the observed movement patterns reproducible, we created 120+ pictograms to visualize the observed characteristic upper/lower limb-, hand/feet-, finger/toe-, torso and head-movements. To further improve the identification of characteristic movement patterns, we are suggesting that patients/patient families develop their own pictogram-based storyboards, to capture the flow of movement patterns in a structured way (https://sleepnetwork.org/scitsit/).
Conclusion: RLS is a clinical diagnosis and participation of the affected individual during the assessment is a must. We are following up on the recommendations of the International Paediatric RLS Study Group, to apply 'structured behavioural observations' [Picchietti et al., 2013]. The SCIT allows 'structured behavioural observations' but individual characteristic movement patterns may still be missed. The pictogram-based approach allows for the

identification of characteristic movement patterns, which may also be self-soothing. Currently, the pictogram concept is being evaluated as an open-source project via our Sleep Network webpage.

MATERNAL AND NEONATAL OUTCOMES FOR RESTLESS LEGS SYNDROME IN PREGNANCY: A SYSTEMATIC REVIEW

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Introduction: Up to 1 in 5 women experience restless legs syndrome (RLS) during pregnancy, making it the most common gestational movement disorder. RLS disturbs sleep across all trimesters but the potential impact on pregnancy is unknown. We aimed to systematically review the evidence for maternal and fetal outcomes associated with gestational RLS.
Methods: Systematic search of Embase, MEDLINE, PsycINFO, Maternity and Infant Care, and Scopus was conducted using MeSH headings and keywords for 'restless leg* syndrome' AND 'pregnancy' or 'birth'. We screened 472 abstracts for relevance and assessed 85 articles against full eligibility criteria. Seventeen full-text papers were eligible for data extraction and risk of bias assessment.
Results: Five of the 17 studies investigated an association between gestational RLS and pregnancy-induced hypertension: 2 large studies found a statistically significant correlation between the conditions and 3 smaller studies remained inconclusive. Preliminary results also point towards a strong relationship between RLS and peripartum depression, and a possible association between RLS and preeclampsia.
Discussion: RLS in pregnancy affects many women but is largely underdiagnosed and undertreated. RLS contributes to sleep disturbance during pregnancy which is known to be associated with adverse pregnancy outcomes. RLS itself may be an independent risk factor for poor maternal and infant health. To date, there are no specific safety guidelines for pharmacological treatment of RLS in pregnancy, and more research into the consequences of gestational RLS will accelerate developments in this area.

RESTLESS LEGS SYNDROME: DOES IT START WITH A GUT FEELING?

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Introduction: Emerging research links gut microbial health with sleep. One common sleep disorder in which the microbiome may play a role is restless legs syndrome (RLS). While the pathogenesis of RLS is not fully understood, a relative state of brain iron deficiency has been described in patients with RLS and appears to induce changes in several pathways (adenosinergic, glutamatergic and dopaminergic) known to be involved in the disease. Insufficient iron may be secondary to dietary iron deficiency or, potentially, gut inflammation. We hypothesized that small intestinal bacterial overgrowth (SIBO), a condition associated with gut dysbiosis (i.e., normally rare gut-residing bacteria are over-represented in the gut), is associated with RLS and may moderate the observed inter-patient variability in serum iron availability.

Materials and methods: Participants were recruited at the Stanford Sleep Center for three groups: RLS and low peripheral iron stores (< 50ng/mL and/or transferrin saturation < 18%), RLS and normal peripheral iron stores, and insomnia (control group). Participants completed questionnaires concerning SIBO symptoms and sleep, including the Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI). They were sent home with a fecal collection kit (Fecal Swab Collection and Preservation System, Norgen Biotek) and a SIBO kit (SIBO Home Breath Test Kit, Quintron). Fecal samples are assayed by the University of Minnesota Genomics Center with microbial community profiling evaluated by 16S ribosomal RNA (16S rRNA) gene sequencing protocols. SIBO breath samples were evaluated by Aerodiagnostics for hydrogen and methane abnormalities.

Results: Fourteen participants, nine diagnosed with RLS (4 men, 5 women) and five diagnosed with insomnia (2 men, 3 women) completed the protocol. All 14 participants indicated poor sleep quality (PSQI ≥ 5). Among the RLS participants, 33% reported moderate and 67% reported severe symptoms of RLS (IRLS scores ranging from 13 to 34 out of 40). All 5 insomnia participants were diagnosed by clinical interview but reported symptoms of subthreshold insomnia on the ISI (scores ranging from 11 to 13 out of 28). SIBO, confirmed by positive breath test and self-reported symptoms, was present in 8 of 9 participants (89%) in the RLS group and 4 of 5 (80%) participants in the insomnia group. By comparison, in the general population, rates are estimated to be 6-15%.

Conclusions: These preliminary data suggest that SIBO may be more prevalent among patients with sleep disturbances compared to the general population, particularly in patients with RLS. Additional analyses will examine fecal microbial composition and additional comparisons with insomnia.

USING AUTOMATIC SKELETON GENERATION TO EXTRACT THE MOVEMENT OF BODY DURING THE SUGGESTED CLINICAL IMMOBILIZATION TEST

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Introduction: Annotation of RLS-patients' movement patterns during standardized video recordings may increase diagnostic yield, improve accuracy and optimize therapeutic interventions. Previously, we showed that manual annotations of structured behavioral observations may vary depending on training background. We hypothesize that an algorithm for automatic skeleton generation can frame and standardize the annotation process. Using OpenPose, an automatic skeleton generation system, we developed the first analysis algorithm to detect RLS-related movements.

Methods: OpenPose is a real-time automatic video-based skeleton extraction system, allowing frame-by-frame analysis. OpenPose was used to extract the 2D-coordinates of 25 body segments during 50 minutes of Suggested Clinical Immobilization Test (SCIT). We based our analysis on 20 velocity or magnitude thresholds; the head movement, as the most sensitive movement, was selected to analyze the performance. The precision (positive predictive value) and recall-rates for the following three methods were calculated using six existing annotations:

(A) Movement detection by velocity. The velocity of body segments in each frame was computed using the difference of 2D-coordinates between the current and the next frame, smoothed using a Butterworth filter. The detected movements are recorded when the velocity of segments exceeds velocity threshold.

(B) Movement detection by velocity using five-point stencil numerical differentiation. The velocity of body segments in each frame was computed using the difference of 2D-coordinates between the current and the next 4 frames. The detected movements are recorded when the velocity of segments exceeds velocity threshold.

(C) Movement detection by magnitudes. The magnitudes of the movements of each body segments in each frame were computed using the maximum of the difference of 2D-coordinates between the current frame and the next 30 frames. Movements are recorded only when the magnitude of segment motion exceeds magnitude threshold.

Results: The precision-recall curves for (A), (B), and (C) were analyzed on 20 velocity or magnitude thresholds. These curves illustrate the trade-off between precision and recall-rate. The area under the precision-recall curve (AUC) represents the level of performance of each algorithm: (A) 0.787, (B) 0.621, and (C) 0.817. In our setting during the SCIT (study subject sitting in a height appropriate chair), we have chosen 0.81 pixel/sec as the velocity threshold, 0.0 pixel/sec as the smoothed velocity threshold and 9 pixels as the magnitude threshold to achieve the highest precision-recall combination for the detection of nose-based head movements for specific annotation: (A) 87.5%; 98.8%; (B) 84.6%; 100.0%; (C) 90.7%; 98.8%.

Conclusions: The magnitude method achieved higher performance than both velocity methods to detect movements. The noise of both velocity methods is higher than of the magnitude method and does not perform with high precision. This noise may be caused by OpenPose itself, due to its pixilation and dithering between frames. The results of precision-recall curves are also affected by the accuracy of annotations. Refining the algorithms, based on expert consensus, is the next step in our research and will 'moderate' and/or 'frame' the clinical discussion as movements of interest (e.g., of the legs) and their

interaction (e.g., with body tension) can be identified automatically.

SCIT#1 VS. #2: FRAMING THE CLINICAL DISCUSSION WITH AN AUTOMATIC SKELETON GENERATION ALGORITHM

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Introduction: The Suggested Clinical Immobilization Test (SCIT) is an adaptation of the laboratory-based SIT allowing standardized observation of movements during clinical assessments, when the patient sits on a height-wise appropriate chair. The diagnostic application of standardized observations during SCIT vary depending on the professional´s training background. In this work, we review our clinical observation-based recognition concepts for the diagnosis of RLS with a skeleton generation algorithm.

Method: Software: OpenPose is a real-time, automated video-based skeleton extraction system (https://github.com/CMU-Perceptual-Computing-Lab/openpose). We extracted 2D-coordinates of 25 body segments during two subsequent SCITs. Movement detection: The magnitudes of the body segment movements were computed frame-by-frame using the maximum difference of 2D-coordinates between the current and next 30-frames. Movements were recorded when the magnitude of segment motion exceeded 2-pixels for sensitive body segments (e.g., nose, shoulders) and 5-pixels for other body segments. These two thresholds were selected based on our previous study on the analysis of automatic skeleton generation algorithm. Data Analysis: Using the algorithm, we analyzed whether the movements of one body part simultaneously influenced the movement of other body parts (< 3s) and calculated the proportion of simultaneous (within total) movements. Data Visualization: The movements in the adaptation and immobilization phases of the 1st and 2nd SCIT were computed. Frequency and duration of the movements of 25 body segments were compared. The two SCITs were divided in two phases: (1) adaptation and (2) immobilization.

Result: Two SCIT-video recordings of 15 participants were analyzed; only descriptive data from phases (1) and (2) are shown. Adaptation phases: SCIT#1 did not show any relationship between frequency and duration. SCIT#2 showed an inverse relationship between the frequency and duration of movements, from highest movement/shortest duration to smallest movement/longest duration: upper-/lower-legs, toes/feet, upper-/lower-arm, which also include the hand, torso, and head (determination coefficient: $R2 = 0.9857$). Immobilization phases: Frequency and duration of head movements were higher than the upper and lower body movements and did not change between SCIT#1 and #2. In SCIT#2, we also saw pattern cascades (highest to lowest effect): head movements affecting leg- more than arm-movements and vice versa, legs affecting head- more than arm-movements. Movements of the left arm most prominently influenced the head and equally the limbs. Movements of the right arm mainly influenced the legs, and less so, the head and left arm.

Conclusion: Clinical experience has demonstrated that two SCITs are necessary, with the first one acting as a trial-run. The computed data analysis of adaptation and immobilization phases confirms this clinical observation. Computed analysis of video recordings also revealed new insights, for example, the effects of leg movements on head movements and vice versa. At this stage of our research, we think that computed analysis offers a new perspective on well-known, but not further investigated movements and movement-cascades. Thus, computed analysis should support a second review of well-known but not

further investigated clinical observations, as novel inter-correlations may become apparent.

Restless Legs Syndrome (RLS)
Board #222 : Poster session 1
ARE THERE CORRELATION AMONG : RLS, IRON AND IL6 IN RUNNERS?

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Introduction: Restless Legs Syndrome (RLS) also called Willis-Ekbom disease occurs in 5-15% of general population around the World. In Brasilian population this syndrome affects 6.40% of people and 12,96 % of marathon runners. The pathophisiology appears to be linked to iron metabolism. Another studies focused in elevation of IL-6 in RLS. In this study is analized the levels of iron, ferritin and IL6 in marathon runners with RLS and marathon runners without RLS, to search a possible link among iron, IL-6 and RLS.

Materials and methods: Thirty five amateurs runners that run the Marathon (42.195m) of São Paulo were investigated. The International RLS Study Group (IRLSSG) criteria was applied to the atlhetes. Informations about kind of physical activities, time of activity, duration of phisical activity during the week and medical history. The inclusion criteria was to conclude the marathon run until 5h. One runner was excluded because finished the proof after five hours. Samples of blood were analized before, immediately after the marathon and 72h after the proof. Iron, ferritine and IL-6 were analized and compared.

Key words: restless legs syndrome, RLS, Willis-Ekbom disease, iron, IL-6, marathon runners.

Results: The researchers found 27.27% of runners that match the IRLSSG criteria for RLS. The analysis of Iron and ferritine didn't show statistical difference (Iron : RLS group : basal= 97,12 pos immediate= 109,63 after 72h = 86,71 ; No RLS group : basal= 94,68 pos immediate= 105 after 72h= 82,14). (Ferritine: RLS group : basal= 119,65 pos immediate= 148,19 after 72h= 139,41 ; No RLS group : basal= 104,5 pos immediate= 121 after 72h=121,36h). Plasma concentration of IL-6 showed a significant elevation immediately after the Marathon in RLS runners and didn't return to the basal levels after 72h (IL6 : RLS group: basal= 16,46 pos immediate=43,93 and after 72h= 52,95; No RLS group: basal=28,24 pos immediate=109,76 after 72h=15,53)

Conclusions: The running stimulates inflammatory and metabolic mecanism. This process is important for body reconstitution. Immediately after the high resistance aerobic exercise (marathon) the athletes with RLS, the IL-6 levels didn't decrease after 72h. The higher levels of IL6 could be linked to pathophysiology of RLS. More studies need to be done.

Restless Legs Syndrome (RLS)
Board #223 : Poster session 1

RLS IN HIGH-INTENSITY EXERCISE ATHLETES: BIOMARKER, IRON CICLE, LIFE QUALITY

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Abstract: Street runners rise in all world and specifically marathon has a lot of practitioners.The research shows that marathon runners have more prevalence of Restless Legs Syndrome, also called Ekbon Syndrome, around 12,96%, than in the general population in Brazil (6,40%) or in the world (5-15%).Why could the prevelance increase? What would they have different beyond the practice of high intensity exercise? Would they suffer with these symptons? All these interrogations give us forces to try understanding more about RLS.
Materials and methods: We studied 35 amateur athletes (M= 41.57 years,SD= 6.24)) who participated in marathon running(42.195m) and finished the proof until 5h.IL6, IL8, TNF, iron, ferritine were analized before the race (basal level), immediately after the marathon and 72h after the proof.International RLS Study Group(IRLSSG)criteria; questionary about RLS severity and life quality were applied.
Results: We found 12.96% of athletes met criteria of RLS based on IRLSSG. The basal level of IL-6 before the running =16,46; immediately after= 43,93 and after 72h =52,95 -RLS group.The control group - basal=28,24; immediately after=109,76 and after 72h=15,53.Plasma levels of IL-8 : basal=35,39; immediately after=151,26; 72h after=32,56 in RLS group ; no RLS group : basal=37,95; immediately after=82,70 and after 72h = 46,87 (p< 0.05).We had 1.5% of RLS athletes with iron < 50µg/dl and the other runners normal values. Iron RLS group : basal= 97,12 ; immediately after=109,63; after 72h= 86,71. Iron no RLS group : basal= 94,68; immediately after=105; after 72h= 82,14. Ferritine RLS group : basal=119,65; immediately after= 148,19; after 72h= 139,41. Ferritine no RLS group : basal= 104,5 immediately after= 121; after 72h= 121,36. TNF in RLS group: basal= 2,83 ; immediately after= 27,99; after 72h= 3,48 . TNF no RLS group : basal 8,47; immediately after= 32,18; after 72h= 5,62 . The quality of life was based on RLS severity also life quality questionary and the athletes demonstrated good results. The research showed in RLS runners, 28,57% runners had severe RLS while 57,14% had moderate RLS.The athletes refered symptom improvement with running in 71,43% of cases.
Conclusion: The study revealed an increase of the prevalence of RLS in high- intensity exercise athetes in this sample in Brazil. These marathoners showed elevation of IL-6 levels . In spite of the runners lost iron after the running, the most of them maintained nomal levels. The other biomarker didn't show diferences as well as iron and ferritine. It could be explained for trigger that phisical activity does in the IL-6. IL-6 is one of the responsible for restoration of body equilibrium when exposed to unbalance like a marathon or other high-intensity phisical activity. But the research showed that in RLS there are an unbalance. IL6 is elevated maybe trying to resolve this regulation. Then, more IL is released and delayed to reach the basal levels. Anyway IL 6 is altered in marathoners with RLS. Further studies must be done to the better understanding of this mechanism.

EVALUATION OF BRAIN IRON DEPOSITS IN RESTLESS LEGS SYNDROME: THE PROMISING ROLE OF TRANSCRANIAL SONOGRAPHY

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Introduction: Midbrain iron deposits (MID) play a fundamental role in the pathophysiology of restless legs syndrome (RLS), particularly those located in mesencephalic substantia nigra (SN). Previous studies have shown reduced iron levels in SN in RLS. Moreover, being intravenous iron one of the most effective therapies, predictors of response are needed. Transcranial sonography (TCS) has been postulated as an affordable and reliable neuroimaging tool to quantify brain iron deposits and thus predict clinical response.
We performed an investigation with the following objectives:
· To analyze whether systemic iron parameters (SIP) have a direct relation with MID as assessed by TCS.
· To analyze whether SN echogenicity changes as a result of intravenous iron therapy (IIT).
· To analyze whether baseline SN echogenicity could predict clinical response to IIT.
Materials and methods: The study was conducted as a prospective observational study in RLS patients (>18 years old). A blood test with SIP was obtained, consisting of total iron binding capacity (TIBC), serum ferritin, hemoglobin, transferrin saturation (TSAT), serum iron, and serum transferrin. TCS was performed over the SN, and the substantia nigra echogenity index (SNEI) was determined according to established methods. Symptom severity was evaluated periodically by means of the international restless legs scale (IRLS). A Spearman correlation and a t test were performed.
Results: A total of 117 patients were studied. Correlations between SNEI and SIP were as follows: TIBC (R=-0.1937;p=0.12), serum ferritin (R=0.0192; n.s.), hemoglobin (R=0.0791; n.s.), TSAT (R=0.0196; n.s.), serum iron (R=0.0202; n.s.), and serum transferrin (R=0.0095; n.s.).
A total of 36 patients received IIT. The sample was stratified into two groups (n=18 in each) according to the median SNEI obtained at baseline: SNEI < 0.186 cm2 (severely hypoechogenic group, sHE) and SNEI ≥0.186 cm2 (severely hypoechogenic group, mHE). Increases in SNEI were 23% (x:0.038±0.0162cm2; p< 0.01) for sHE, in contrast to 3.6% (x:0.008±0.057cm2; p=n.s.) for mHE.
The average reduction in IRLS scale score was 8.75±6.45 points (p< 0.01) for sHE and 2.1±8.51points (p=n.s.) for mHE.
Conclusions: SNEI values increased reflecting an improvement in brain iron as a result of IIT. The increase in SNEI was more prominent in patients with lower SNEI, reflecting a greater absorption of iron in the brain in patients with lower iron deposits at baseline. Clinical improvement following IIT was also greater in this subgroup.
Serum iron parameters are not correlated to SNEI values and do not predict clinical response to IIT.
TCS is a useful tool for determining MID in RLS, and thus for identifying which patients could benefit most from IIT.

ANNOTATION OF RLS VIDEO RECORDINGS DURING THE SUGGESTED CLINICAL IMMOBILIZATION TEST – METHODOLOGY DEVELOPMENT

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Introduction: Restless legs syndrome (RLS) is a neurological sensorimotor disorder characterized by discomfort causing an urge-to-move (mainly) of the limbs that worsens during periods of rest. The suggested clinical immobilization test (SCIT) has been developed for application in clinical practice as an adaptation of the lab-based suggested immobilization test (CNS Neuroscience & Therapeutics, 2016; 11:894-905). During the SCIT, participants are asked to sit still and relax on a height–wise appropriate chair, barefooted, with both feet on the floor for a maximum of 5 minutes. Typically, visible and perceived tension suppresses movement patterns and triggers RLS-related discomfort from participant descriptions. Our current research investigates how to annotate SCIT-videos in the best way for developing a machine learning algorithm. Previous work analyzing SCIT-snapshots with two body posture categories (+6 subcategories) and seven descriptive movement categories (+45 subcategories) has shown inter-rater consistency (ICC) rates between 0.823-0.895 for movements, but 0.588 for tension described per posture. As a next step, we investigated defining tension per posture via a simplified annotation concept using only three descriptive main-categories: to what degree the observed participant shows whole, isolated and/or communicative body movements; absence of these was associated with periods of interest for investigating reduced tension.

Materials and methods: (A) Two research assistants (RAs) collaboratively annotated head, upper/lower limb and torso movements in 40 SCIT snapshots derived from video-recordings. The camera was positioned facing the sitting participant at eye level. For visualizing subtle, passive movements affecting torso posture, shoulders and hips of the participants during the SCIT were marked. A third RA, after an hour's training, reviewed the same data set; ICC of movement categories and characteristics were investigated with Cohen's Kappa coefficient. (B) The isolated and communicative dataset was further reviewed for movement characteristics by four experts (two neurologists; one kinesiologist; one psychologist/methodologist); disagreements and discrepancies were analyzed.

Results: (A) Movement categories, Cohen's Kappa for whole body: 0.847; isolated body: 0.889; communicative 0.917. Movement characteristics, Cohen's Kappa for head: 1; upper limb: 1; lower limb: 0.98; torso; 0.556. (B) Expert review revealed high agreement in movement descriptions (agreed: 92%; unsure: 0; disagree: 8%) and low for tension (44%; unsure: 28%; disagree: 28%).

Conclusions: Similar to our first annotation concept, which required a large time commitment, with a very simplified annotation concept, we yielded high agreement for movements and low agreement for tension. The description of tension (periods) was affected

by low agreement on torso movements, despite marking shoulders and hips for visualizing torso postures reflective of tension. These findings may be affected by the camera position, reducing depth-dimension in snapshots, which in real life is corrected by our seeing-experience. Changing the camera position and developing an algorithm for automatic skeleton generation to visualize torso posture is the next step in our research. This annotation concept may allow for a feasible method of creating the first big data set of behavioural annotations.

REVIEW OF IRON DEFICIENCY GUIDELINES IN THE CONTEXT OF IRON DEFICIENCY-RELATED SLEEP/WAKE BEHAVIOURS

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Introduction: Low stored iron levels characterize iron deficiency (ID). ID is the most common nutritional deficiency in the world, disproportionately affecting children and women. High level evidence is elucidating the role of iron and ID in restless legs syndrome (RLS) and attention-deficit hyperactivity disorder (ADHD), however, this is often overlooked in the clinical setting. The goals of this scoping literature review are to (1) review to what degree RLS and ADHD have been included in ID clinical guidelines; and (2) compare the biomarkers and cutoff values as they pertain to ID, RLS, and ADHD.
Materials and methods: A scoping literature review was conducted in June 2019 in PubMed (English, full text available online) using 3 separate search phrases without any date restrictions: (1) ID anemia AND (filter: guideline) (2) "RLS" AND guidelines AND consensus; (3) ADHD OR "attention deficit hyperactivity disorder" AND (filter: guideline); (4) additionally, North American and European websites of national medical affiliations were searched.
Results:
A. ID guidelines: n=14

   i.   As of 2015, 3/14 mentioned RLS & ADHD as comorbid conditions; 1/14 provided a serum ferritin cutoff value specific for RLS patients;
   ii. Main biomarker: serum ferritin, cutoff values varied between guidelines; 5/14 included CRP, as ferritin is an acute phase reactant.

B. RLS guidelines: n=12; main biomarker: serum ferritin, cutoff values changed over time with advancing knowledge; iron supplementation was identified as first line treatment.
C. ADHD guidelines: n=21; 2/21 included ID as a possible cause and supplementation as a treatment option.
Conclusions: Elemental iron is vital for numerous processes in the human body, including dopamine synthesis and myelination in the brain, and also as a central component of the oxygen-carrying molecule, hemoglobin. ID is a physiological state that *precedes* anemia, and is associated with restlessness affecting day- and nighttime behaviours. Thus, iron supplementation should be used as a first line measure to alleviate symptoms of restlessness associated conditions such as RLS and ADHD. To reflect the most recent emerging evidence, guidelines, biomarkers (depending on tier-service levels, e.g. primary, secondary, tertiary, quaternary care), cutoff values, and clinical best practice should be re-reviewed, and guidelines should be amended.

INCREASED GRAY MATTER DENSITY AND FUNCTIONAL CONNECTIVITY OF THE PONS ASSOCIATED WITH RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a sensorimotor disorder, although some studies suggested that it is related to central nervous system abnormalities, the mechanism underlying the RLS is still under debate. The purpose of this study was to uncover the pathologic location of restless legs syndrome (RLS) by exploring structural and functional alterations of the brainstem.

Materials and methods: Subregions of brainstem were segmented to explore the subregional alterations in gray matter density in a cohort of 20 drug-naive idiopathic RLS patients and 18 normal controls (NC). Furthermore, whole brain functional connectivity analyses, correlation analyses, and multivariate pattern analyses using linear support vector machine (SVM) were conducted.

Results: We found significantly increased gray matter density in 2 clusters of pons (pons_1 and pons_2) and 1 cluster in the midbrain in the RLS compared to NC group. Further functional connectivity analyses revealed significantly decreased functional connectivity between midbrain and right middle occipital gyrus (MOG), between pons_1 and right orbital part of superior frontal gyrus (OrbSFG), and between pons_2 and right parahippcampus (ParaHIPP) in the RLS compared to NC. Moreover, the functional connectivity between pons_2 and right supplementary motor area (SMA) was significantly increased in the RLS compared to NC, which was also marginally correlated with RS_RLS scores in the RLS. SVM-based classification achieved an AUC of 0.955 using gray matter density of pons_2, and functional connectivity between pons_2 and SMA as features.

Conclusions: The alterations of gray matter density and functional connectivity of pons imply that the pons might involving in pathologic process of RLS, which might have the potential to discriminate RLS patients from normal controls.

IL1B POLYMORPHISM IS ASSOCIATED WITH ESSENTIAL TREMOR BUT NOT RESTLESS LEGS SYNDROME IN CHINESE POPULATION

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Introduction: Our previous study find a possible *Map2k5/Skor1* haplotype risk shared by restless legs syndrome (RLS) and essential tremor (ET) in Chinese Population. However, this finding was not confirmed in a another large cohort of ET. The aim of the study was to investigate the genetic links between RLS and ET in other possible candidate genes.

Materials and methods: A total of 225 ET patients, 158 RLS patients (25 ET patients also had restless legs syndrome (RLS) and 229 controls were recruited. The diagnosis of RLS was based on revised International RLS Study Group diagnostic criteria and the diagnosis of ET was based on the Consensus Statement of the Movement Disorders Society on tremor. Polymerase chain reaction (PCR) and sequencing were used to detect 12 single nucleotide polymorphisms (SNPs) in seven candidate genes for RLS (*HMOX1, HMOX2, VDR, IL17A, IL1B, NOS1 and ADH1B).*

Results: Among 14 selected SNPs, the frequency of *IL1B* rs1143634C allelic variant was lower in RLS patients than controls. Moreover, after adjustment for age and sex, rs731236 of VDR were found associated with increased risk of RLS in the dominant model. However, none of those results survived Bonferroni correction. For ET, rs1143633 of *IL1B* (odds ratio [OR] =2.57, p=0.003, recessive model), and the statistical result remained significant after Bonferroni correction. We also performed a query in Genotype-tissue Expression (GTEx), Brain eQTL Almanac (Braineac) databases and Blood expression quantitative trait loci (eQTL) browser. The significant association was only found between genotype at rs1143633 and *IL1B* expression level of putamen and white matter in Braineac database, which was more prominent with homozygous (GG) carriers.

Conclusions: Our study did not find any shared genetic risks between RLS and ET. Although we reported the association of *IL1B* polymorphism with the risk of ET in Chinese population. However, this association might suggest a marker of *IL1B* SNP associated with ET instead of the casual variant. Further studies are needed to confirm our finding.

INITIAL CLINICAL RESULTS FROM THE COMPRESSION THERAPY FOR RESTLESS LEG SYNDROME *(REST)* STUDY: USE OF A NOVEL WEARABLE INTERMITTENT LEG COMPRESSION DEVICE FOR RLS

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Introduction: Intermittent pneumatic compression (IPC) has been shown in multiple studies, including a randomized, placebo-controlled trial, to result in clinically significant improvement in symptoms of Restless Leg Syndrome (RLS). The downside of current IPC systems includes several issues that are not conducive to nighttime use including bulky loud air compressors and uncomfortable stockings with tethered cords. A novel mechanical device (Cirvo®, Radial Medical Mountain View CA) for lower leg intermittent sequential compression was designed to address these limitations by providing intermittent compression in a wearable device that offers the additional benefit of quiet operation, monitoring and digital engagement of patients to improve compliance.

Materials and methods: Under IRB approval, 6 patients with diagnosis of RLS per Hopkins-Hening Diagnostic Questionnaire and International Restless Leg Syndrome Study Group Severity Scale (IRLSS) of greater than 15 were enrolled in the CompRESsion Therapy for Restless Leg Syndrome *(REST)* study. Patients were given the Cirvo® device that delivered 4 weeks of 4 different programs of intermittent compression that had variations in the timing and force of compression. Patients then choose their preferred program from an additional 4 weeks of therapy. All subjects were instructed to wear the device for a minimum of 1 hour before the typical onset of symptoms. IRLSS was assessed on a weekly basis. Validated Quality of Life (EQ-5D), Clinical Global Impression (CGI-I) and Sleep (MOS) scores are collected at 8 weeks.

Results: There were no adverse events using the Cirvo® device at home. The average baseline IRLSS score was 31. All patients who complied with the therapy showed initial improvements in IRLSS with an average score during the first 4 weeks of therapy of 17.8. Enrolled patients have not yet reached the 8-week mark for final IRLSS score, QOL or Sleep survey results.

Conclusions: Initial results of the *REST* study show clinically significant improvement in RLS with the use of a wearable intermittent leg compression device. The study will continue to enroll up to 30 patients and report future results of QOL, CGI-I and Sleep surveys in addition to IRLSS.

TREATMENT OF RESTLESS LEGS SYNDROME AT THE UNIVERSITY OF WASHINGTON

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Introduction: Restless legs syndrome (RLS) is a common neurological disorder. RLS is characterized by an often unpleasant or uncomfortable urge to move the legs that occurs during periods of inactivity, particularly in the evenings, and is transiently relieved by movement. It is associated with significant morbidity, and early recognition and management can have a profound impact on quality of life. RLS is likely under-diagnosed, and even in patients where it is diagnosed, treatment may be inadequate.

Material and methods: The Leaf research database was used to obtain retrospective data for all patients with diagnosis codes for restless leg syndrome (using ICD-9 333.94 and ICD-10 G25.81) in the database of University of Washington Medicine, a large health care system. The appropriateness of their pharmacological treatment was analyzed, including the use of treatments that could exacerbate RLS. Sub-analysis for medication orders was performed.

Results: Restless leg syndrome was diagnosed in n=12,192 patients. We measured the rate of prescription of medications with higher level of evidence, which represent the first-line treatment for RLS: pramipexole (10.5%, n=1,283), ropinirole (8.9%, n=1,091), and rotigotine (0.22%, n=27). We discovered no patients who were prescribed intravenous iron, despite the fact that this is an indicated treatment. We also measured the rate of prescription of medications which are commonly used in clinical practice, namely levodopa (3.2%, n=386), gabapentin (24.3%, n=2,961), and pregabalin (3.9%, n=482).
We also analyzed medications with a low level of evidence: carbamazepine (0.9%, n=110), clonazepam (5.6%, n=684), tramadol (7.5%, n=916), oxycodone (16.9%, n=2,056), ferrous sulfate (2.8%, n=342), and other oral iron (16.0%, n=1,951). A significant proportion of patients were prescribed opioids (62.2%, n=7,589). Finally, we measured the use of SSRIs (23.6%, n=2,876) and SNRIs (10.8%, n=1,318) which may worsen RLS symptoms.

Conclusions: The dopaminergic medications with higher level of evidence were only used only in a small percentage of patients (18.4%). Gabapentinoids were also prescribed in a minority of patients (25.8%). A large proportion of patients were prescribed opioids (62.2%), which may not be the optimal treatment. Some patients were prescribed SSRIs and SNRIs, which can worsen symptoms of restless legs syndrome. This analysis shows that there are many opportunities for improvement in the management of patients with RLS.

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COMORBIDITIES OF PATIENTS WITH RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a common neurological disorder that is likely under-diagnosed. RLS is characterized by an often unpleasant or uncomfortable urge to move the legs that occurs during periods of inactivity, particularly in the evenings, and is transiently relieved by movement. It is associated with significant morbidity, and early recognition and management can have a profound impact on quality of life.

Materials and methods: The Leaf research database was used to obtain retrospective data for all patients with ICD-9 or ICD-10 code diagnosis for restless leg syndrome (using ICD-9 333.94 and ICD-10 G25.81) at the University of Washington Medicine, a large health care system providing healthcare for WWAMI states that include Washington, Wyoming, Alaska, Montana and Idaho. Demographics, employment and insurance were analyzed in this patient population.

Sub-analysis for comorbidities was performed.

Results: Restless leg patients (N=12,192) had female predominance with 63.5% (N=7,747) female patients. A slight majority of the patients were younger than 65 years old, 53.65% (n=6,541). Psychiatric comorbid conditions included depressive disorders (47.9%), anxiety disorders (22.7%), tobacco use disorders (15.6%), alcohol abuse (7.4%), opioid dependence (7.3%) and cannabis use (4.8%). Other comorbidities we looked at included hypertension (55.2%), insomnia (35.8%), diabetes (25%), and migraine (15.7%).

Of note, 27% of RLS patients had commercial insurance. 22% were fully employed; 27.8% were unemployed and 31.7 % were retired.

Conclusions: Patients diagnosed with restless leg syndrome have a significant co-morbidity burden, high rates of depression anxiety, and substance use disorders.

We found also high comorbidity of hypertension, insomnia, diabetes and migraine.

Pathophysiological concepts of comorbidities have yet to be identified.

RLS patients have a lower rate of employment compared to the general population, demonstrating the functional impact of the disorder or its comorbidities.

PHARMACOTHERAPY OF PATIENTS WITH RESTLESS LEGS SYNDROME WITH AND WITHOUT PSYCHIATRIC COMORBIDITIES

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Introduction: Restless legs syndrome (RLS) is a common neurological disorder. RLS is characterized by an often unpleasant or uncomfortable urge to move the legs that occurs during periods of inactivity, particularly in the evenings, and is transiently relieved by movement. These symptoms worsen quality of life of patients. RLS can be a source of distress in patients, often mimicking depression. Comorbidity between RLS and depression is known and results of recent studies indicate up to twofold increased of RLS with depression compared to controls. However, many medications which are used for the treatment of depression can worsen RLS. Therefore, pharmacotherapy for patients with both RLS and depression must be considered carefully.

Materials and methods: The Leaf research database was used to obtain retrospective data for all patients with ICD-9 or ICD-10 code diagnosis for restless leg syndrome (using ICD 9 - 333.94 and ICD 10 G25.81) at University of Washington Medicine. The relationship between psychiatric comorbidities of RLS and treatments for these conditions was analyzed. Sub-analysis for medication orders was performed with respect to psychiatric comorbidities of depression, anxiety, bipolar, and somatoform disorders using ICD-9 and ICD-10 codes.

Results: Of patients with both RLS and depression (n = 5842), antidepressants were prescribed in 81.0% (n = 4733), opioids in 73.3% (n = 4284), oxycodone in 19.4% (n = 1133), gabapentin in 32.3% (n = 1884), SSRIs in 42.5% (n = 2481), SNRIs in 18.9% (n = 1103), bupropion in 17% (n = 1,074), venlafaxine in 9.9% (n = 579), sertraline in 14.6% (n = 854), fluoxetine in 11.3% (n = 662), amitriptyline in 6.1% (n=359), trazodone in 17.4% (n=1015), nefazodone in 0.4% (n = 26), and mirtazapine in 7% (n = 403). Of patients with RLS but without depression (n = 6350), antidepressants were prescribed in 31.4% (n = 1997), opioids were prescribed in 52.1% (n = 3306), oxycodone in 7.65% (n = 486), gabapentin in 16.8% (n=1068), SSRIs in 6.22% (n = 395), SNRIs in 3.39% (n = 215), bupropion in 1.4% (n = 86), venlafaxine in 1.2% (n = 78), sertraline in 1.9% (n = 125), fluoxetine in 1.2% (n = 76), amitriptyline in 2.6% (n = 162), trazodone in 6.1% (n = 385), nefazodone in 0.05% (n = 3), and mirtazapine in 1.1% (n = 70).

Conclusions: Antidepressants and opioids were the two most commonly prescribed medication groups in patients with RLS. Many patients were prescribed SSRIs and SNRIs, which can worsen symptoms of restless legs syndrome. In patients who had comorbid depression, 81% were prescribed antidepressants and 73% opioids. Only 17% of patients were prescribed bupropion, an antidepressant appears not appear to aggravate RLS because of a different mechanism of action. Antidepressants were prescribed fairly commonly in RLS patients without depression, though these medications can worsen RLS symptoms and lead to lower quality of life in these patients. This analysis shows that there are many opportunities for improvement in the management of patients with RLS and psychiatric comorbidities, such as the use of bupropion.

RLS WITH PLMS IN A CHILD WITH HEMOLYTIC ANEMIA CAUSED BY PYRUVATE KINASE DEFICIENCY

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Introduction: Pyruvate kinase deficiency is the second most common cause of enzyme-deficient hemolytic anemia, following G6PD deficiency. The prevalence of the disease is around 51 cases per million. We report an interesting case in a child affected with RLS-PLMS no previously described in the literature.

Materials and methods: Case report: An eight years old girl was referred to our Sleep Unit because excessive daytime sleepiness and snoring and restless sleep. She presented isolate episodes of somnambulism. She complained about unpleasant sensations in the legs such us laying down, restlessness of the legs at night, in addition to attention deficits and poor school performance.

Past medical history, she was born at 35 weeks of GA, birth weight 3.250 gr. At the age of 15 days, was admitted because a cardiorespiratory arrest and hyperbilirubinemia and an exchange transfusion was performed. The psychomotor developments were normal. She was diagnosed as having hemolytic anemia due to pyruvate kinase deficiency at 7 years of age. Neurological and neuropsychological assessments, repeated video-polysomnography, sustained immobilization tests (SIT), and extended laboratory testing for anemia were perform.

Results: Anthropometric measurements: weight 30.6 Kg, height 130 cm, BMI 18 kg/m2. The Pediatric Daytime Sleepiness Scale (PDSS) was 22. The neurological examination was normal. A video-PSG recording showed a disrupted and fragmented sleep with a prolonged sleep latency (56 min) a reduction of REM sleep (9.6%), elevated WASO (51 min), and a reduced sleep efficiency index (88%); PLMS index 33.4/h. Respiration was normal, mean SaO2= 95 %. Continuous body movements and postural changes were recorded as well as a mild bruxism. The 30 min SIT - before PSG - showed continuous PLMS and legs discomfort. A neuropsychological assessment showed an impairment in executive functions, normal verbal and visual memories, and sustained attention difficulties with hyperactivity and impulsivity, without behavioral alterations.

Laboratory tests. Erythrocyte count 3.36 10E6 µg/L, hemoglobin 10.9 g/dl, serum iron 91 µg/dl, ferritin 236 µg/L, transferrin 182 mg/dl ,transferrin saturation index 39% and soluble transferrin receptor 20 mg/L. Vitamin B12 323 µg/L; folate 11.7 µg/L and bilirubin 3.2 mg/dl.

Ultrasound examination of the abdomen was normal. A 1.5 Teslas brain MRI was within the normal limits.

She was treated with sustained release methylphenidate 37 mg/d, Folic Acid and vitamin D3. One year later, a new v-PSG showed an improved sleep efficiency (96%), with a lower sleep latency (35 min), PLMs index 11.6/h and WASO (13 min).

RLS was subjectively ameliorated as well as well as the ADHD with an improvement in school skills.

Conclusions: RLS with PLMS was associated with anaemia and high values of serum ferritin and soluble transferrin receptor.

MRI and other brain iron measures have limited sensitivity because of the lack of information in childhood anemias in general. A 3T MRI would allow quantifying the brain iron content in several structures, but unfortunately, it is not available in our center.

NOVEL BIOMARKERS FOR RESTLESS LEGS SYNDROME BY PROTEOMIC ANALYSIS

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Introduction: The diagnosis of restless legs syndrome (RLS) is based on clinical findings, and there is no definite consequences of pathogenesis in RLS. The aim of the study was to identify a diagnostic biomarker and provide new insight into the underlying pathomechanisms for RLS by using serum proteomic analysis.

Materials and methods: Drug naïve idiopathic RLS patients were recruited at neurology outpatient clinic in CHA university hospital from June 2017 to February 2018. Patients were examined by PSG, and RLS severity with subjective sleep quality was assessed. We obtained overnight fasting serum samples from drug naïve idiopathic RLS patients (n=7) and healthy sex-and - age matched controls (n=6). We examined hemoglobin, BUN, Creatinine, AST, ALT, ferritin, iron, TIBC, CRP, vitamin D levels and proteins were identified thorough matrix-assisted laser desorption/ionization-time-of-flight mass spectrometry (MALDI-TOF-MS) and nano LC-MS/MS proteomic analysis.

Results: Seven RLS patients were all women (median age: 39[34-46] years), and they had moderate to severe RLS (median IRLS 27[range, 20-33]). We identified 35 proteins, of which displayed significantly altered expression level in patients with RLS as compared to controls. Alph-2 macroglobulin precursor and complement component C4A were down regulation, and complement C3, Beta-2-glycoprotein I apolipoprotein H and PK-120 precusor were overexpression significantly in more than four of 7 patients.

Conclusions: We identified in blood a group of proteins with altered expression in patients with RLS that may provide diagnostic biomarker. Altered protein profiles indicated that immunity, inflammation, complement play a role in RLS pathophysiology.

MULTIMODAL MRI REVEALS ALTERATIONS OF SENSORIMOTOR CIRCUITS IN RESTLESS LEGS SYNDROME

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Introduction: Integrated information on brain microstructural integrity and iron storage and its impact on the morphometric profile is not available in restless legs syndrome (RLS). We applied multimodal MRI including diffusion tensor imaging, the transverse relaxation rate (R2*), a marker for iron storage, as well as grey and white matter volume measures to characterize RLS related MRI signal distribution patterns and to analyze their associations with clinical parameters.
Methods: Eighty-seven patients with RLS (mean age 51, range 20-72, years; disease duration, mean 13 years, range 1-46 years, of those untreated n=30) and 87 healthy control subjects, individually matched for age and gender, were investigated with multimodal 3T-MRI.
Results: Volume of the white matter compartment adjacent to the post and precentral cortex and fractional anisotropy of the frontopontine tract were both significantly reduced in RLS compared to healthy controls, and these alterations were associated with disease duration (r=0.25, p=0.025 and r=0.23, p=0.037, respectively). Corresponding, grey matter volume increases of the right primary motor cortex in RLS (p< 0.001), were negatively correlated with the right fractional anisotropy signal of the frontopontine tract (r=-0.22; p< 0.05). Iron content evaluated with R2* was reduced in the putamen as well as in temporal and occipital compartments of the RLS cohort compared to the control group (p< 0.01).
Conclusions: Multimodal MRI identified progressing white matter decline of key somatosensory circuits that may underlie the perception of sensory leg discomfort. Increases of grey matter volume of the premotor cortex are likely to be a consequence of functional neuronal reorganization.

EFFECT OF AEROBIC EXERCISE AND YOGASANA PROGRAM ON PERIPHERAL NEUROPATHY PATIENTS WITH RESTLESS LEG SYNDROME

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Introduction: RLS is a hardly studied, probably under-diagnosed condition in India. The exact prevalence of restless legs syndrome in India is not known as not much literature available on restless legs syndrome from India. RLS is even more common in individuals with peripheral neuropathy iron deficiency, pregnancy and end-stage renal disease. There is a very limited study about non pharmacological management of this disorder. It is very important to find an adjunct therapy.

Materials and methods: In this study there 60 patients of age group 40 to 60 years were drawn by purposive random sampling methods. The patients were diabetic neuropathy with restless leg syndrome were selected and screened by National Institute of Health criteria for Restless leg syndrome. They are divided into two groups, group A and group B. Group A as control group were given pharmacological treatment only. Group B as experimental group were given pharmacological therapy along with aerobic exercises and yogasana program. The patients were assessed with restless leg syndrome questionnaire, fatigue severity scale, perceived stress scale before the test and after the test.

In aerobic exercise program based on Vo2 max (100 age in years) have been administered for calculation of maximum heart rate. Low intensity exercises of 40-60% of their age predicted maximum heart rate is given to the patient (5 min warm up, 20 min-walking and 5 min-relaxation exercises). Aerobic exercise programme given 3 days per week (Monday, Wednesday and Friday) for a period of 12 weeks.

— Yogasana programme given 30 minutes per day, 3 days per week (Tuesday, Thursday and Saturday) for 12 weeks (5 min warm up, 15 min- asana, 5-pranayama, 5 min-savasana).The patients were assessed with Nottingham sensory assessment scale, restless leg syndrome questionnaire, fatigue severity scale, perceived stress scale before the test and after the test. The collected raw data are analyzed by ANACOVA. All the data were analyzed in the computer using "SPSS" statistical package. The level of Confidence was fixed at 0.001 level of significance.

Results:

— In RLS Questionnaire the post test means of Group B 11.10 and Group A 20.27 resulted in an `F' ratio of 86.10 which indicates there was statistically significant difference between both groups.

— In stress the The post test means of Group B 14.80 and Group A 21.40 resulted in an `F' ratio of 93.80 which indicates there was statistically significant difference between both groups

— In Fatigue, the post test means of Group B 26.66 and Group A 40.73 resulted in an `F' ratio of 94.66 which indicates there was statistically significant difference between both groups

Conclutions:

1. The treatment with aerobic exercise and yogasana program to patients had showed that there is a significant effect in reducing abnormal restless leg syndrome symptoms.

2. It was concluded that the aerobic exercise and yogasana program had showed significant effect in reducing psychological variables such as fatigue and stress among the experimental group when compared with the control group.

Acknowledgements: I thank Dr.Nagoba Assistant Dean, MIMSR Medical college latur

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THE STUDY OF DYNAMIC CEREBRAL AUTOREGULATION IN PATIENTS WITH RESTLESS LEGS SYNDROME

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Objective:
To explore the dynamic cerebral autoregulation in patients with restless legs syndrome, and to find the potential therapeutic target for improving neurological symptoms of patients. In order to identify early and intervene the influencing factors in time, so as to improve the quality of patients'life .

Methods:
In this study, we selected 48 RLS patients who underwent video polysomnography from June 2017 to December 2018 in the Department of Neurology, First Hospital of Jilin University. According to the IRLS scale, the patients were divided into mild RLS group, moderate RLS group, severe RLS group and extremely severe RLS group. And we chosed 12 healthy volunteers matched in age, sex and other aspects, who cooperated with and informed consent during the whole process of the study as the control group.We used video polysomnography to analyze the sleep structure, leg movement index and awakening index of patients.TCD and continuous fingertip blood pressure monitor were used to synchronously record bilateral middle cerebral artery blood flow velocity (CBFV) and arterial blood pressure (ABP) for 10 minutes.We usedtransfer function analysis (TFA) to derive the parameters of dynamic cerebral blood flow automatic regulation: gain, phase difference (PD), correlation function, and then to evaluate the changes of dynamic cerebral autoregulation in patientsrestless legs syndrome.

Results:
Compared with the control group, the left and right phase differences in moderate RLS group, severe RLS group and extremely severe RLS group were significantly decreased (P < 0.05), suggesting that the function of dCA was impaired.The left and right phase differences after 1 month of treatment were significantly different from those before treatment.The sleep structure characteristics of different groups showed that there were significant differences in total sleep time, N1%, N3%, REM%, sleep efficiency, awakening index and leg movement index.The relationship between clinical factors and dCA parameters was analyzed by univariate regression model. It was found that total sleep time, sleep efficiency, awakening index and leg movement index were correlated with phase difference impairment.

Conclusion:
Thedynamic cerebral autoregulation was impaired in moderate, severe and extremely severe RLS patients. The dCA function of RLS patients was improved after treatment.The sleep structure of RLS patients was disordered.The sleep structure of RLS patients is disordered, they was characterized by reduced total sleep time, low sleep efficiency, increased legs movement index and awakening index.The more serious the restless leg symptoms, the more obvious the change of sleep structure.

TRANSCREAL SONOGRAPHY AS A NOVEL NEUROIMAGING TOOL TO DETERMINE BRAIN IRON DEFICIENCY IN RESTLESS LEGS SYNDROME: RESULTS IN A CHILEAN SAMPLE

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Introduction: Brain iron deficiency (BID) is considered to play a key pathophysiological role in Restless Legs Syndrome (RLS). However, to this date, no simple, direct methods exist to evaluate BID in humans. Moreover, systemic iron deficiency, as measured by various serologic parameters such as serum ferritin or transferrin saturation (Tsat), does not provide a reliable marker of BID.
Transcraneal sonography (TCS) has been postulated as an affordable and reliable neuroimaging method to quantify BID, particularly in the Substantia Nigra (SN).
The objective of this study was to investigate whether the SN echogenicity indices (SNEI), correlate with RLS symptom severity and with serum markers of iron deficiency.
Materials and methods: We performed a descriptive study in a sample of 16 consecutive adult subjects diagnosed with RLS from our center in Santiago de Chile. Subjects underwent TCS to obtain the SNEI, serum iron markers (ferritin, iron, transferrin, transferrin saturation, total iron binding capacity (TIBC), and hemoglobin). RLS severity was measured by means of the IRLS scale and a multiple suggested immobilization test (mSIT). We excluded from the study patients with alterations in iron metabolism (such hemochromatosis or chronic inflammatory processes) and patients in whom TCS couldn´t be performed for technical/anatomical reasons. Analysis was performed by Pearson correlation R. Given the pilot nature of this study, we considered clinically significant values of $p < 0,1$.
Results:
- Higher SNEI scores showed a trend towards correlation with lower severity of RLS symptoms as measured by both mSIT (R: -0,3, p< 0,09) and IRLS scale (R: - 0,46, p< 0,1).
- In contrast, none of the serological iron parameters correlated with symptom severity (n.s.).
- Neither did any of the serological iron parameters correlate with TCS.
Conclusions: Despite the lower number of subjects, our study showed in a Chilean sample that TCS results are correlated with symptom severity, and probably reflects low BID scores in the SN. In contrast, serum iron parameters are of little value to determine BID.
Our study underscores the need to develop neuroimaging tools further, such as TCS, to better investigate the pathophysiology of RLS but also to identify which patients might benefit from iron treatment.

CRANIOFACIAL MORPHOLOGY IN OSA PATIENTS TREATED BY ORAL APPLIANCE WITH AND WITHOUT SUFFICIENT EFFECTS

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Introduction: Better understanding of therapeutic efficacy of the oral appliance (OA) for obstructive sleep apnea (OSA) patients is essential to medical and dental clinicians. The aim of this study is to identify morphologic features of craniofacial skeleton in OA-treated OSA patients with and without sufficient effects.

Materials and methods: Eight men and four women OSA patients (age: 58.7 ± 13.0 years old, BMI: 24.3 ± 2.3) diagnosed by polysomnography or unattended portable sleep-monitoring devices were enrolled in this retrospective study. All patients were diagnosed as having mild to severe OSA by medical clinicians and underwent OA therapy by dentists. The median of apnea-hypopnea index (AHI) or respiratory event index (REI) was 29.6 (interquartile range (IQR): 17.4). OA was fabricated according to the previous studies (Journal of Oral Health and Biosciences, 2015 and 2019). One dental clinician evaluated patients' oral conditions and sleep habits and complains by clinical interview and examinations. REI was measured during sleep with wearing OA after around 4-month treatment with OA. OSA patients were divided into two groups according to the cutoff point of REI as a cutoff value of mild and moderate-severe OSA. Effective and non-effective groups (EFF and NEFF) were defined according to the cutoff REI of 15 (Auris Nasus Larynx, 2009). On the lateral cephalograms taken without OA wear, the z scores for liner and angular measurements were calculated and compared between the two groups by Mann-Whitney U test.

Results: NEFF group consisted of five men and two women and EFF group was three men and two women. The median of BMI and age were not significantly different between NEFF and EFF groups ($P = 0.15$ and $P = 0.64$, respectively). Furthermore, the median of apnea-hypopnea index or REI before fabrication of OA had no significant difference between NEFF (median: 35.7, IQR: 16.3) and EFF (median: 25.6, IQR: 27.7) groups ($P = 0.27$). However, the inclination of upper incisor against Frankfurt horizontal plane had significantly higher value in NEFF group (median: 0.66, IQR: 0.89) than in EFF group (median: -1.26, IQR: 2.12) ($P = 0.02$). Meanwhile, the interincisal angle had significantly smaller value in NEFF group (median: -0.83, IQR: 1.50) than in EFF group (median: 0.35, IQR: 2.51) ($P = 0.05$). There were no significant differences between the two groups in other cephalometric measurements.

Conclusion: This study suggests that the inclination of upper incisor against Frankfurt horizontal plane or interincisal angle were possibly available to estimate the effective of OA therapy on OSA. This means that when both upper and lower incisors are significantly inclined lingually, OA therapy might probably aid the recovery on OSA.

Sleep Breathing Disorders
Board #236 : Poster session 1
RADIOFREQUENCY THERMOABLATION FOR SNORING TREATMENT

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Introduction: Snoring is a long breathing sound when inhaling during sleep that is displayed with varying degrees of intensity and frequency. Snoring raises many social and everyday problems. Treatment includes medical and surgical procedures. There are some surgical procedures rarely performed due to their complications and limitations. In current study, we delivered radiofrequency thermoablation in three patients for treating snoring.
Materials and methods: The research was performed by a nonrandomized prospective quasi-experimental method. Twenty outpatients with complaints of snoring underwent tests for inclusion criteria. After taking demographic history of the patients, the snoring scale Visual analogue scale with 10 points based on the comment of the spouse or the roommate were documented. Furthermore, Epworth Sleepiness Scale was assessed for each participant. Each patient underwent overnight polysomnography. The intensity of snoring upon overnight polysomnography and other data was documented. If the Epworth Sleepiness Scale showed mild to moderate rate of sleep apnea (11-15), the choice of radiofrequency ablation therapy was described for the patients. Three individuals who fulfill the inclusion criteria entered the study after obtaining the written informed consents. Over one session treatment, nasal drug-induced sleep endoscopy (DISE) was applied to determine snoring severity and presume site of obstruction. Thermoplasty probe was introduced at the site of nasal conjunction to nasopharyngeal and 10 seconds of 65 w radiofrequency energy were applied at the kissing shaped sites for four times. No repeated procedure was carried out on any of the participants (Figure 1).
Results: The mean age of the patients was 47 (SD=10.7) years, with a range of 25-65 years, 66.6% were men, and the mean body mass index was 29 (SD=4.5). The mean snoring score was significantly improved from 17.39 (SD=3.02) to 11.50 (SD=6.46) (p< 0.005). The mean drowsiness score was also significantly reduced from 6.8 (SD=6.9) to 3.93 (SD=4.19) (p< 0.005). No persistent negative impact was observed in speech or swallowing. Pain and bleeding were limited. After seven weeks of treatment, all spouses reported significant improvement of snoring in patients after one stage of treatment (p = 0.004). Remarkable quality of life improvement was reported in patients. No post-procedure complication such as ulceration and fistula formation were reported after radiofrequency thermoablation.
Conclusions: Radiofrequency thermoablation as a minimally invasive method, due to tolerability and lack of pain and the ability to perform this procedure under local anesthetic is considered an outstanding and cost-effective technique for snoring treatment on outpatients.

Sleep Breathing Disorders
Board #238 : Poster session 3
GENDER DIFFERENCES IN PATIENTS WITH DEPRESSION AND OBSTRUCTIVE SLEEP APNEA

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Introduction: While sleep apnea is frequent in men, depression occurs more frequently in women. Women and men with obstructive sleep apnea syndrome (OSAS, AHI>10/h) and comorbid affective disorder complain about different symptoms.

Materials and methods: 211 patients of a sleep center (95 female; 116 male; mean age 58 y. (f) and 52 y. (m)) suffering from major depressive disorder (F32.x; F33.x) underwent routine assessment with psychometric tests (WHO-5, BDI, MADRS) and ssubsequent psychiatric examination. Subjects with AHI >10 (determined by polysomnography) were included for data analysis. All patients completed the ESS questionnaire and a sleep diary. We analyzed the associations between gender, comorbid diagnosis and test scores using descriptive statistics, regression analysis and backward regression analysis.

Results: ESS scores were significantly higher in males and more strongly associated with obesity. In females, ESS scores were negatively associated with the presence of insomnia disorder. There were no gender differences particularly with regard to comorbid diseases, smoking and the use of psychopharmacologic drugs.

Conclusions:
Male patients with OSA and MDD reported significantly higher ESS scores.
Females more frequent complained about insomnia problems and depressed mood, carrying the risk of overlooking OSA in this group. Higher Age and higher bodyweight can contribute to the development of both disorders.
The underlying factors of the coexistence of OSAS and depressive symptoms are among others hypofrontality and a disturbed serotonin function.
Gender specific differences should be considered when diagnosing OSA in a sleep center as well as in a psychiatry in/outpatient setting.

Limitation:
There was neither a comparison with a control group nor a randomization.

EVEN IN CONSIDERATION OF AGE, BLOOD COAGULATION AND FIBRINOLYTIC MARKERS BECOME HIGHER DEPENDING ON THE SEVERITY IN OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Cerebrovascular disorder is likely to occur in patients with obstructive sleep apnea (OSA). The abnormalities of coagulation and fibrinolytic systems are considered as one of the reason, but there is no detailed study.
Materials and methods: We measured D-dimer (μg/ml), prothrombin-fragment1+2 (pmol/L), thrombin-antithrombin complex (ng/ml), plasmin- α2 plasmin inhibitor complex (μg/ml), thrombomodulin (FU/ml) and plasminogen activator inhibitor-1 (ng/ml) for 155 patients (60 ± 14 years, 71% male) who had no atrial fibrillation, normal renal function and did not take any anticoagulant agents. All patients were performed gold standard polysomnography. They were divided into 4 groups as Normal group (AHI<5), Mild group (5≦AHI<15), Moderate group (15≦AHI<30) and Severe group (30≦AHI).
Results: Compared with control, Fibrinogen, D-dimer, F1+2, and PIC were gradually increased as severity of SAS advanced, while TAT, PAI-1 and Thrombomodulin were similar among the 4 groups. Age-based covariance analysis among 4 groups classified by AHI also increased significantly according to OSAS severity. (Fibrinogen; P value<0.01, D-dimer; P value<0.05, F1+2; P value<0.01, PIC; P value<0.001 , respectively)
Conclusions: The abnormality of coagulation and fibrinolytic system might be involved with cerebrovascular disease in OSA.

DEVELOPMENT OF AN OBJECTIVE TOOL FOR PREDICTING OBSTRUCTIVE SLEEP APNEA AMONG ADULTS: PAN APNEA INDEX

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In this study, we considered only objective parameters to predict OSA which enhances reliability for diagnosis especially in occupational settings.

Introduction: Obstructive sleep apnea is an important health problem which is commonly under-diagnosed especially in the workplace settings. We tried to obtain one model with more objective variables because of greater reliability in occupational settings.

Materials and methods: A total of 374 patients who were suspicious to have obstructive sleep apnea (OSA) underwent polysomnography (PSG) for the first time from March 2017 to Jun 2018 in Baharloo sleep clinic, Tehran, Iran were enrolled in the study. Before PSG, all patients completed a questionnaire including demographic characteristics. Systolic and diastolic blood pressure was measured for all participants. Furthermore, a blood sample was collected for measuring fasting blood sugar and HbA1C. All the patients underwent full PSG. Respiratory Disturbance Index (RDI) was calculated and recorded for all patients.

Results: A total of 271 (72.5%) participants were male. Their mean age and BMI (body mass index) was 48.58 ± 13.04 years and $30.4\pm5kg/m2$, respectively. The prevalence of RDI ≥15 was 295 (78.87%). Using regression analysis, several models were obtained, where the best one yielded sensitivity and specificity of 78.31% and 67.09%, respectively. Area under cure of this model was 78%. The variables of this model included systolic blood pressure (SBP), age, Neck Height Ratio (NHR), FBS, BMI, and gender (PAN- apnea index) with a cutoff point ≥3 for high risk individuals.

Conclusions: In this study, we considered only objective parameters to predict OSA which enhances reliability for diagnosis especially in occupational settings.

SLEEP CHARACTERISTICS AND OBSTRUCTIVE SLEEP APNEA IN TYPE 2 DIABETES MELLITUS

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Introduction: The purpose of our study was to analyze sleep structures and obstructive sleep apnea (OSA), and clarify the association between sleep parameters and glycemic control.
Materials and methods: A total of 75 subjects were enrolled(men 32, women 43, mean aged 57.32±4.12), 25 type 2 diabetes mellitus group, 25 prediabetes group and 25 control group. All subjects performed laboratory test related to metabolism, including hemoglobin A1c and fasting glucose, and performed the nocturnal polysomnography to analyze the sleep parameters.
Results: Subjects with type 2 diabetes mellitus demonstrated a significantly decreased amount of slow wave sleep (SWS) (77.9±30.0min, p=0.026) and shortened REM sleep latency (median 75min, p=0.018) compared to prediabetes and control. 60% of our sample had OSA (apnea-hypopnea index [AHI] ≥5 /h). Prevalence of Moderate-to-sever OSA (AHI ≥15) was positively associated with type 2 diabetes and HbA1c level. In multivariate analysis, low HDL-C, presence of diabetes, high TG were independently associated with moderate-to-severe OSA (all p < 0.05). Univariate regression analyses showed that diabetes family history (β = 0.068, p=0.016), dyslipidemia (β = 0.196, p=0.000), Ln RBDSQ scores (β = 0.075, p=0.003), Ln SWS (β = -0.132, p=0.012), Ln mean O2 saturation (β = -2.659, p=0.027) were associated with Ln HbA1c.A multiple regression analysis showed that dyslipidemia (β = 0.162, p=0.000), Ln SWS (β = -0.134, p=0.02) were independently associated with Ln HbA1c.
Conclusions: Sleep health is modifiable risk factor that could improve glycemic control in type 2 diabetes. Our results suggest that subjects with type 2 diabetes mellitus with proper slow wave sleep time and early detection of sleep disorder such as obstructive, could help control glucose levels.

Sleep Breathing Disorders
Board #237 : Poster session 1
OBSTRUCTIVE SLEEP APNEA, SHORT SLEEP DURATION AND DRUG ADHERENCE IN PATIENTS WITH HYPERTENSION: THE ELSA-BRASIL STUDY

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Introduction: Hypertension (HTN) is the leading cause of cardiovascular mortality. One of the crucial steps for its successful treatment is the appropriate adherence to the anti-hypertensive therapy. It is conceivable that sleep disorders such as Obstructive Sleep Apnea (OSA) and Short Sleep Duration (SSD) may impair this adherence due to poor sleep quality and potential impact on cognitive performance but the evidence is scanty. The objective of the presente study was to evaluate the association between OSA and SSD with the adherence to antihypertensive treatment in civil servants from the ELSA-Brasil cohort study.
Materials and methods: Consecutive participants with a previous diagnosis of HTN under specific drug treatment performed clinical evaluation, home sleep monitoring (Embletta Gold™) for one night and wrist actigraphy (Actiwatch2™) for seven days to determine OSA and SSD, respectively. OSA was defined by an apnea-hypopnea index ≥15 events/hour. SSD was defined by a mean sleep duration < 6 hours. Adherence to therapy was evaluated by the 4-itens Morisky questionnaire. We defined poor/medium adherence by the presence of >0 score. We performed a logistic regression analysis to evaluate the predictors of poor/medium medication adherence in these participants.
Results: A total of 411 hypertensive participants were analyzed (mean age: 54±8 years, 47% men). Medium/low adherence to anti-hypertensive therapy were observed in 62%. Compared to the high adherence (score=0), the participants with medium/poor adherence had higher frequency of excessive daytime sleepiness (35.9 vs. 46.1%), lower frequency of high degree education (50.6 vs. 40%) and lower monthly per capita income ($1021.9 vs. $805.2). No differences were observed for OSA (50.6 vs. 47.5%) and SSD (24.4 vs. 29%). Logistic regression analysis showed that race other than whites (OR: 1.66;95% IC: 1.06-2.61), lower per capita income (OR: 1.76;95% IC: 1.05-2.94) and excessive daytime sleepiness (OR: 1.55;95% IC: 1.01-2.40) were the independent variables associated with medium/poor adherence to anti-hypertensive treatment.
Conclusions: In a large cohort of patients with HTN, non white race, lower economical status, escessive daytime sleepiness, but not OSA or SSD, were associated to impaired adherence to anti-hypertensive therapy.
Acknowledgements: The authors thank the research team of the ELSA-Brasil baseline study for their contribution, all participants included in this study, the ELSA-Brasil headquarters in Sao Paulo.

IS EPWORTH SLEEPINESS SCORE RELIABLE AS A SCREENING TOOL FOR OSA?

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Introduction: The Epworth Sleepiness Scale (ESS) is a widely used screening tool for evaluation for sleep apnea (OSA) and as a criteria for making decisions about CPAP therapy. However a significant proportion of patients with OSA are seen to have normal ESS scores. The purpose of this study was to evaluate the prevalence of normal ESS score in patients with a diagnosis of OSA and identify correlates of this phenotype.

Materials and methods: A retrospective evaluation on all patients referred to our sleep center and who underwent overnight polysomnography (PSG). OSA defined as a AHI of > 5. ESS score < 10 was considered normal, mild if 11-12, moderate 13-15 and high if >16.

Results: 526 patients were included - 241 M and 285 F. 51% of patients had a normal ESS (< 11), 13% of patients had mildly abnormal ESS, 15% of patients had a moderately severe and 21% had severe ESS each. Patients with OSA and normal ESS were older (56 +/- 13 years vs 52+/- 14) more likely female (63% were F vs 45%) with a lower BMI (35 +/- 8 vs 37 +/- 8). Patients with normal ESS had less severe OSA but mean values were still severe. (AHI 32 +/- 25 vs 43 +/- 30).

Conclusions: A normal ESS is seen in more than 50% of all patients with a positive diagnosis of OSA and thus is seen to be an unreliable predictor of OSA. Normal ESS tends to be seen with greater age, female gender, and lower BMI and these may be groups where use of ESS as a screening tool may yield a greater degree of false negative results.

NON-CONTACT DETECTION OF HEAD POSTURE DURING SLEEP

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Introduction: Obstructive sleep apnea (OSA) is a respiratory disorder characterized by the collapse of pharyngeal airway during sleep. About 10% of the population have OSA. The severity of OSA is often associated with sleeping in the supine position. Therefore, positional therapy that involves wearing items, such as backpack, to encourage sleeping in the lateral position, is a simple treatment for OSA. The current studies monitor the effects of supine posture of whole body (trunk) on sleep apnea severity. However, recent studies have shown that head position has more effect on sleep apnea severity than the trunk position.
The available approach to monitor the head position during sleep is to attach an accelerometer sensor to the head. However, attaching sensor to head is inconvenient during sleep and alters sleep conditions due to the addition of a physical device. Therefore, the goal of this study was to use a non-contact algorithm based on processing of infrared video to detect head position during sleep.
Materials and methods: Individuals referred for diagnosis of sleep apnea in the sleep laboratory of Toronto Rehabilitations Institute were recruited. Simultaneously with full polysomnography, infrared video of overnight sleep was recorded. The gold standard of the head position is manual annotation. Three machine learning approaches were used to detect head position during sleep. In the first method (presence features), Haar feature-based cascade classifiers were used to detect nine binary features: the presence/absence of left eye, right eye, both eyes, left ear, right ear, nose, mouth, frontal face, and side-view face. The second method (landmark features) used the 3D coordinates of 68 facial landmarks detected via the hourglass deep convolutional network.Landmark points were translated to place the nose tip at the origin and were normalized to the nose length. Extracted features from each method were used to train five different binary classifiers to detect supine versus lateral head positions. Classifiers used were linear support vector machine (SVM), radial basis function SVM, logistic regression, multi-layer perceptron, and random forest. In the third method, Convolutional Neural Network (CNN) structures (DarkNet19) was trained on the whole recorded images to predict head position during sleep.
Results: Fifty subjects, age: 53±15 years, BMI: 29±6 kg/m2, 30 men and 20 women, AHI: 25±29 event/hour, sleep duration: 5±1 hours, were included in this study. The presence features, landmark features were respectively estimated head position with 59.9% and 66.3% accuracy and 72.5% and 77.7% F1-Score. Both methods had poor performance in detecting the head position, as compared to the Darknet19 estimated head position with 88.3% accuracy and 91.3% F1-Score.
Conclusions: In this work, we developed a highly accurate algorithm that can automatically detect head position during sleep. The proposed method can be implemented in the real-time and provide robust position detection under realistic sleep environment (e.g. the use of blankets). The developed method can be used to monitor sleep positions overnight to provide feedback for positional therapy.

AN UPDATE ON THE ASSOCIATION BETWEEN PERIODONTAL DISEASE AND SLEEP-DISORDERED BREATHING

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Introduction: The aim of this systematic review was to update evidence answering four questions: 1) Is there an association between sleep-disordered breathing (SDB) and periodontitis? 2) Is there evidence of causality? 3) Is there a dose-response relationship between the two conditions? and 4) Is there evidence on efficacy of periodontitis interventions on the occurrence and/or severity of SDB?

Materials and methods: Six electronic databases were searched for articles until November 2018. Handsearching of reference lists and grey literature were also conducted. The inclusion criteria were adults diagnosed with SDB (confirmed through overnight polysomnographic studies) and periodontitis (based on the 2017 classification system of periodontal and peri-implant diseases and conditions), compared to subjects without SDB/periodontitis. Only prospective and retrospective longitudinal studies as well as epidemiological studies were considered. Two independent reviewers assessed articles for inclusion. Risk of bias was determined using the NIH quality assessment tools. PROSPERO registration number CRD42018118043.

Results: Out of 194 identified studies; only nine were included in this review. Five of the studies were cross-sectional in design and four were case-control. The samples sizes in the studies ranged from 52 to 29,284 subjects. All studies assessed the association between SDB and periodontitis and all but one reported significant association between the two conditions. Two studies additionally evaluated the dose-response relationship and reported negative findings. One study evaluated the efficacy of periodontal flap surgery on OSA severity and reported significantly attenuated odds for OSA. The risk of bias was low in one study and moderate in the rest.

Conclusion: There is fair evidence to support an association between SDB and periodontitis. Future studies are needed to further explore causation, potential dose-response relationships, and the efficacy of periodontitis interventions on SDB occurrence/severity.

THE ASSOCIATION BETWEEN TEMPOROMANDIBULAR JOINT DISORDERS AND SLEEP DISORDERS IN ADULTS: A SYSTEMATIC REVIEW

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Introduction: Due to the scarce and conflicting evidence that investigated the relationship between sleep disorders and temporomandibular disorder (TMD), the objective of this systematic review was to provide a comprehensive synthesis evaluating the relationship, if existent, between TMD and sleep disorders in adult subjects.
Materials and methods: PubMed, Embase, Evidence Based Medicine Reviews, and ProQuest Dissertations and Theses were searched for studies published in English until December 2017. Unpublished/grey literature and reference lists of identified articles were also examined. Inclusion criteria were male and female adults with established TMD diagnosisusing the RDC/TMD criteria, presence of a subjectively or objectively assessed sleep disorder, prospective/retrospective longitudinal study designs, as well as case-control, and cross-sectional studies. Methodological quality assessment was carried out by two independent authors using the National Heart, Lung, and Blood Institute quality assessment tools.
Results: Twenty-two studies (ten cross-sectional, ten case-control, and two prospective cohort) met the inclusion criteria. Sixteen studies were of fair quality, four were good, and two were poor quality. TMD was assessed in relation to sleep quality (SQ) in eight studies, sleep bruxism (SB) in seven studies, and obstructive sleep apnea (OSA) in two studies.
Conclusions: There is consistent fair evidence to support an association between TMD and SQ. Evidence is inconclusive on the relationship between TMD and SB and insufficient on TMD's link with OSA. This study highlights the need for higher-quality randomized controlled trials to clarify the association between TMD and sleep disorders.

SLEEPING HABITS IN STUDENTS FROM A MEDICAL SCHOOL IN PORTUGAL

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Introduction: For many students, the university is a critical transition time that is associated with an insufficient number of sleeping hours as well as poor sleep quality. Chronic sleep deprivation, in addition to being common among medical students, is comparatively more prevalent than in students from other areas. There are few studies in the literature about this subject, namely in Portugal, where there are no studies about sleep in medical students.
Our purpose was to characterize and compare the sleeping habits of medical students of a Medical School in Lisbon (Faculdade de Medicina de Lisboa) of every year during the academic year of 2016/2017.
Materials and methods: An anonymous, self-rating, non refundable online survey was created and emailed to all six years students of Faculdade de Medicina de Lisboa using an online platform called Survs®.
Results: Out of a total of 2172 students, 679 responses were obtained. All six years students of Faculdade de Medicina de Lisboa, beside the right idea about the number of hours that they should sleep, most of them during the class period slept only 6-7 hours per night and in the examination period the pre-clinical years (1st to 3rd) slept less hours than the clinical years (4th to 6th) and they also had more daytime sleepiness, depression, anxiety and stress than the clinical years.
Conclusions: The pre-clinical year's students revealed worst outcomes comparing with the clinical years on the number of hours slept during the examination period, daytime sleepiness, depression, anxiety and stress.

Sleep Breathing Disorders
Board #264 : Poster session 2

FOLLOW-UP OF OBSTRUCTIVE SLEEP APNEA TREATMENT: DIFFICULTIES FACED BY PRIMARY CARE UNITS

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Introduction: Obstructive sleep apnea (OSA) management is challenging for health systems. Due to the increasing demand for hospital sleep units (SU), there has been growing interest in ambulatory models of care. Since 2015, the Portuguese model determinates the referral to primary care (PC) units of OSA patients with CPAP compliance and efficacy and without treatment complaints.
The aim of this study was to evaluate the difficulties faced by primary care physicians in the follow-up of patients with OSA after discharge from sleep centers.
Materials and methods: An anonymous, non-refundable and online survey was created and emailed to all primary care physicians belonging to the Lisbon North primary care units.
Results: We obtained 187 responses, whose physicians presented an average age of 37.7 (+ 11.3) years. Most respondents reported that they never (27.8%) or rarely (54.5%) had access to the reports of CPAP adherence delivered by home respiratory care providers. When questioned about the reports, 61.5% presented difficulties in their interpretation, and only 28.3% performed some therapeutic attitudes (mask replacement and / or humidifier placement).
Regarding the recognition of the side effects of CPAP therapy as well as their correction, only 41.7% and 16.6% presented an affirmative answer, respectively.
In relation to the renewal of the CPAP prescription in the Electronic Prescription (EP) of respiratory home care platform; most of them (85.6%) didn't report any difficulty.
When they needed to refer patients to a hospital sleep unit, 77% reported it was an easy process, being the main reasons for a new hospital referral: difficulties in adherence / adaptation to CPAP (65%), presence of side effects (24.1%), daytime sleepiness (18.7%) and difficulties in EP (12.3%).
Conclusions: This study showed that a better articulation of primary care with the home respiratory care providers is still necessary, as well as more training of general practitioners in the management of OSA in our country.

Sleep Breathing Disorders
Board #265 : Poster session 2

PEAKS OF SYSTOLIC BLOOD PRESSURE WHILE SLEEPING ARE ASSOCIATED WITH THE SEVERITY OF IMPAIRED COGNITIVE FUNCTION IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Obstructive sleep apnoea (OSA) is characterised by periods of partial and/or complete cessation of breathing during sleep. Intermittent hypoxia and sleep disruption have been linked to the cognitive impairment observed in OSA patients, however the correlations are weak-moderate, making it likely that additional factors contribute to the impairment. The stress associated with periods of severe hypoxia is known to transiently elevate blood pressure during sleep in OSA, causing nocturnal blood pressure spikes. There is a lack of research on the effects of these spikes on cognitive function in OSA patients. The present study investigated whether the overnight peak in systolic blood pressure (PSBP) is associated with the extent of cognitive impairment in OSA.

Materials and methods: Participants (N = 75) aged 18 to 65 years (M 41.5 ± 3.1) were recruited from the Sleep Medicine and Research Centre at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. All participants underwent overnight full polysomnography (PSG) and neurocognitive assessments. PSG was used to obtain information on sleep parameters (i.e., the apnoea-hypopnoea index [AHI]). Nocturnal blood pressure was measured throughout the night using pulse transit time. Cognitive function was assessed using the 10-minute psychomotor vigilance test (PVT) to measure processing speed and sustained attention, and the Austin maze (AM) to measure the executive function.

Results: PSG results showed that of the 75 participants, 12 did not have OSA, 26 had mild OSA, 18 had moderate OSA and 19 had severe OSA. Participants were divided into two groups based on the median PSBP (low PSBP group (n=37): mean PSBP = 142.4; range = 50; AHI =16.1; high PSBP group (n=38): mean PSBP = 186.3; range =91; AHI =26.1). The groups differed significantly with respect to AHI, body mass index (BMI) and age. Analysis of covariance, controlling for BMI and age was used to compare the cognitive function of the two groups. The high PSBP group were shown to have significant cognitive impairments when compared to the low PSBP group in terms of mean PVT reaction time (RT) (p = 0.03), median PVT RT (p = 0.01) fastest PVT RT (p = 0.003), PVT RT lapses > 500 milliseconds (p = 0.04), AM time (p =< 0.001) and AM errors (p= 0.01).

Conclusions: Our findings show that in participants with OSA a higher peak in nocturnal systolic blood pressure is associated with significant impairments in cognitive processing speed, sustained attention and executive function. The extent of impairment is as large as that associated with blood oxygen desaturations and/or arousals from sleep, in the same cohort (unpublished data). Thus, spikes in nocturnal blood pressure may represent an additional factor that contributes to brain injury and cognitive dysfunction in OSA. Since PSBP can differ substantially from resting SBP, future PSG studies may consider including PSBP as a standard measure.

Acknowledgement: We would like to thank all the staff who assisted with data collection at the King Abdulaziz University Hospital, Jeddah, Saudi Arabia.

CRANIOFACIAL CHARACTERISTICS OF SYNDROMIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The aim of this study was to analyze the dental and craniofacial morphology of syndromic patients referred for overnight polysomnography (PSG) and to study its correlation with Apnea-Hypopnea Index (AHI).

Materials and methods: All syndromic patients referred for overnight PSG were invited to participate. A systematic clinical examination including extra- and intra-oral orthodontic exam was performed by calibrated orthodontists. Standardized frontal and profile photographs with reference points were taken and analyzed using *ImageJ®* software to study the craniofacial morphology. Spruyt and Gozal sleep questionnaire was used along with others that assessed the demographics and level of education of the parents. PSG data were studied and analyzed for correlation with craniofacial features.

Results: The sample included 52 syndromic patients (50% females, mean age 9.38 ± 3.36 years, 51% obese) diagnosed with 21 different syndromes, of which 24 patients had craniofacial photography analysis done. The severity of AHI was correlated with decreased midfacial height (nose height r=0.448 , *P* = 0.032) and increased thyromnetal angle (r = 0.467, *P = 0.022*). Most of the sample (40%) had severe OSA, while only (5.8%) had no OSA. Down's syndrome was the most common syndrome (40%) followed by Goldenhar syndrome (5%), Pierre Robin Sequence (5%), DiGeorge syndrome (5%), Treacher-Collin Syndrome (4%) , Prader-Willi Syndrome (4%) and other syndromes. All patients with Down's syndrome were diagnosed with OSA (57% severe AHI, 65% obese), and their AHI was significantly correlated with increased sternomental distance and decreased neck depth/mandibular length. Obesity was not correlated to the severity of AHI for Down's syndrome or other syndromic patients

Conclusion: Decreased midfacial height and obtuse thyromenal angle was correlated with increased AHI for syndromic patients. Neck anatomy of Down's syndrome patients could be a major predictor for the severity of OSA. Obesity does not seem to play a major role in the severity of OSA for syndromic patients. Detailed description of dental and craniofacial morphology of syndromic patients was covered and discussed.

OBSTRUCTIVE SLEEP APNEA AS A RISK FACTOR FOR PRIMARY OPEN ANGLE GLAUCOMA AND OCULAR HYPERTENSION

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Introduction: Both glaucoma and obstructive sleep apnea (OSA) are quite prevalent. OSA may partly cause or worsen glaucoma, although etiopathogenesis is unclear. Episodic hypoxia and lack of oxygenation of the optic nerve or intermittent arousal-associated increased sympathetic tone with increased release of vasoconstrictors (catecholamines, angiotensin II, vasopressin) and/or atrial natriuretic peptide (ANP) may be implicated. Nonetheless, studies investigating OSA as a risk factor on different glaucoma phenotypes are missing. The aim of the present investigation was to study OSA as a risk factor for the various clinically important phenotypic glaucoma categories.

Materials and methods: In this prospective study, glaucoma patients underwent a one-night four-channel sleep screening study for OSA. Inclusion criteria were diagnosed glaucoma or ocular hypertension, positive snoring history without any previous sleep-related testing, age> 18 years, body mass index (BMI) ≤34.9 kg / m². Patients with active malignant tumors, COPD (Stadium Gold 2-4) and Raynaud´s phenomenon were excluded. Relevant study endpoints were apnea-hypopnea-index (AHI), desaturation index, intraocular pressure (IOP), mean defect depth (MMD) and clinical glaucoma phenotype. Comparisons were performed by Wilcoxon/Kruskal-Wallis rank sum test and Chi-square approximation. Correlation coefficients were also calculated.

Results: 91 glaucoma patients (47 females, median age 64.3 years, median BMI 26.62 kg/m²) were included for analysis. There was no strong correlation between IOC or MDD and the AHI. BMI and age did not confound the results. A separate analysis of patient groups with different glaucoma phenotypes, namely primary open angle glaucoma (POAG), low-tension-glaucoma (LTG) and ocular hypertension (OH), was done. OSA was significantly more prevalent in patients with POAG and OH than in LTG patients (p=0.0009). This effect was even more obvious in females (p=0.0006) than in males (p=0.011).

Conclusions: : IOP or MDD did not show any strong correlation with the AHI, although the clinical glaucoma phenotypes did. Based on these findings, we recommend that patients with newly diagnosed POAG and OH who snore should be routinely screened for OSA by a 4-channel sleep study.

SLEEP APNEA TESTING IN CONSECUTIVE OLDER FAMILY MEDICINE PATIENTS: SYMPTOMS AND HEALTH STATUS TWO YEARS LATER.

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Introduction:
Obstructive sleep apnea (OSA) common in older family medicine patients, yet it is difficult to identify which patients to refer for sleep apnea testing. We took the approach of offering all older patients a sleep evaluation, including overnight polysomnography (PSG), regardless of sleep complaints or signs of OSA. We followed their progress for two years in order to observe changes in symptom profiles and in health markers among those who adhere to treatment and those who refuse or discontinue treatment.

Materials and methods:
Consecutive older family medicine patients (n=178, M, age = 56) underwent in-laboratory polysomnography (PSG) and completed the Sleep Symptom Checklist (SSC). Health status was obtained through chart review. Those receiving a diagnosis of OSA were followed for treatment according to usual medical practice, primarily positive airway pressure (PAP) therapy. After two years, we re-contacted participants to enquire about treatment, adherence and health status. We compared OSA symptom profiles and presence of hypertension, hyperlipidemia, and diabetes at initial testing and after 2 years of usual medical care.

Results:
At 2 years post diagnosis, we were able to obtain follow-up data for 84 participants. All but 4 had received a diagnosis of OSA. Women were well represented in this sample, 61%. After 2 years, 36% of patients were continuing OSA treatment, primarily positive airway pressure (PAP).
Group comparisons show that those who persisted with PAP treatment had worse OSA scores as measured by PSG at initial testing, as well as more severe symptoms than those who refused treatment, including worse insomnia and sleep disorder symptoms. After 2 years, there was improvement in symptom severity on all SSC subscales. Interaction effects show that the improvements were largely in the adherent group. For the sleep disorder symptoms, there was a significant interaction effect, whereby adherent participants improved significantly compared to those who refused/discontinued treatment; these participants showed no significant improvement in symptom severity.
On health measures, the adherent group showed a small increased frequency of both hypertension and diabetes at initial testing compared to the treatment refusers/drop-outs. These health status measures did not change significantly for either group after 2 years.

Conclusions:
This older family medicine sample was not typical of a sleep clinic population since they were all offered sleep testing regardless of suspected OSA. The most notable results include 1) a high presence of OSA, 2) a high proportion of women volunteering for testing, 3) adherence to treatment was associated with improvement of insomnia and sleep disorder symptoms, 4) the presence of metabolic syndrome (hypertension, hyperlipidemia, diabetes) remained stable after two years, regardless of treatment adherence. In this relatively healthy sample, the benefit of OSA treatment regarding health outcome may require longer than two years to be evident.

Sleep Breathing Disorders
Board #241 : Poster session 1
RELATIONSHIP BETWEEN PERCEIVED BENEFIT OF PAP THERAPY AND ADHERENCE TO PAP THERAPY IN ADOLESCENTS WITH OSA

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Introduction: There is an increasing prevalence of persistent, severe obstructive sleep apnea (OSA) post adenotonsillectomy in the paediatric population. This is in part due to the obesity epidemic and obesity related OSA. Consequently, there has been a three-fold increase in paediatric positive airway pressure (PAP) therapy prescribed for home use, as PAP remains the most efficacious treatment for persistent OSA, shown to improve OSA symptoms and daytime sleepiness. However, paediatric PAP adherence rates are between 40-60% and have remained static over the past decade. In the adolescent population, barriers to PAP adherence are not fully understood. The aim of this study was to compare the barriers to PAP use between adherent and non-adherent adolescents with OSA.

Materials and methods: This was a prospective study of 69 adolescents (72% male) 10-17 years of age, with moderate-severe OSA prescribed home PAP therapy. All participants underwent clinical assessment including PAP adherence data download of prior 30 days, and completion of Barriers to Adolescent PAP Use Questionnaire (BAPQ). PAP therapy adherence was defined as PAP usage greater than 4hrs/night for 70% of the 30 nights. Perceived PAP benefit was compared between objectively adherent and non-adherent groups using the Chi squared test for categorical variables.

Results: Of the 69 participants, 35 (50.7%) met adherence criteria (mean age 13 ± 2.52 years, 75.7% male) and 34 (49.3%) were non-adherent (mean age 13 ± 2.49 years, 61.1% male). In the adherent group, 28/35 (80%) reported a perception of daytime benefit from PAP use, whereas 7/35 (20%) reported no daytime benefit from PAP use. Despite lack of adherence to PAP, 15/34 (37.5%) reported a perception of daytime benefit from PAP therapy, whereas 19/34 (62.5%) reported no daytime benefit from PAP use. There is strong evidence of a relationship between patients with objective adherence and reporting a perceived daytime benefit (X^2=9.25, df = 1, p-value= 0.00470). Clinically adherent patients were found to be 1.81 (CI= [1.20, 2.74]) times more likely to perceive daytime benefit from PAP therapy than non-adherent patients. Notably, adherent patients who report no daytime benefit from PAP use are predominantly those OSA patients with underlying complex comorbidities, suggesting sub-optimal daytime functioning even with PAP use. Non-adherent patients who report benefit were comprised predominantly of patients with uncomplicated OSA.

Conclusions: Adolescent OSA patients prescribed PAP therapy demonstrate a greater propensity for perceiving PAP benefits when they are adherent to therapy, as reported in 80% of this cohort. However, a sizable proportion of non-adherent patients, 37% in this cohort, may, in fact, perceive daytime benefits when they use PAP. Further research is required to ascertain the profound barriers that would prevent an adolescent from undertaking a therapy that they perceive benefit from. Adolescent patients are at the crux of transition to adult health care and autonomy over healthcare decisions, making this a critical time to invest greater resources into identifying PAP adherence barriers and determining relevant adherence strategies.

IMPACT OF HYPOVENTILATION ON COGNITIVE FUNCTION IN PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: Cognitive function is impaired in some patients with obstructive sleep apnea (OSA). Although historically attributed to intermittent hypoxemia and sleep fragmentation, hypercapnia has recently been proposed to play a role in its pathogenesis. The objective of this study was to determine whether hypoventilation contributes to impaired cognitive function in OSA.

Methods and Materials: Adult patients with severe OSA diagnosed by in-lab polysomnography (PSG) that included transcutaneous carbon dioxide (tCO_2) monitoring were recruited. Arterial blood samples were collected immediately prior to PSG and analyzed for arterial CO_2 ($Paco_2$), oxygen (Pao_2), pH and bicarbonate. Patients were divided into three groups using the following criteria--*no hypoventilation* (NoHypo: $Paco_2 \leq 45mmHg$ and tCO_2 increase during sleep< 10mmHg and a peak tCO_2 during sleep$\leq 55mmHg$; n=71), *sleep hypoventilation* [SleepHypo: ($Paco_2 \leq 45mmHg$ and tCO_2 increase during sleep$\geq 10mmHg$) OR ($Paco_2 \leq 45mmHg$ and a peak tCO_2 during sleep>55mmHg); n=42] and *awake hypoventilation* (AwakeHypo: $Paco_2 > 45mmHg$; n=28). Patients completed a comprehensive sleep and medical history and three cognitive tests - the Montreal Cognitive Assessment Test (MoCA), the Rey Auditory Verbal Learning Test (RAVLT) and the WAIS-IV Digit Symbol Coding Test (DSC). A MoCA score< 26 (range 0-30) was used to indicate cognitive impairment. RAVLT and DSC scores were expressed as z-scores relative to age-adjusted norms. Group comparisons were performed using ANOVAs with cognitive score comparisons controlled for age, gender and education. Tukey tests were used for post-hoc multiple comparisons. The relationship between cognitive test scores and tCO_2 increase during sleep, peak tCO_2 during sleep and $Paco_2$ were assessed using linear regression.

Results: The apnea-hypopnea index (AHI) for the 3 groups were: NoHypo: 76±46, SleepHypo: 63±40, and AwakeHypo: 85±55 (p=0.140; mean±SD). The SleepHypo and AwakeHypo groups had greater nocturnal hypoxemia compared to the NoHypo group (mean Sao_2: 84.4±3.6% and 82.0±5.6% *versus* 88.3±3.2%, p≤0.001; Sao_2< 90%: 85.7±12.9 and 95.2±7.7 *versus* 64.1±27.7% total sleep time, p≤0.001). Mean Sao_2 was also lower for the AwakeHypo *versus* SleepHypo groups (p=0.038). The tCO_2 increase during sleep was greatest for the SleepHypo group [12.4±3.9mmHg *versus* 5.5±1.9 and 8.7±4.9mmHg for the NoHypo and AwakeHypo groups (p≤0.001)]. $Paco_2$ was 48.9±5.6mmHg in the AwakeHypo group compared to 39.4±3.4 and 40.1±3.4mmHg for the NoHypo and SleepHypo groups (p≤0.001). Total MoCA scores were 24.4±2.7, 24.9±2.6 and 24.2±2.3 for the NoHypo, SleepHypo and AwakeHypo groups (p=0.514), and 56, 55 and 79% of patients had a MoCA score< 26 (p=0.086). RAVLT scores were similar to age-matched norms (p≥0.282). However, DSC scores were 1.0±1.0, 0.6±0.7 and 1.2±0.7 standard deviations below age-matched norms for the NoHypo, SleepHypo and AwakeHypo groups (p≤0.001). RAVLT and DSC were similar between groups (p≥0.057). Finally, MoCA total and RAVLT scores were not correlated with AHI, mean Sao_2 or Sao_2< 90% or $Paco_2$ (p≥0.240), but there was a weak negative correlation between DSC and $Paco_2$ (r=-0.19, p=0.038) independent of age, gender and education.

Conclusions: These findings indicate that cognitive impairment is common in patients with severe OSA and is related more to slow cognitive processing than to impaired memory. Furthermore, awake hypercapnia may contribute to impaired processing speed in OSA.

PREVALENCE OF PATIENTS AT RISK FOR PROGRESSION OF CHRONIC KIDNEY DISEASE IN A SLEEP CLINIC COHORT WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Chronic kidney disease (CKD) is associated with significant morbidity and mortality and is common in patients with obstructive sleep apnea (OSA). This may be due to OSA contributing to the pathogenesis of CKD, or to common co-morbidities shared by both disorders such as hypertension, diabetes and obesity. Regardless of CKD etiology, co-existence with OSA may accelerate CKD progression as the kidneys are exposed to intermittent hypoxemia which has been demonstrated to cause kidney injury in experimental animal models and alter renal function in human subjects. Risk of CKD progression can be quantified by combined analysis of glomerular filtration rate estimated from serum creatinine (eGFR) and albuminuria, reflected by the albumin:creatinine ratio (ACR) in the urine. The objective of this study was to determine the prevalence of moderate-to-high risk of CKD progression in a cohort of patients referred to a sleep clinic for suspected OSA.
Materials and Methods: Adults referred for suspected OSA to one of 3 academic sleep centres participating in the Canadian Sleep and Circadian Network (CSCN) OSA cohort study were recruited. All patients completed a detailed medical and sleep questionnaire, were assessed for OSA by either a home sleep apnea test (HSAT) or in-lab polysomnography (PSG), and provided blood and urine samples for measurement of eGFR and ACR respectively. OSA severity was established from the oxygen desaturation index (ODI, 4% desaturation) and the mean nocturnal oxygen saturation (SaO_2). CKD progression risk was determined from a heat map incorporating both eGFR and ACR (KDIGO 2012 Clinical Practice Guideline; normal values: eGFR≥90 ml/min/1.73m^2, ACR < 3mg/mmol).
Results: Four hundred and ninety-five patients (306 (62%) male, age: 55±12y, BMI: 35.9±8.6 kg/m^2) were recruited, of whom 47 (9.5%) reported a previous CKD diagnosis and 51 (10.3%) reported a history of albuminuria. Objectively, 313 (63%) had eGFR< 90, 58 (11.7%) had eGFR< 60, and 94 (19%) had albuminuria (ACR>2.99 mg/mmol). The cohort was divided into 3 groups based on ODI: < 15 (no or mild OSA, ODI: 6±5, n=105), 15-30 (moderate OSA, ODI: 21±4, n=162), and >30 (severe OSA, ODI: 56±21, n=228). Mean SaO_2 fell significantly across the 3 groups (ODI< 15: 92.1 (90.6-94.0); ODI 15-30: 90.4 (87.8-91.9); ODI>30: 86.7 (83.0-89.1), p< 0.001). BMI increased significantly across the 3 groups (ODI< 15: 32±6.8; ODI 15-30: 33.9±7.8; ODI>30: 39.1±8.9 kg/m^2, p< 0.001). Although the prevalence of hypertension, diabetes and cardiovascular disease increased with the severity of OSA, only diabetes reached statistical significance between the groups (p=0.03). After stratification by OSA status, 11.4% of the no or mild OSA group, 31.5% of the moderate OSA group, and 32.5% of the severe OSA group were considered to be at moderate to high risk of CKD progression independent of mean SaO_2, BMI and diabetes (p for trend< 0.001). The risk of CKD progression was maintained when patients with prior CKD diagnoses were excluded.
Conclusion: Patients with moderate to severe OSA have an increased risk of CKD progression. Further investigation is required to determine if treatment of OSA decreases this risk.

AORTIC ROOT DIAMETER IN OBESE PATIENTS WITH AND WITHOUT SLEEP APNEA SYNDROME, HYPOVENTILATION SYNDROME OR BOTH

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Background: We know that the relation between anthropometric variables and aortic dimensions have been recognized and confirmed in echocardiographic studies of the aortic root. On the other hand, several studies reported the close link between OSA and aortic root size dilation measured at the sinuses of Valsalva. This study aims to investigate aortic root diameter in obese patients according to the absence or presence of OSA, OHS or the combination of both.

Methods: Consecutive obese asymptomatic patients were referred to a sleep disorders lab between January 2011 to December 2016 before bariatric surgery or **an** etiological hypertension assessment. Demographic, clinical, echocardiographic data, sleep parameters and arterial blood gases were recorded.

Aortic root diameter was measured according to Roman et al.´s 1 recommendations at end diastole, in the parasternal long-axis view : the sinuses of Valsalva (A1); the sinotubular junction (A2); the proximal ascending aorta (A3) in addition, the horizontal primary portion of aortic arch before the brachiocephalic artery bifurcation was measured in the suprasternal view.

Results: Of 851 obese patients with a mean age of 52 old years, and a mean BMI of 36.6, with a significant majority of women (74% vs 26%), 389 (46%) were obese (Group 1), 33 (4%) were obese with OHS (Group 2), 368 (43%) were obese with OSA (Group 3) and 61 (7%) were obese with both OHS and OSA (Group 4). Obese patients group was younger than OSA group, OHS group and OSA / OHS group respectively; < 0,0001, 0,001, 0,003. No difference was observed concerning hypertension, diabetes, tobacco and dyslipidemia. No difference was also observed concerning weight and BMI. Patients with OSA and OHS showed a higher AHI than patients with OSA alone: p = 0,001

Concerning the aortic root, no difference was observed between the four groups at level Ao 2 and Ao 4. **However, the OSA group showed a significant difference for A1 and A3 diameter comparing to the obese group; respectively p = 0,001 and < 0,0001, The probability of the dilatation of AO3 (the proximal ascending aorta) was positively linked to OSA development** when Multivariate Logistic Regression Analyses was used.

Conclusions: Several studies reported the link between OSA and aortic root dilatation at the sinuses of Valsalva. In our Obese patient study, we confirmed the dilatation of the aortic root in patients with OSA. The second important aspect this study shows is that the dilatation concerns the proximal ascending aorta. To our knowledge, this is the first study which highlights this result. Regarding OHS et Aortic root dilatation, the small number of this group probably don't allow us to give a clear answer. More investigations are needed in this way, and our study is still in progress to that effect.

Reference: 1/ M.J. Roman, R.B. Devereux, R. Kramer-Fox, *et al.***Two-dimensional echocardiographic aortic root dimensions in normal children and adults**
Am J Cardiol, 64 (1989), pp. 507-512

OBESE ASYMPTOMATIC PATIENTS WITH AND WITHOUT SLEEP APNEA SYNDROME, HYPOVENTILATION SYNDROME OR BOTH : WHAT ABOUT ECHOCARDIOGRAPHIC PARAMETERS

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Background: Sleep apnea syndrome (OSA), Hypoventilation syndrome (OHS), or both are common in obese patients and are at cardio-vascular risk disorders. The early detection of any abnormalities allows us to anticipate the occurrence of complications,
The aim of this echocardiographic study was to evaluate any subclinical abnormalities in obese asymptomatic patients with and without (OSA), OHS or both
Methods: In this prospective study, consecutive obese asymptomatic patients were referred to the sleep disorders lab between January 2011 to December 2016 before bariatric surgery or hypertension assessment. Demographic, clinical, echocardiographic data, sleep parameters and arterial blood gases were recorded.
Results: Of 851 obese patients 52 old years, mean BMI 36.6 kg with a significant majority of women 74% vs 26% , free of pulmonary pathologies, 389 (46%) were obese (Group 1), 33 (4%) were with OHS (Group 2), 368 (43%) were with OSA (Group 3) and 61 (7%) were with both OHS and OSA (Group 4).
Obese patients Grp was more younger than OSA Grp, OHS Grp and OSA/ OHS Grp respectively; < 0,0001, 0,001, 0,003.
No difference was observed concerning weight and BMI. However, patients with OSA/OHS had a higher Waist and Neck sizes comparatively to the other groups respectively P = 0,002, 0.0001, 0,002 while just, neck size was significantly higher in the OSA Grp compared to obese Grp: p = 0.0001, In contrast, no difference was observed between OHS Grp and obese Grp.
Equally, patients with OSA/OHS showed a higher AHI than patients with OSA alone: p = 0,001
The analysis also showed that $PaCO_2$ of OHS, And OSA/OHS groups was significantly different from the OSA and obese Grp; p < 0,0001. However, in the OSA Grp Pa CO2 observed (under 45 mmHg) a significant difference comparing to obese Grp; p = 0,001.
Additionally, Multivariate Logistic Regression Analyses, found that the increase of Neck size, and PaCO2 increase the probability to develop OSA; odd ratio >1.
Regarding echocardiographic parameters, while, no significant difference was seen between the four groups concerning Left atrial volume (LA), the E/A ratio, and LV EF, CO, ICO and pulmonary artery systolic pressure (PASP), the E/E' ratio was significantly higher in the OSA/OHS compared to obese Grp : P = 0,004. This significant result of E/E' was directly related to the presence of the OSA/ OHS on the Multivariate Logistic Regression Analyses: odd ratio >1.
Conclusions: In this study, we show that the combination of OSA and OHS expose obese asymptomatic patients to develop early LV diastolic abnormalities witch caractered par E/E' ratio. Those patients have the particularity to have a higher waist and neck sizes and show more severe OSA.
The increase of neck size, and PaCO2 are related to the occurrence of OSA in obese patient. We suggest that obese asymptomatic patients should have systematically arterial blood gases control when polysomnography is required. They should have a cardio-vascular checking in case were the OSA or OHS or both were diagnosed. We should also improve the program of prevention and therapeutic education.

EVALUATION OF SLEEP DISORDERED BREATHING IN PEDIATRIC PATIENTS WITH SUSPECTED ROHHAD SYNDROME

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Introduction: Rapid-onset obesity with hypothalamic dysfunction, hypoventilation and autonomic dysregulation (ROHHAD) syndrome is a rare and complex disease. A lack of defined etiology and variable clinical presentation of initial symptoms make early ROHHAD diagnosis difficult. Moreover, there is a paucity of specific data highlighting sleep-disordered breathing (SDB) in children with suspected ROHHAD both at presentation and longitudinally. The objective of this study was to characterize the clinical presentation of SDB in suspected ROHHAD patients.
Materials and methods: This was a retrospective study of children with suspected ROHHAD syndrome between 4 and 13 years of age who underwent a baseline polysomnogram (PSG). Patient demographics, referral history and PSG data were recorded at baseline. Data is presented as mean ± SD unless otherwise indicated.
Results: Of the 9 children included in this study, 9/9 (100%) were obese (mean age 7.8 ± 3 years, mean BMI = 35.7 kg/m^2 ± 6.3 kg/m^2, 44% male). At initial presentation, 9/9 (100%) were diagnosed with obstructive sleep apnea (OSA), 2/9 (22%) had co-existent central sleep apnea (CSA) and 3/9 (33%) had co-existent nocturnal hypoventilation (NH). The mean obstructive AHI (OAHI) was 27.9/hour ± 28.0 with 4/9 (44%) children having mild OSA, 1/9 (11%) moderate OSA and the remaining 4/9 (44%) with severe OSA. Mean CO_2 during sleep was 43.6 mm Hg (ranging from 28.0 mm Hg - 62.0 mm Hg). Currently, data from PSGs at a 2.3-year median follow-up (mean age 7.8 ± 3 years, mean BMI = 35.7 kg/m^2 ± 6.3 kg/m^2, 44% male) 9/9 (100%) still had OSA, 1/9 (11%) had co-existent CSA, and 7/9 (78%) had co-existent NH. Furthermore, one child had passed away from the complications of ROHHAD; 4/9 require bi-level positive airway pressure with one of these patients requiring additional oxygen and 4/9 patients are maintained on continuous positive airway pressure.
Conclusions: Children with suspected ROHHAD at baseline have a high prevalence of OSA requiring ventilatory support. Early identification of clinical phenotypes at risk of ROHHAD in SDB patients is crucial to allow for an evaluation of disease progression. Further research is needed to understand long-term ventilatory needs in children with suspected ROHHAD syndrome.

CONTRIBUTION OF DRUG-INDUCED SLEEP ENDOSCOPY IN COMPARISON WITH AWAKE ENDOSCOPY IN THE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME: EXPERIENCE OF A FRENCH ENT SLEEP CENTER

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Introduction: The aim of the study was to evaluate the contribution of drug-induced sleep endoscopy in comparison with awake endoscopy to identify upper airway obstruction sites and to manage patients with obstructive sleep apnea syndrome (OSAS).
Materials and methods:
Retrospective monocentric study included all OSAS patients with drug-induced sleep endoscopy during one-year period. A correlation analysis was performed between main upper airway obstruction sites visualized during awake endoscopy and main upper airway obstruction sites visualized during drug-induced sleep endoscopy. We used Kappa score for classifying correlations. After the drug-induced sleep endoscopy, the percentage of modified treatments, efficacy rate of second-line treatments were reported (AHI reduced at least 50% or < 20/h).
Results: This study included 57 patients with 59% of severe OSAS (AHI≥30): 77% of men, mean age of 45 years, mean BMI of 28 Kg/m^2 and mean AHI of 36/h. Forty-two patients had a therapeutic failure for first-line treatment of OSAS (Continuous positive airway pressure (CPAP) or mandibular advancement device (MAD)). The main upper airway obstruction sites visualized during drug-induced sleep endoscopy were predominantly soft palate (72%), oropharynx (56%), multisite in 67%. Between awake endoscopy and drug-induced sleep endoscopy, there was a strong correlation for the oropharyngeal obstacle (Kappa score = 0.64), low correlation for the soft palate (Kappa score = 0.29) and the tongue base (Kappa score = 0.28), and a very low correlation for the epiglottis (Kappa score = 0.14). After drug-induced sleep endoscopy, 33.3% of mandibular advancement devices indications were modified. The OSAS treatment was modified after drug-induced sleep endoscopy in 78.4% of patients .The effectiveness rate of treatment was 69%, 65% and 57% respectively for MAD, oropharyngeal and palatal surgery and 65% in case of first-line failure treatment for OSAS.
Conclusions: The poor concordance between awake endoscopy and drug-induced sleep endoscopy to identify main upper airway obstruction sites with the exception of the oropharynx, the multisite character of the obstruction under evaluated during awake endoscopy justify the realization of sleep endoscopy in patients in first-line OSAS failure treatment, before surgery or to evaluate the efficacy of MAD.

EVALUATION OF UPPER AIRWAY OBSTRUCTION AND NASAL COMPLIANCES IN PATIENTS WITH MORBID OBESITY BEFORE BARIATRIC SURGERY: A MONOCENTRIC PROSPECTIVE OBSERVATIONAL STUDY

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Introduction: The population of patients with morbid obesity shows a high risk of developing obstructive sleep apnea syndrome (OSAS). The objective of this study was to analyze the obstructive pathophysiology of the upper airway in obese patients, particularly nasal dynamic ventilatory function to allow a better understanding and management of OSAS in these patients.

Materials and Methods: This monocentric prospective observational study included all consecutive patients with morbid obesity (Body Mass Index (BMI) ≥35kg/m²) before bariatric surgery. They received a complete ENT clinical examination including naso-pharyngeal endoscopy, respiratory polygraphy, and nasal functional tests with rhinomanometry and acoustic rhinometry. Gender, age, BMI, cervical circumference, anatomical description of obstructive sites (including tonsillar score and Mallampati score assessing tongue obstruction), nasal resistances and nasal fossa geometry (section area of the MCA1 (minimal Cross sectional area or valve), compliances (or nasal elasticity) have been reported. Subjects were analyzed according to the severity of OSAS (severe OSAS with apnoea-hypopnea index AHI ≥30: SS and non-severe OSAS groups (AHI< 30: NSS) and compared to a control group (21 healthy snoring control patients without OSAS).

Results: Seventy-nine patients were included in the study with 59 women (74.7%), a mean age of 43.7 ± 11.4 years and a mean BMI of 42 ± 5.4 kg/m². OSAS was diagnosed in 70 patients (88.6%) (IAH≥5) including a severe OSAS in 40 (50.6%) patients. Only 9 (11.4%) patients were free from OSAS. Among the obstructive sites of upper airways, only the Mallampati score was significantly correlated with AHI (p = 0.009) with 42 patients (53.9%) with a score ≥ 3 (score corresponding to some difficulties of intubation). Patients with severe OSAS had a long soft palate more frequently than the group without severe OSAS (respectively 35% and 12.8% (p = 0.002)) and reduction of upper airway behind the soft palate in 50% of cases compared to 23.1% in the group NSS (p = 0.01) and a significantly greater cervical circumference than the NSS group. Compared with the control group, nasal resistances were higher (p = 0.03) and MCA1 were narrower in obese patients (p = 0.003) with no significant difference depending on the severity of OSAS. Nasal compliances were significantly lower in our study population compared to the control group (p < 0.0001).

Conclusion: Patients with morbid obesity have an almost constant presence of OSAS with reduced nasal compliances, reduced size of their nasal cavities and resistances that appear to be higher than in control patients with no observed difference depending on the degree of severity of OSAS. These nasal features would probably promote OSAS in this population.

DIAGNOSTIC ACCURACY OF SCREENING QUESTIONNAIRES FOR OBSTRUCTIVE SLEEP APNOEA IN ADULTS WITHIN DIFFERENT CLINICAL COHORTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Obstructive sleep apnoea (OSA) is a prevalent public health problem, characterised by repeated interruption in breathing due to upper airway collapse during sleep. Despite the high prevalence of OSA and its consequences, an estimated 93% of women and 82% of men with moderate to severe OSA remain undiagnosed. Untreated OSA is associated with cardiovascular disease, hypertension, metabolic disease and cognitive impairment. Not surprisingly morbidity and mortality are higher in untreated patients, as compared to non-OSA counterparts, at significant cost to Health Care Services, thus prompt diagnosis and treatment is of clinical relevance. Polysomnography (PSG), the gold standard for the diagnosis of OSA, is expensive and time-consuming, hence a simple and reliable screening questionnaire may help to identify patients at high risk of OSA that may require further investigation and treatment. Therefore, the objective of this systematic review and meta-analysis is to evaluate the diagnostic accuracy and clinical utility of existing screening questionnaires for OSA in adults from different clinical cohorts.

Materials and methods: Databases (*Scopus, Web of Sciences, PubMed, CINAHL PLUS, LILACS)* and grey literature (*ETHos, OpenGrey, Google Scholar, Proquest*) were searched from inception to 18 October 2018. Two reviewers independently screened the titles and abstracts of the search results. After excluding the studies that were not eligible, full-text articles of the remaining publications were retrieved. These publications were evaluated by two independent reviewers against the selection criteria. We included prospective studies of patient-based questionnaires as screening tools for OSA in adults that were validated by level one or level two PSG. Two reviewers independently extracted the data and evaluated the methodological quality of the studies according to the QUADAS 2 criteria. For each study, 2 x 2 contingency tables were constructed and the true positive, false positive, true negative and false negative results were extracted for each Apnoea Hypopnoea Index (AHI) cut-off. For each identified questionnaire, accuracy parameters for similar target populations were analysed together.

Results: 41 studies (including 9726 patients) met the eligibility criteria. In the sleep clinic population, the STOP-Bang questionnaire (questionnaire threshold of ≥3), had the greatest sensitivity at an AHI threshold of ≥5 (91.3%, n=18 studies), ≥15 (93.8%, n=15 studies) and ≥30 (95.6%, n=13 studies). The corresponding specificity values for the STOP-Bang questionnaire were 33.9%, 25.8% and 26.6% respectively. In the surgical population, the STOP-Bang questionnaire (questionnaire threshold of ≥3), also had the greatest sensitivity at an AHI threshold of ≥5 (84.6%, n=4), ≥15 (90.3%, n=6) and ≥30 (96%, n=3). The corresponding specificity values for the STOP-Bang questionnaire were 39.4%, 26.8% and 26.1% respectively.

Conclusions: This meta-analysis confirms the high performance and clinical utility of the STOP-Bang questionnaire in sleep clinic and surgical settings for screening of OSA.

Studentship and Raising Health Charitable Funds Award, Leicestershire Partnership NHS Trust, United Kingdom

HOW MANDIBULAR ADVANCEMENT SPLINTS ALTER GENIOGLOSSUS AIRWAY DILATION PATTERNS DURING INSPIRATION IN AWAKE PEOPLE WITH OBSTRUCTIVE SLEEP APNOEA MAY HELP PREDICT TREATMENT OUTCOMES

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Introduction: The efficacy of mandibular advancement splints (MAS) in obstructive sleep apnoea (OSA) is variable between patients, and this cannot be predicted reliably. Using tagged magnetic resonance imaging (MRI), we have previously observed that narrowing of the upper airway was associated with greater dilatory movement of the genioglossus during inspiration in people without OSA, and that the dilatory pattern was related to OSA status. Because mandibular advancement enlarges the airway by holding the mandible forward, we hypothesised MAS would alter how the genioglossus dilates the airway during wakefulness, and that motion may be related to MAS treatment outcome.

Materials and methods: 87 untreated OSA participants (20 women, apnoea hypopnoea index (AHI) 7-102 events/hr, body mass index (BMI) 18-51 kg/m^2, aged 19-76 years) underwent a MRI scan (Achieva 3TX, Philips) wearing a MAS. Mid-sagittal tagged MRI images were collected to quantify tongue dilatory movement with the jaw in neutral position (baseline) or advanced at 70% of the maximum, using harmonic phase methods. Imaging parameters: TR/TE = 400/16 ms, FOV = 220x196 mm, slice thickness = 10 mm, in-plane spatial resolution = 0.86x0.86 mm, tag spacing = 8.6 mm. Genioglossus dilation pattern was quantified over 3 inspirations using the antero-posterior movement of the back of the tongue. Treatment outcome was determined after approximately 12 weeks of therapy. Polysomnograms were scored following the criteria of the American Academy of Sleep Medicine v2.4.

Results: 22 participants had mild OSA (5 < AHI ≤ 15 events/h), 30 had moderate OSA (15 < AHI ≤ 30 events/h) and 35 had severe OSA (AHI > 30 events/h). Sixty-two percent of OSA subjects had a minimal dilation pattern (< 1mm) at baseline and this proportion increased to 74% when the mandible was advanced. MAS altered tongue dilatory patterns for 39% (34/87) of participants. MAS was more likely to alter the genioglossus dilatory pattern of people with a tendinous pterygomandibular raphe (Fisher's exact test, P=0.04). Subjects with a beneficial (anterior movement > 1 mm) or non-beneficial dilatory patterns (posterior movement > 1 mm) at baseline were more likely to change (72% and 63%, respectively) than those who had minimal patterns (80% did not change). Seventy-two participants completed the study, and 34 were responders (AHI< 5 or AHI≤10 events/h with change in AHI>50%), 9 were partial responders (change in AHI >50%), and 29 non-responders (change in AHI< 50% and AHI ≥10 events/h). When MAS did not alter tongue dilatory pattern, the presence of pterygomandibular raphe was associated with poorer treatment outcomes (Fisher's exact test, P=0.02). When MAS altered tongue dilatory pattern, 80% of those who changed for non-beneficial pattern were non-responders, and 71% of those who changed for beneficial were full or partial responders.

Conclusions: Changes in inspiratory tongue dilatory motion during wakefulness with MAS is associated with MAS treatment outcomes. The mechanism of action of MAS on upper airway dilator muscles differs between subjects, likely reflecting differences in the underlying causes of OSA.

Research Council of Australia

Sleep Breathing Disorders
Board #363 : Poster session 2
SNORING DURING PREGNANCY AS A PREDICTOR OF FUTURE OBSTRUCTIVE SLEEP APNOEA: A CASE-CONTROL STUDY

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Introduction: Obstructive sleep apnea (OSA) is common in pregnancy. Gestational diabetes and hypertension predispose women to future cardiometabolic disease. If snoring during pregnancy predicts future OSA, then pregnancy may provide a key opportunity for early intervention or prevention.

Methods: We analysed data collected by the Sleep Apnea Genetics International Consortium (SAGIC) from female patients attending at sleep clinics. The exposure of interest was retrospective self-report of snoring during pregnancy. The outcome was OSA on diagnostic polysomnography.

Results: Of 579 women with a previous pregnancy (mean age 52.4, SD 12.9 years), 372 had a current diagnosis of OSA (cases) and 207 did not (controls). Current OSA was stratified into mild, moderate, and severe based on apnoea-hypnoea index. Confounders included body mass index, ethnicity, and age. Multinomial regression demonstrated that severe OSA was significantly associated with report of snoring during pregnancy (adjusted odds ratio=3.53, CI 95% 1.17-10.67, p-value = 0.03). Mild and moderate OSA was not significantly associated with a history of snoring in pregnancy, but analysis was limited by small numbers of women who snored. Sensitivity analysis demonstrated that snoring was the only sleep disturbance associated with OSA.

Discussions: Women who snore during pregnancy appear to have a higher risk of developing severe OSA in later life. Prospective studies are required to confirm a longitudinal association. Detection and management of gestational OSA may aid to prevent or reduce OSA in later life, as well as reduce adverse outcomes in pregnancy.

PREDICTORS OF ADHERENCE TO POSITIVE AIRWAY PRESSURE THERAPY IN CHILDREN: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: While positive airway pressure (PAP) is effective for treating sleep-disordered breathing (SDB) in children, adherence is poor. Studies evaluating predictors of PAP adherence have inconsistent findings, and no rigorous reviews have been conducted. This systematic review aims to summarize the literature on predictors of PAP therapy adherence in children.

Methods: Studies evaluating baseline predictors of PAP therapy adherence in children (6-18 years) with SDB were included. We searched MEDLINE, Embase, CENTRAL, CINAHL, Clinicaltrials.gov, and the last four years of conference abstracts. Results were described narratively, with random-effects meta-analyses performed where feasible. Risk of bias and confidence in the evidence were assessed.

Results: We identified 50 factors evaluated across twenty-eight studies (21 full text articles, seven abstracts). The highest rates of PAP therapy adherence were most consistently found with female sex, younger age, Caucasian race, higher maternal education, greater baseline apnea-hypopnea index (AHI), and presence of developmental delay. Pooled estimates included odds ratios of 1.48 (95%CI: 0.75-2.93) favoring female sex, 1.26 (95%CI: 0.68-2.36) favoring Caucasian race, and a mean difference in AHI of 4.32 (95%CI: -0.61-9.26) events/hour between adherent and non-adherent groups. There was low quality evidence to suggest that psychosocial factors like health cognitions and family environment may predict adherence.

Conclusion: In this novel systematic review, we identified several factors associated with increased odds of PAP therapy adherence in children. These findings may help guide clinicians to identify and support children less likely to adhere to PAP therapy, and should be considered when developing interventions to improve adherence.

"DIGITAL TWIN" BASED APPROACH TO PATIENT SPECIFIC DIAGNOSIS AND THERAPY OF OSA

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Introduction: The causes of obstructive sleep apnea are multiple and usually a combination of several factors. Craniofacial malformations, or syndromes, but also anatomical and geometric variations of the upper respiratory tract in combination with increasing body weight and age are among the main causes. As part of a complex research approach, these causes were analyzed on a patient-specific basis and treatment scenarios were developed, each of these was tested using a virtual model of the patient.

Materials and methods: The investigation was based on a group of 22 supposedly OSA patients admitted to the Dortmund General Hospital. All patients were examined in the sleep laboratory. Subsequently, the patients were extensively examined clinically and radiologically on MRI and CBCT. The patient-specific data (DICOMs, age, gender, BMI, respiratory curve) were evaluated by a sophisticated numerical analysis (CFD and FSI) by CADFEM Medical Company. The experimental setup at the University of Wuppertal was used to validate the simulation results.

Results: By analogy with AHI, a specific OSA index was derived using the effect size plots to evaluate the simulation results with respect to OSA prediction. The evaluation procedure was tested retrospectively on 74 patients classifying 76% of the cases as OSA. Additionally, the ROC analysis was performed to estimate the correlation between the specific OSA index and the specific geometric values resulting in area under curve of 90%. A highly automated workflow was developed and integrated in the cloud-based simulation environment. The interaction with the latter was accomplished through a user friendly lean user interface. The workflow applied to the studied patient group was able to automatically determine the anatomical regions of the obstruction and to predict the optimal therapy. So the effectiveness of a MAD can be analyzed and protrusion determined. Furthermore, it was also demonstrated that the efficiency of other treatment procedures (such as utilizing a cPAP device or performing a surgical procedure) could be evaluated in advance using the patient-specific "digital twin" model.

Conclusions: This new methodology allows to significantly reduce the time required to provide the patient specific diagnosis and select an patient specific therapy, as well as to increase the success rate of the treatment. By incorporating appropriate age-dependent correlations of the biomechanical parameters into the "digital twin" model, the progression of the disease can be anticipated and intervened preventively.

PREDICTING HYPOVENTILATION IN SELECTED PATIENTS FOLLOWING HOME SLEEP APNEA TESTING

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Introduction: Although home sleep apnea testing (HSAT) is increasingly the diagnostic test of choice in patients with suspected obstructive sleep apnea , some of these patients will have co-existing hypoventilation due to shared risk factors and similar clinical presentations. The purpose of this study was to determine if clinical and HSAT parameters predict hypoventilation during sleep and wakefulness.

Materials and methods: This study was a retrospective analysis of consecutive patients referred to the FMC Sleep Centre for split-night polysomnography (PSG) for suspected sleep hypoventilation. Inclusion criteria were: age $\geq$ 18 years, suspected hypoventilation based on HSAT and clinical assessment by a board-certified sleep physician, and arterial blood gas (ABG) analysis on the night of PSG. Exclusion criteria included: a previous diagnosis of sleep disordered breathing, known neuromuscular disease, or use of supplemental oxygen therapy. Multivariable regression of clinical and HSAT data was used to identify predictors of sleep hypoventilation, defined as: 1) increase in transcutaneous partial pressure of CO_2 ($TcPCO_2$) >10mmHg to a value >50mmHg or 2) peak $TcPCO_2$ >55mmHg. Similar analysis was used to predict awake hypoventilation ($PaCO_2$>45mmHg).

Results: One hundred and forty two patients (58% male) were included. Mean (SD) age was 56 (13) years and mean body mass index (BMI) was 41.8 (19.6) kg/m^2. Univariate predictors of sleep hypoventilation included BMI, awake SpO_2, as well as $PaCO_2$, PaO_2, and bicarbonate from ABG analysis. Univariate predictors of sleep hypoventilation from HSAT included mean SpO_2, nadir SpO_2, and time with SpO_2 below 90%, 85%, and 80% thresholds. On multivariate analysis only $PaCO_2$ was predictive of sleep hypoventilation. Awake hypoventilation could not be predicted from the clinical assessment and HSAT data.

Conclusions: Awake $PaCO_2$ predicts sleep hypoventilation when it is suspected following clinical assessment and HSAT and could be used to triage patients for PSG. Further research is required to determine if more sophisticated analysis of the HSAT can be used to predict these outcomes independently of ABG results.

Sleep Breathing Disorders
Board #248 : Poster session 3

PREDICTING CPAP FAILURE IN PATIENTS WITH SUSPECTED SLEEP HYPOVENTILATION

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Introduction: Home sleep apnea testing (HSAT) is frequently used to diagnose obstructive sleep apnea. However, the oximetry pattern on the HSAT may also suggest sleep hypoventilation, leading to polysomnography to identify patients requiring non-invasive ventilation (NIV) rather than CPAP therapy. This approach is costly and may delay initiation of therapy in resource constrained settings. The purpose of this study was to identify clinical and physiologic predictors of the need for NIV during polysomnographic titration of positive airway pressure therapy.

Materials and methods: This study was a retrospective analysis of consecutive patients referred to the FMC Sleep Centre for polysomnography for suspected sleep hypoventilation. Inclusion criteria were: age ≥ 18 years, suspected hypoventilation based on HSAT and clinical assessment by a board-certified sleep physician, and arterial blood gas (ABG) sampling on the night of polysomnography. Exclusion criteria included: a previous diagnosis of sleep disordered breathing, known neuromuscular disease, or use of supplemental oxygen therapy. The primary outcome was failure of CPAP to correct nocturnal hypoxemia, leading to initiation of non-invasive ventilation; as per a physician-approved protocol and aligned with provincial funding policy in Alberta, failure of CPAP was defined as pulse oximetry < 85% for 5 consecutive minutes on CPAP ≥18 cmH2O. Chart review was performed to identify predictors of CPAP failure from patient characteristics, HSAT, ABG and pulmonary function testing.

Results: One hundred forty two patients (58% male) were included. Mean (SD) age was 56 (13) years and mean body mass index (BMI) was 41.8 (19.6) kg/m^2. Thirty (21%) patients failed CPAP. Univariate predictors of CPAP failure included awake oxygen saturation measured by pulse oximetry (SpO2) or ABG (SaO2), partial pressures of carbon dioxide (PaCO2) and oxygen (PaO2), serum bicarbonate, mean SpO2 from HSAT and time with SpO2 below 90%, 85%, and 80%. Oxygen desaturation index from HSAT, using both 3% and 4% thresholds, was not predictive. Multivariate analysis showed SpO2, PaO2, and PaCO2 all predicted CPAP failure. CPAP failure did not occur in patients with SpO2 > 94%. PaO2 ≥ 68mmHg decreased the likelihood of CPAP failure significantly (Negative Predictive Value 0.98).

Conclusions: Awake hypoxemia and/or hypercapnia predicted CPAP failure in patients with suspected sleep hypoventilation based on the oximetry pattern on HSAT. Adequate awake oxygenation measured using pulse oximetry or arterial blood gas sampling could be used to exclude CPAP failure. Although these results may help to triage patients with suspected sleep hypoventilation, further validation is required.

Sleep Breathing Disorders
Board #168 : Poster session 1
FAMILY EXPERIENCES WITH THE LOCAL PAEDIATRIC PAP SERVICE

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Introduction: Starting a child on PAP can come with specific challenges both for staff and families. Children starting PAP locally are likely to be on this treatment long term so ensuring that the initial experience is positive is important. We have recently made changes to the long term support service for children using PAP at home, so undertook a review of current services and family needs with the aim of ensuring the current practice was appropriate and acceptable.

Materials and methods: Families with a child using PAP at home were contacted regarding taking part in the research. Semi-structured family interviews were completed. Interviews were audiotaped and transcribed. Thematic analysis was performed, utilising NVIVO software, to determine recurring themes. Parents/guardians provided consent to take part and where possible the child using PAP provided assent.

Results: Sixteen families were interviewed. Age at CPAP initiation varied from 0.5-15 years and age at interview was 1-18 years. Co-morbidities of the children included: Obesity (n=5) Downs Syndrome (n=2), Muscular Dystrophy (n=2) Retrognathia (n=2) Prader Willi (n=1) Other airway issues (n=4). Recurring themes described by families included:
(1) Practical mask/machine issues - most families experienced teething issues with the device, ongoing problems included marks on the face and children being unable to adjust the mask themselves due either to age or disability. (2) Wider impact on family - most families felt that parental sleep was improved once their child was using PAP. (3) Understanding goal of treatment - relief of symptoms was a positive feedback for both parents and children to carry on with treatment. (4) Education and communication long term - both short term and long term contacts were felt to be important to establish and maintain treatment. Families with older children using PAP had some reservations about transitioning to adult services (5) New technology - families with newer devices felt reassured that data could be viewed by the specialist team without the need for an appointment.

Conclusions: Paediatric sleep physician, sleep laboratory and sleep nurse integration was seen as an effective model for short and long term care of children using PAP at home. Families were happy they knew who and when to contact staff. A transition plan is important to facilitate the transition to adult services.

HIGH DOSE ZOPICLONE DOES NOT CHANGE OSA SEVERITY, THE RESPIRATORY AROUSAL THRESHOLD, GENIOGLOSSUS MUSCLE RESPONSIVENESS OR NEXT-DAY SLEEPINESS AND ALERTNESS IN SELECTED PEOPLE WITH OSA

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Introduction: Recent studies of standard doses of hypnotics indicate that hypnotics either reduce or do not change OSA severity measured via the apnoea-hypopnoea index (AHI). Additionally, previous hypnotic studies indicate that they do not worsen genioglossus muscle responsiveness and activity during sleep. A 1-month trial of a standard dose of zopiclone (7.5mg) taken nightly was shown to modestly reduce the AHI versus baseline without changing other sleep parameters or next-day sleepiness. Therefore, this study aimed to determine the effects of a higher dose of zopiclone (15mg) on the AHI, sleep parameters, the respiratory arousal threshold, genioglossus muscle responsiveness and next-day sleepiness and alertness in selected people with OSA (low-moderate respiratory arousal thresholds without major overnight hypoxaemia). We hypothesised that a higher than standard dose of zopiclone may yield greater increases in the respiratory arousal threshold and therefore drive larger reductions in the AHI, but that this may be at the expense of increased hypoxaemia and next-day impairment.

Materials and methods: 28 participants (AHI=29 ± 20events/h) suspected to have low-moderate respiratory arousal thresholds were studied during two in-laboratory polysomnographies with an epiglottic pressure catheter and genioglossus intramuscular electrodes. Each visit was conducted 1-week apart after either 15mg of zopiclone or placebo according to a double-blind, randomised, cross-over design (ACTRN12617000988358). Subjective sleepiness and alertness via a 30-minute driving simulator task were assessed each morning.

Results: The AHI did not change from placebo to zopiclone (29 ± 20 vs. 27 ± 22events/h, p=0.54) nor did the nadir SaO_2 (84[79 to 88] vs. 84[79 to 89]%, p=0.96). The respiratory arousal threshold (-21[-14 to -27] vs. -22[-14 to -29]cmH$_2$O, p>0.99), peak genioglossus muscle responsiveness (-0.27[-0.09 to -0.61] vs. -0.19[-0.06 to -0.47]%max/cmH$_2$O, p=0.37) and other sleep parameters also did not change (e.g. arousal index= 36 ± 18 vs. 35 ± 20 events/h, p=0.95), nor did the majority of next-day sleepiness (KSS= 5 ± 2 vs. 6 ± 2, p=0.19) and alertness measures (e.g. steering deviation= 57[46 to 80] vs. 66[46 to 91]cm, p=0.58).

Conclusions: Contrary to our hypothesis and previous studies with standard doses of zopiclone, high dose zopiclone does not systematically reduce OSA severity or alter key components of upper airway physiology or next-day sleepiness or alertness. The mechanisms for these unexpected findings require further investigation. Nonetheless, these new data combined with other recent zopiclone studies in OSA indicate its favourable safety profile in this patient population albeit with minimal or no therapeutic benefit.

BARRIERS TO ACCEPTANCE AND UPTAKE OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY AFTER A ONE-MONTH TRIAL AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Obstructive Sleep Apnea (OSA) is a sleep-related breathing disorder associated with increased risk of hypertension, cardiovascular events, excessive daytime sleepiness, occupational and vehicular accidents, and death. While Continuous Positive Airway Pressure (CPAP) therapy is the gold standard treatment for OSA, its rates of use remain low. Reported CPAP initiation rates range from 30% to 70%. In Changi General Hospital (CGH), Singapore, patients diagnosed with OSA are offered a one-month CPAP trial. A previous study in CGH revealed that among patients who purchased CPAP after the trial, adherence rates were high (78.5%). However, uptake rates were low, with only one in two patients buying the CPAP post-trial. This study aimed to explore the barriers to CPAP uptake among these patients.

Materials and methods: This was a retrospective study. Participants were 361 patients diagnosed with OSA at CGH who opted not to purchase the CPAP post-trial between January 2011 and December 2015. Medical records were reviewed to obtain demographic and polysomnographic data. Telephone interviews were conducted to assess participants' knowledge of OSA, outcome expectancies, and barriers to CPAP uptake. Participants who had undergone surgery or decided to purchase the CPAP at a later date were excluded.

Results: From 223 contactable patients, 112 met inclusion criteria and consented to the phone interview (96 male patients, mean age = 48.57 years, mean Apnea-Hypopnea Index = 43.87 events/hr). While 74.1% of participants displayed an understanding of OSA, 46.4% were unaware of the consequences of untreated OSA. About half of the participants (55.4%) did not think they would be affected by these consequences, and two-thirds did not think CPAP would improve their health or daily performance (61.6% and 67% respectively). Majority (75%) believed they needed treatment for OSA, but the top reasons for not buying the CPAP were: discomfort (82.1%), did not experience benefit (55.4%), inconvenience (53.6%), and cost (41.1%). Participants who cited their reason as "did not experience benefit" were less likely to think that CPAP would be helpful for them, $\chi^2(1) = 43.1$, $p < .05$.

Conclusions: Comfort, ease of use, and outcome expectancies are main factors influencing decisions to initiate CPAP therapy among OSA patients post-trial. In addition, patients who had negative experiences with CPAP or reported that they did not experience benefit during the trial period were less likely to believe in the effectiveness of CPAP. This suggests that patients' experiences during the trial may contribute to their subsequent outcome expectancies. As such, close follow-up and provision of troubleshooting assistance for navigating difficulties with CPAP use during the trial phase may increase CPAP uptake rates. Educating patients about the personal implications of untreated OSA could also enhance CPAP acceptance.

PRELIMINARY STUDY ON THE APPLICATION OF UPPER-AIRWAY MODEL CONSTRUCTION WITH 3DMIA IN OSAHS OF CHILDREN

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Introduction: To investigate the applicability of 3DMIA[1] software to upper airway modeling in children with obstructive sleep apnea hypopnea syndrome (OSAHS).
Materials and methods: A total of 12 children diagnosed with OSAHS by polysomnography were included in this study. Data regarding upper airway structure were collected via spiral CT while sleeping and awake, from which a three-dimensional model of the upper respiratory tract from the nasopharynx to the supraglottic region using 3DMIA software was constructed. The upper airway volume and airway minimum cross-sectional area were measured employing software algorithms.
Results: The upper airway volume and airway minimum cross-sectional area of the 12 children during sleep were significantly less than while awake (P < 0.01).
Conclusions: 3DMIA software modeling and software algorithm measurement were more objective than traditional radiology (e.g. Fujioka) with respect to evaluation of the extent of the upper airway narrowing in OSAHS children, and showed good applicability to studying upper airway morphology and function in children with OSAHS.

Sleep Breathing Disorders
Board #245 : Poster session 1

MID-SAGITTAL TONGUE TISSUE STIFFNESS IS HIGHER IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA DURING WAKEFULNESS COMPARED WITH CONTROL SUBJECTS: AN ULTRASOUND SHEAR-WAVE ELASTOGRAPHY STUDY

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Introduction: The tongue plays a critical role in the development of obstructive sleep apnea (OSA) because it comprises the major dilator muscle of the upper airway (UA), namely the genioglossus (GG) muscle. In chronic diseases such as OSA, the biomechanical properties of the tongue tissue may be altered in response to UA resistance and intermittent hypoxia. This study aims to evaluate the potential of tongue tissue stiffness measurement in participants with OSA and healthy controls through ultrasound (US) shear-wave elastography (SWE).
Materials and methods: From October 2017 to December 2018, transcutaneous submental SWE was performed in 46 participants (20 healthy controls and 26 patients with OSA; 14 women and 32 men; aged 24-69 years) using a US system. Tongue tissue stiffness quantification with shear modulus of 0-200 kPa was recorded during normal breathing and the Müller maneuver (MM). Polysomnography (PSG) was used as the reference standard.
Results: Mid-sagittal tongue tissue stiffness was significantly higher in awake patients with OSA than in controls during normal breathing and the MM (normal breathing: 36.58 kPa vs. 21.12 kPa; MM: 37.30 kPa vs. 21.74 kPa, respectively; $P < .0001$). The posterior third of the tongue in patients with OSA had the highest value of shear modulus during the MM ($P < .001$). Shear modulus values of the posterior third of the tongue were significantly higher in mid-sagittal scanning than in coronal section in all participants during normal breathing and the MM. With cutoffs of 27.6 and 35.2 kPa for the whole tongue and posterior third during the MM, respectively, the sensitivity obtained was 69.2% (18 of 26) and 76.9% (20 of 26), and specificity was 85% (17 of 20) and 95% (19 of 20) respectively, for detecting OSA. The corresponding areas under the receiver operating characteristic curve were 0.82 and 0.88, respectively.
Conclusions: Quantifying tongue elasticity in a clinical setting is difficult. Through US SWE, we demonstrated that the stiffness (quantified as the shear modulus) of the tongue was higher in awake OSA patients than in healthy controls during normal breathing and the MM. The posterior third of the tongue showed the highest shear modulus value on SWE during the MM. Optimal cutoff values of shear modulus in the tongue tissues were identified. US SWE is an available tool that may objectively assess tongue tissue stiffness in patients with OSA during wakefulness.

CORRELATION OF SLEEP MICROSTRUCTURE WITH DAYTIME SLEEPINESS AND COGNITIVE FUNCTION IN YOUNG AND MIDDLE-AGED ADULTS WITH OBSTRUCTIVE SLEEP APNEA-HYPOPNEA SYNDROME

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Introduction: To compare microstructural features of sleep in young and middle-aged adults with differing severities of obstructive sleep apnea-hypopnea syndrome (OSAHS), and to investigate the relationship between sleep microstructural fragmentation and cognitive impairment, as well as daytime sleepiness, in these patients.
Materials and methods: A total of 134 adults with snoring (mean age, 37.54±7.66 years) were classified into four groups based on apnea-hypopnea index: primary snoring, mild OSAHS, moderate OSAHS, and severe OSAHS. Overnight polysomnography was performed to assess respiratory, sleep macrostructure (N1, N2, N3, R), and sleep microstructure (arousal, cyclic alternating pattern [CAP]) parameters. Cognitive function and daytime sleepiness were assessed using Montreal Cognitive Assessment (MoCA) and Epworth Sleepiness Scale (ESS).
Results: As OSAHS severity increased, MoCA gradually decreased and ESS gradually increased. N1%, N2%, and N3% sleep were significantly different between the severe OSAHS group and the primary snoring, mild OSAHS, and moderate OSAHS groups (all $P<$ 0.05). Overall arousal index, respiratory-related arousal index, CAP time, CAP rate, phase A index, number of CAP cycles, and phase A average time differed significantly in the moderate and severe OSAHS groups compared with the mild OSAHS and primary snoring groups (all $P<$ 0.05). The strongest correlations identified by stepwise multiple regression analysis were between phase A3 index and the MoCA and ESS scores.
Conclusions: Sleep microstructure exhibited significant fragmentation in patients with moderate and severe OSAHS, which was associated with decreased MoCA and increased ESS scores. This suggests that phase A3 index is a sensitive indicator of sleep fragmentation in OSAHS.

CLINICAL SYMPTOMS AND SLEEP STRUCTURE CHANGES WITH CONTINUOUS AIRWAY POSITIVE PRESSURE TITRATION AMONG ASIAN SLEEP APNEA PATIENTS WITH LOW AROUSAL THRESHOLD

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Introduction: Low respiratory arousal threshold (ArTH) has been observed to be prevalent in non-obese obstructive sleep apnea (OSA) patients, and is associated with poor adherence to continuous positive airway pressure (CPAP) treatment. Sleep disturbance among low ArTH patients may have contributed to the low CPAP adherence. This study aimed to examine the prevalence of low ArTH among OSA patients, and the associations between clinical features of Asian OSA patients and low ArTH. The second aim was to examine sleep structure changes between PSG and CPAP titration studies among low ArTH patients.

Materials and Methods: PSG data for 5,209 adults who were referred to a sleep center in Taiwan were reviewed retrospectively. Among them, 3,718 had an AHI ≥ 5, and 206 had CPAP titration studies. Participants with AHI ≥ 5 were dichotomized into low and high ArTH groups according to their PSG parameters, i.e., apnea-hypopnea index (AHI), nadir oxygen saturation, and hypopnea fraction. We compared clinical complaints and chronic illness history between high and low ArTH groups by chi-square tests and ANOVA. The associations between low ArTH and clinical symptoms as well as chronic illness history were examined by multivariate logistic regressions. The intra-individual sleep structure changes between PSG and CPAP titration studies were examined by paired t test.

Results: 50.2% OSA patients had a low ArTH. Compared with high ArTH patients, low ArTH patients were younger, had a lower percentage of women and obesity, and had a lower AHI. In logistic regression models, we found that snore, and chronic illness history of hyperlipidemia and hyperuricemia were negatively associated with low ArTH. After controlling for age, sex, BMI and AHI, no chronic illness history was associated with low ArTH, but morning headache, bruxism, and nocturia were significantly associated with low ArTH. During CPAP titration study, low ArTH patients had decreased stage changes, and increased percentage of slow wave sleep as well as rapid eye movement sleep compared with PSG study, although the extent was smaller than high ArTH patients.

Conclusions: Low ArTH was prevalent in our sample. Morning headache, nocturia, and bruxism were associated with low ArTH, but the causal relationship needs further study. Low ArTH patients benefited from CPAP titration study for improved sleep structure.

MONITORING AT HOME BEFORE AND AFTER TONSILLECTOMY: A FEASIBILITY STUDY

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Introduction: Tonsillectomy and/or adenoidectomy (T/A) are commonly performed procedures in children. The most common indication for surgery is suspected or diagnosed Obstructive Sleep Apnea (OSA). Polysomnography (PSG) is the gold standard for diagnosing and assessing OSA [1]. While pulse oximetry is part of the standard monitoring used during PSG, its potential as a standalone tool to diagnose those patients most at risk of post-operative respiratory events has been investigated but is yet to be fully realized [2]. We aimed to determine the feasibility of using the Phone Oximeter-OSA app to monitor children at home before and after T/A procedures.

Materials and methods: Following Research Ethics Board approval and informed consent, children from 3 months to 17 years of age, scheduled for T/A, were enrolled in this study. A Masimo pulse oximetry sensor (LNCS Inf-3TM) was attached to the participant's big toe and connected to the Phone Oximeter. Overnight pulse oximetry data was collected on the Phone Oximeter-OSA app for three nights at home before surgery, and three consecutive nights immediately post-surgery, at home or in the hospital (if admitted). The app records heart rate, blood oxygen saturation (SpO2), photoplethysmography, and signal quality index (SQI). Participants were stratified into five groups based on the clinical assessment of pre-op risk as determined by the anesthesiologist from history and examination. The best preoperative recording ($\geq$ 3 hours and SQI $\geq$ 70%) for each participant was selected for analysis and the following features were characterized in 1-min signal segments: the average SpO2 (SpO2ave), the cumulative time spent below an SpO2 of 90% and 94% (t90%, t94%) in minutes/hour, and the number of SpO2 desaturations >3% below baseline with a duration of at least 5 seconds (n3%). The means of each feature were compared to the assessments done by the anesthesiologist, using the Kruskal Wallis T-test to evaluate overnight SpO2 dynamics. No correction for multiple comparisons was performed and research staff were not blinded to the anesthesiologists´ stratification of pre-op risk.

Results: 125 patients were enrolled with a median [IQR] age of 6.30 [4.23] years and pre-op risk stratified as no risk (n=7), low risk (n=37), neither high nor low risk (n=17), high risk (n=24), very high risk (n=3). No significant differences in the means of SpO2ave (H=5.739,df=4,p=.849), t90 (H=4.530,df=4,p=.339), t94 (H=3.447,df=4,p=.486) and n3% (H=5.739,df=4,p=.220) across the categories were found.

Conclusions: The initial phase of the study has confirmed that it is feasible to obtain recordings of sufficient quality at home. The analyzed SpO2 characterization features did not significantly change with the clinical assessment of pre-op OSA risk by the anesthesiologist. This may indicate that clinical history and examination alone may not be able to diagnose and determine OSA severity. Hence determining the best post-op disposition for children undergoing T/A in the absence of PSG is likely to be arbitrary. Future work will involve analyzing night-to-night variability to account for outliers and provide a more in-depth picture of OSA risk in children.

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THE NASAL CYCLES DURING SLEEP ON OSA

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Background and Objectives: The phenomena of periodic cycles of vascular engorgement on the nasal cavity mucosa that alternate between right and left sides are termed the "nasal cycle."It has been reported that nasal cycle duration during sleep is longer than in wakefulness by Kimura et al. They also reported that the reversal of cyclic phase during sleep(RCS) tended to be associated with REM sleep and postural changes. In this study, we evaluated the nasal cycle on the patients with Obstructive Sleep Apnea(OSA).
Methods: We measure airflow independently through each nostril with PSG on 27 subjects with OSA aged 24 to 69 years diagnosed by polysomnography.
Results: Eleven of 27 (40.7%) subjects with OSA presented RCS during sleep.
In 11 subjects, the mean number of RC during sleep is 2.36±1.37(the total number is 26). Eleven of 26(42.3%) reversals occurred associated with postural changes. RCS occurred in REM sleep is only 1 subject (7.7%).
Considerations: According to the study done by Kimura et al, RC tended to be associated with REM sleep(68.8%) and postural changes(18.8%) in healthy subjects. In OSA subjects, it was 16.2%, 50.0% each. So, RCS that was associated with postural changes was increased and RCS that was associated with REM sleep was decreased in OSA subjects. As AHI rose, RCS became hard to occur. It was considered that OSA patients present entirely different nasal physiology from healthy subjects.

Sleep Breathing Disorders
Board #273 : Poster session 2

NOCTURNAL HYPERTENSION INCREASES RISK OF CARDIOVASCULAR DISEASE IN MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Obstructive sleep apnea (OSA) is one of the most commonsleep-disordered breathing characterized by repeated obstruction/narrowing of the upper airways during sleep that causes intermittent hypoxemia and hypercarbia.There is increasing sympathetic neural tone, which causes vasoconstriction and marked increase in blood pressure. Normally, sleep is associated with a 10%-15% reduction in systolic and diastolic blood pressure (BP) compared to wakefulness.But in OSA patients, the blood pressure increases during sleep, this condition is called nocturnal hypertension. Many studies show association of nocturnal hypertension and cardiovascular risk. However, the relationship of nocturnal hypertension to cardiovascular outcomes in OSA patients is still unclear. The aim of our study was to investigate the association of nocturnal hypertension with cardiovascular risk in obstructive sleep apnea patients.

Materials and methods: In prospective observational cohort study, the data of patients aged between 30-74 years and diagnosed as OSA by polysomnography in Phramongkutklao hospital was collected from March 2018 to January 2019. All subjects were monitored nocturnal blood pressure by pulse wave transit time. We stratified cardiovascular risk by using Framingham 10-year risk of general cardiovascular disease. The primary objective was analyzed by logistic regression analysis.

Results: We prospectively examined 146 patients diagnosed OSA between March 2018 to January 2019. All subjects were predominately in male (67.1%) and aged 52.52±13.31 years. Most OSA patients had hypertension and dyslipidemia as comorbidities. Their OSA severities were mild (16.4%), moderate (29.5%) and severe (54.1%).The prevalence of nocturnal hypertension was 61% in OSA patients and 76.84% in OSA patients with hypertension. The OSA patients with nocturnal hypertension had a higher cardiovascular risk score than those without nocturnal hypertension (OR 1.04, 95% CI 1.01 to 1.08; P=0.026). The risk factors for nocturnal hypertension were apnea-hypopnea index (AHI) severity, arousal index, oxygen desaturation index and mean oxygen saturation. There was significant association between nocturnal blood pressure pattern and AHI severity.

Conclusions: OSA and nocturnal hypertension was associated with increased cardiovascular risk compared with OSA without nocturnal hypertension. Nocturnal hypertension in OSA patients were associated with severity of OSA, ODI and arousal index.

Acknowledgements: Sleep technologists at sleep center at Phramongkutklao hospital.

SCREENING FOR OBSTRUCTIVE SLEEP APNEA PREDICTS CARDIOPULMONARY EVENTS IN PATIENTS UNDERGOING BRONCHOSCOPY WITH MODERATE SEDATION

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Introduction: There are limited data on the risk for sedation-related cardiopulmonary events in patients with undiagnosed obstructive sleep apnea (OSA) during flexible bronchoscopy.

Materials and methods: To evaluate the prevalence of high-risk patients for OSA by using a screening questionnaire and to determine whether screening predicts patients who are at risk for cardiopulmonary events during bronchoscopy with sedation, we prospectively enrolled 290 consecutive patients who underwent the procedure with moderate sedation. The STOP-BANG questionnaire was used to identify patients at high risk for OSA (score $\geq$ 3 of 8) or low risk (score < 3 of 8).

Results: The prevalence of a STOP-Bang score $\geq$ 3 was 67.2% (195/290). There were 26 (27.4%) cardiopulmonary events in the 95 patients with a STOP-Bang score < 3 compared with 81 (41.5%) events in the 195 patients with a STOP-Bang score $\geq$ 3 (P = 0.019). In multivariable analysis, a STOP-Bang score $\geq$ 3 was significantly associated with a higher rate of cardiopulmonary events (adjusted odds ratio, 1.85; 95% confidence interval, 1.06 - 3.21; P = 0.030).

Conclusions: Approximately two thirds of patients undergoing bronchoscopy with moderate sedation were at risk for OSA. Being at high risk for OSA was significantly associated with cardiopulmonary events during the procedure.

Acknowledgements: ClinicalTrials.gov number, NCT03325153

ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNEA AND BREAST CANCER: NATIONAL INSURANCE SERVICE SURVEY

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Introduction: Some studies have argued that obstructive sleep apnea (OSA) increases the risk of breast cancer. However, the results are often conflicting. This study aimed to investigate associations between OSA and breast cancer incidence using the Korea National Health Insurance Service database.

Materials and methods: This retrospective cohort study analyzed data from the Korea National Health Insurance Service database. A total of 45,773 women (≥ 20 years of age) newly diagnosed with OSA between 2007 and 2014 were included. The control group of 228,865 subjects was selected using propensity score matching by age and sex. The mean follow-up duration was 4.5 ± 2.3 years. The primary endpoint was newly diagnosed breast cancer.

Results: The breast cancer hazard ratio (HR, 95% confidence interval [CI]) was calculated for patients with OSA and compared with that of the control group. The incidence of breast cancer among patients with OSA was significantly higher than among the controls (HR 1.16, 95% CI 1.02-1.32). In particular, the incidence of breast cancer was higher among patients aged ≥ 65 years (HR 1.56, 95% CI 1.03-2.31).

Conclusions: OSA may be a risk factor for breast cancer in women. This clinical data provide meaningful evidences for a connection between OSA and breast cancer.

SURGICAL MANAGEMENT OF OSAHS - OVERCOMING CHALLENGES IN SLEEP SURGERY IN A DEVELOPING COUNTRY

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Introduction: The protocol of using Nasal CPAP as the Gold standard treatment of OSAHS is being followed worldwide. However in certain situations Surgery is indicated.
In addition to known common issues that merit Surgery such as Non-Compliance etc. in third world countries, an additional challenge is for the patient finding the funds for the procurement of the CPAP machine. These patients often need to be offered sleep surgery after proper counselling regarding their expectations from sleep surgery - in spite of having benefitted with a Nasal CPAP during trial. They opt in for surgery as this is the affordable option for them.
At our tertiary care institution in Western India, sleep surgery is being done for patients presenting with OSAHS with either non-compliance or, inability to afford the CPAP machine. A chronic problem we face is patients being lost to follow up and a desire to avoid any investigations once surgery is completed, unless there are complications. In view of this other modalities are needed to monitor these patients.
Materials and methods: 15 patients who have undergone or, are to undergo sleep surgery (Z-palatopharyngoplasty and Radiofrequency Ablation of the Soft palate, lateral pharyngeal wall and Base of tongue) are being assessed. These are diagnosed OSAHS patients confirmed by Polysomnography and are either Nasal CPAP non-compliants or, too poor to afford a Nasal CPAP machine. The patients submitted answers to two questionnaires- the Epworth Sleepiness Scale (ESS) and the STOP-BANG. A Visual Analog Scale (VAS) was also used to assess the subjective feelings of improvement, if any. All patients underwent Drug induced sleep endoscopy (DISE) to enable surgical decision using the VOTE classification. 7 patients have undergone surgery in the form of Z-palatopharyngoplasty and/or Radiofrequency Ablation of the Soft palate, lateral pharyngeal wall and Base of tongue.8 patients are within the 3 month follow up period and will be evaluated once that period is complete.
Results: Post-operative Polysomnography not possible in these patients as they cannot afford a second PSG, however the Comparison between pre and post op STOP-BANG and ESS scores shows specific improvements following surgery. The results were subjected to the Wilcoxon Signed Rank Test. THE STOP-BANG Showed a change from 4 to 2 (p=0.027), the ESS changing from 9.0 to 3.0 (p=0.027) and the VAS showed a change from 33.0 to 20.0 (p=0.061).
Conclusions: This preliminary report suggests that utilisation of the VAS, ESS and STOP-BANG as tools for diagnosing, monitoring, and follow up of patients unwilling to undergo a second Polysomnography is a possibility which needs to be further explored. Initial results indicate that these can be aids in the assessment of surgical outcomes, however further case series are required in order to perform optimal statistical analysis of the same.
Acknowledgements: 1. Dr. Murry W Johns, Epworth Hospital, Melbourne
2. Toronto Western Hospital, University Health Network, University of Toronto

SLEEPINESS ASSESSED VIA CONTINUOUS OCULAR ALERTNESS MEASURES IN OBSTRUCTIVE SLEEP APNOEA PATIENTS DURING REGULAR ON ROAD DRIVING

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Introduction: Obstructive sleep apnoea (OSA) is associated with excessive daytime sleepiness and a 2-7 fold increased risk for motor vehicle accidents. Fitness to drive assessment in OSA is difficult due to a lack of accurate, validated, objective tools that can be easily implemented clinically. This study determined whether continuous ocular alertness measures, recorded via glasses (Optalert) worn during regular driving, could identify sleepy driving in OSA.

Materials and methods: 16 (10 male) untreated moderate to severe OSA patients (AHI≥15) and 16 healthy gender and age-matched controls (±5 years) were recruited. Inclusion criteria were: age 21-80 years, ≥4 hours of driving weekly, ≤300mg of caffeine consumed daily and an Epworth Sleepiness Scale (ESS) score ≤18. Additional criteria for healthy controls were: an ESS≤8 and a multivariate apnoea prediction index < 0.5 indicating low risk for OSA.

Participants were fitted with Optalert glasses that continuously recorded eyelid movements via infrared sensors. Across a seven-day period, each time participants drove they wore the glasses and completed a drive diary that recorded drive time and pre- and post-drive sleepiness (Karolinska Sleepiness Scale [KSS]). Optalert software provided ocular values for each minute that were averaged across all driving for each participant and compared between groups via paired t-tests with means ± SDs reported.

Results: The OSA group were similar in age to the healthy group (49.8 ± 7.1 vs. 49.2 ± 7.2 years, p=.383), but had greater ESS scores (10.3 ± 4.7 vs. 3.3 ± 2.4, p=< .001) and higher BMI values (kg/m2 = 40.5 ± 6.4 vs. 23.0 ± 3.7 kg/m2, p=< .001). The apnoea-hypopnoea index in the OSA group was 48.2 ± 23.0.

Total drive minutes were similar between the OSA and control groups (489.0 ± 198.8 vs. 586.7 ± 393.5, p=.413). The OSA group had higher pre- and post-drive KSS scores (post-drive = 4.3 ± 1.2 vs. 2.3 ± 1.2, p< .001). For ocular measures, a composite ocular score - the Johns Drowsiness Scale, was twice as high for the OSA group (1.1 ± 0.8 vs. 0.6 ± 0.5, p=.019). The amplitude-velocity ratio of eyelid closing was 1.6 ± 0.3 for the OSA group and 1.5 ± 0.2 for the control group (p=.058). Time in milliseconds between the maximum velocity of the eyelid closing and reopening was 100 ± 30 for the OSA group and 80 ± 20 for the control group (p =.084). Blink total duration (p=.249), % of long eye closures (p =.272) and % of time with eyes closed (p =.411) were not different between groups.

Conclusions: OSA patients were subjectively and objectively sleepier than healthy individuals during regular driving. Ocular alertness measures can provide non-invasive sleepiness assessment during extended periods of regular driving, with potential for fitness to drive assessment. Further work should assess individual differences amongst OSA patients, determine how these measures relate to adverse driving events and establish at risk cut-off values.

Sleep Breathing Disorders
Board #248 : Poster session 1
CHARACTERISTICS OF SLEEP APNEA PATIENTS IN MONGOLIAN FIRST SLEEP CENTER

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Introduction: In Mongolia we not studied yet sleep apnea prevalence and In Mongolia luck of study of seep related breathing disorders and treatment.

In 2018, we established the First Sleep Center at the General hospital for state special servants (GHSSS) in Mongolia, which led to diagnose and differentiate and to treat of various sleep disorders, including obstructive sleep apnea patients.

In addition, it has become possible to provide evidence-based research in this area as it has the potential to provide CPAP treatment for OSA. Therefore, for the first time in our country, the diagnosis of OSA with the help of the PSG and the need for treatment of CPAP in the patients as necessary is the basis for the study.

Material and methods: Descriptive study was conducted in First sleep center of General hospital for state special servants of Mongolia to investigate daytime sleepiness, neurobehavioral function in patients with mild and severe obstructive sleep apnea (OSA) and to assess the response to 45 days of treatment with CPAP.

Before commencement of CPAP, and at the end of each 45 days treatment period, patients underwent the neurobehavioral assessment and completed the Epworth Sleepiness Scale (ESS) and Quality of Life and PSQI.

The Human Research Ethics Committees approved the project and written informed consent was obtained from each patient. Patients recruited into the study were referred for investigation of symptomatic sleep-disordered breathing (snoring, observed breathing pauses in sleep, and daytime sleepiness). They were eligible for inclusion in the study if they were more than 18 year of age and if their overnight diagnostic sleep study showed an AHI of above 15/h.

The Statistical (EXCEL, "R") program was used. Multiple regression analysis was used to assess the relationship between variables. A p value of 0.05 was taken as significant.

Results: We did all of 97 (55male, 42female) sleep study from 15th November, 2018 to 11th July, 2019. From this we find out 37 obstructive sleep apnea patient (12 female, 25 male) AHI above 15.

15 patients (5female, 10 male) from 37 had CPAP treatment for 1,5 months.

Neurobehavioral test, ESS test and FOSQ test, FS-36 tests were measured at baseline, after 45 days of treatment with CPAP.

Patients used CPAP for a mean (SD) of 5.53 (3.13) h per night and the mean AHI on the night of CPAP implementation was 4.24 (2.9).

Conclusion: CPAP improved self-reported symptoms of OSA, including snoring, restless sleep, daytime sleepiness, and irritability (in-house questionnaire).

We found benefit of CPAP in every tests of neurobehavioral function, generic SF-36 (36-item Short Form Medical Outcomes Survey) or sleep-specific (Functional Outcomes of Sleep Questionnaire) quality of life questionnaires.

Furthermore we will do oral appliance treatment for these patients and will do randomized controlled trail.

A CROSS SECTIONAL STUDY ON THE PREDICTORS OF OBESITY HYPOVENTILATION SYNDROME AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SEEN AT THE LUNG CENTER OF THE PHILIPPINES

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Introduction: Obesity Hypoventilation Syndrome (OHS) remains under-diagnosed due to lack of appropriate predictors which establish a concrete association with daytime hypercapnia or its acceptable surrogates like end-tidal carbon dioxide (EtCO2). Patients with OHS have higher morbidity, lower quality of life, more health care expenses and higher mortality hence, early diagnosis and treatment is important. We aim to determine the predictors of Obesity hypoventilation syndrome among patients with Obstructive Sleep Apnea seen at the Lung Center of the Philippines.

Materials and methods: This is a cross-sectional analytical study involving review of medical records of patients who underwent polysomnography with end tidal carbon dioxide in the sleep laboratory at Lung Center of the Philippines.

Results: A total of 127 obese OSA patients with a mean age of 41 years old were recruited. Of the 127 subjects, 32.3% (41 out of 127) had obesity hypoventilation syndrome. In comparison between OHS versus Eucapnic OSA group we found that OHS patients had significantly higher BMI (43.4 vs 35.6 cm; $p < 0.0001$)], higher Mallampati score (4.0 vs 3.0; $p < 0.009$), higher ESS score (16.0 vs 12.0; $p < 0.002$)] and higher neck circumference (46.0 vs 44.0 cm; $p < 0.008$). Polysomnographic parameters also showed that subjects with OHS had significantly higher Respiratory disturbance index (114.3 vs 91.3 per hour; $p < 0.0001$), oxygen desaturation index (90.0 vs 49.7 per hour; $p < 0.0001$), sleep time with $SpO_2 < 90\%$ (56.4 vs 44.1 minutes; $p < 0.0001$) and maximum end-tidal $PaCO_2$ (61 vs 49 mmHg; $p < 0.0001$). The average awake SpO_2 (97 vs 96%; $p < 0.0001$), nocturnal mean SpO_2 (88 vs 95%; $p < 0.0001$) and lowest SpO_2 (57 vs 77%; $p < 0.0001$) were also significantly lower in subjects with obesity hypoventilation syndrome. Continuous positive airway pressure was significantly higher in the OHS group [14 vs 10 mmHg; $p < 0.001$). Bi-level positive airway pressure therapy was more commonly needed in 41.5% of subjects with OHS compared with 4% of subjects with eucapnic OSA. Multivariate logistic regression analysis correlated with maximum end-tidal PCO2 showed that Body mass index ≥ 35.6 kg/m^2, nocturnal mean $SpO_2 \leq 93\%$, sleep time with $SpO_2 < 90\% \geq 60$ minutes and Mallampati score ≥ 4 were related factors for obesity hypoventilation syndrome.

Conclusions: The following cut off points can be used as predictors for early diagnosis of OHS: Body mass index ≥ 35.6 kg/m^2, Nocturnal mean $SpO_2 \leq 93\%$, sleep time with $SpO_2 < 90\% \geq 60$ minutes and Mallampati score ≥ 4.

SLEEP SPINDLES AND THEIR ASSOCIATION WITH OBSTRUCTIVE SLEEP APNEA SEVERITY IN MEN AND WOMEN

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Introduction: Obstructive sleep apnea (OSA) is a condition that affects up to 50% of adults after 65 years old. OSA has recently been linked to an increased risk of mild cognitive impairment and dementia, but mechanisms linking OSA to neurodegeneration have not been elucidated yet. Men and women may be affected differently by obstructive sleep apnea as they have different symptoms. Sleep spindles are oscillations that occur during stage 2 of NREM sleep. Higher spindle densities have been associated with better memory consolidation and sleep consolidation. Moreover, reduced spindle density is associated with mild cognitive impairment and dementia. Here, we investigated whether more severe OSA is associated with abnormal spindle characteristics in men and women aged 55 and older.

Materials and methods: We tested 103 adults (64.2 ± 6.7 years old; 24 women) with a full night of in-laboratory polysomnography. Controls represented 17.5% of the sample (apnea-hypopnea index < 5), 35.9% had mild OSA (apnea-hypopnea index >5 and < 15), and 46.6% had moderate to severe OSA (apnea-hypopnea index >15). We measured three OSA severity markers: the apnea-hypopnea index, time with oxygen saturation < 90% and the micro-arousal index. Sleep spindles were automatically detected on F3, C3, P3, O1 and we measured the following spindle characteristics: density, amplitude, duration, and oscillation frequency. Correlations between OSA severity (apnea-hypopnea index, time with oxygen saturation < 90% and the micro-arousal index) and sleep spindles were performed in men and women separately, and were considered significant at $p < 0.01$.

Results: On average, women had lower apnea-hypopnea index than men (t (49,269) = 2.63, $p < 0.01$). In men, OSA severity was not significantly correlated to spindle characteristics. Among the 24 women, however, spindle amplitude on F3 was negatively correlated with apnea-hypopnea index (r = -0.638, $p < 0.001$). No correlations were observed between any spindles characteristics and time spent with oxygen saturation < 90% or the micro-arousal index.

Conclusions: Our results show that, in men, OSA has no association with spindle characteristics. However, in women, more severe OSA is associated with reduced spindle amplitude in the frontal region. The impact of reduced spindle amplitude on daytime cognitive function is not clear and whether women are more vulnerable than men to the cognitive consequences of OSA need to be investigated in future studies.

MANDIBULAR ADVANCEMENT DEVICE IS AN EFFICACIOUS TOOL TO TREAT OBSTRUCTIVE SLEEP APNEA AND REVERSE LEFT VENTRICULAR HYPERTROPHIC REMODELING

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Introduction: Obstructive Sleep Apnea (OSA) is known to be associated with cardiovascular comorbidities such as left ventricular (LV) hypertrophy, diastolic dysfunction and pulmonary hypertension, and may be partially reversed by CPAP therapy. However, it remains elusive whether OSA per se is an independent factor for hypertrophic remodeling beyond associated comorbidities like arterial hypertension and obesity. Furthermore, data are scarce regarding the effect of mandibular advancement devices (MAD) on LV remodeling and function in OSA patients. The aim of this prospective clinical trial is to evaluate the effect of a custom-made, titratable MAD on LV geometry and function in OSA patients.
Materials and methods: In this ongoing study, 100 patients with moderate to severe OSA will be included and treated with MAD therapy (SomnoDent® Flex™, SomnoMed Ltd, Australia). At baseline and 6-month follow-up, participants undergo a type 3 home sleep test (HST; MediByte, Braebon Medical Corporation, Kanata, Ontario, Canada), 24-hour ambulatory blood pressure (BP) monitoring, a comprehensive 2D Doppler and tissue Doppler echocardiography combined with speckle tracking, and objective adherence measurement.
Results: Up to this date, 90 patients started MAD therapy and 52 patients completed the 6-month follow-up visit (age: 48±11 years; 74% male; baseline AHI-HST: 18.5±16.6 events/hour; body mass index (BMI): 27±3 kg/m²; 24-hour systolic BP: 124±14 mmHg, 24-hour diastolic BP: 76±7 mmHg). Twenty-five patients were lost to follow-up, mainly due to the time-consuming protocol, and in 13 patients the 6-month follow-up appointments are currently being planned as a function of the individual timing when the MAD was fitted.At 6-month follow-up (n = 52), a statistically significant decrease in AHI ($p < 0.001$) to 8.3±9.1 events/hour was observed compared to the baseline measurement. Overall, systolic and diastolic BP values, parameters of LV systolic and diastolic function, and pulmonary artery pressures were within normal ranges and did not change under MAD therapy. In contrast, the interventricular septum (IVS) thickness was at the upper limits of normal at baseline, and showed a significant decrease at 6-month follow-up (10.9±2.1 mm vs. 10.3±1.9 mm, $p < 0.05$). There was no correlation between the decrease of IVS thickness and the change in BP during 6-month follow-up.
Overall objective adherence was high (average MAD use 6.6±2.3 hours per night, and MAD usage >4 hours per night in 86% of patients). In these compliant users, IVS thickness decreased from 10.9±1.9 mm at baseline to 10.2±1.7 mm at 6-month follow-up. This reduction in IVS thickness was significant in these compliant users ($p < 0.05$), in contrast to the non-compliant patients.
Conclusions: The preliminary results of this ongoing clinical trial showed that MAD is efficacious in reducing OSA severity with high rates of objectively measured adherence. In our mildly obese, normotensive study cohort with moderate to severe OSA, we observed early hypertrophic remodeling of the interventricular septum at baseline, with significant improvement at 6-month follow-up regardless of systemic blood pressures suggesting that OSA is also an independent factor in the pathophysiology of LV hypertrophy in these patients.

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HOME TREATMENT OF SLEEP APNEA BY ELECTRICAL AURICLE STIMULATION: 7-YEAR RESULTS BASED ON NIGHTLY USE OF THE EAS SYSTEMS

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Introduction: Electrical auricle stimulation (EAS) is a novel noninvasive method for treatment of obstructive (OSA) and central sleep apnea (CSA) syndrome. It was developed and introduced by the research team of prof. Zoltan Tomori and prof. Viliam Donic in 2014 in Kosice, Slovakia. Also presented on World Sleep 2017 in Prague. EAS is patented worldwide, including the USA and Europe. The method is based on our hypothesis that EAS can reflexively activate the brainstem inspiratory generator to restart breathing in humans during sleep. It can eliminate airway obstructions by sending a short electrical impulse to a specific stimulation area located on outer part of the auricle, where afferent neuron pathways start. Such stimulation can quietly and comfortably result in resumption of ventilation and improve the quality of sleep. From 2013 to 2019 two generations of EAS systems have been developed; both are suitable for sleep apnea treatment at home. Both EAS systems share the same principle, however, the second generation (EASM) was significantly miniaturized utilizing a built-in battery powered stimulator, while the computer was replaced by a mobile android device. The second generation is a user-friendly wearable device easy to transport and setup. In the present study, we sought to analyze the results of nearly 7-year (2013-2019) use of EAS systems at home by a male patient with severe OSA, confirmed by full night laboratory-based polysomnography.

Materials and methods: During sleep, the EAS device applied electrical stimuli to the auricle of the ear, upon cessation of breathing, until breathing was resumed. A reference night, (without stimulation) showed the following parameters: time in bed (TIB)=412 min; apnoe index (AI)=65,2/h; Body Mass Index (BMI)=28.5 kg/m^2 and was compared to nights with stimulation using the first generation EAS system and the second generation (EASM) system. Out of 1430 EAS stimulation nights 946 were evaluated. The EAS period was followed by the EASM with 43 night recordings collected and 38 nights evaluated. Some nights are missing for various reasons.

Results: Stimulation by the EAS system induced an increase in the TIB ($p < 0,001$) from 2013 (TIB=370,20 ± 7,56 min) to 2019 (TIB=437,9 ± 6,72 min) and a decrease in the AI ($p < 0,001$) from 2013 (AI=31,46 ± 1,78/h) to 2019 (AI=6,89 ± 0,48/h). The number of electrical impulses per night generated by EAS system had a tendency to decrease (2013, n=1800; 2019, n=988). Comparison of TIB and AI between the EAS (TIB = 375,54 ± 5,88 min; AI = 16,89±0,83/h) and the EASM system (TIB=367,1 ± 8,23 min; AI = 4,85 ± 0,58/h) was in favour of EASM ($p < 0,001$; $p < 0,01$). The patient felt subjectively very good with no side effects reported during the treatment period using the EAS/EASM.

Conclusions: 7-years of home treatment using EAS/EASM in a patient with severe OSA showed significant improvements in TIB and AI parameters. Comparison between EAS and EASM showed similar results in TIB and AI parameters. The patient felt better on both systems, however, EASM was considered more comfortable.

VIDEOENDOSCOPIC EVALUATION OF SWALLOWING IN PATIENTS UNDERGOING EXPANSION PHARYNGOPLASTY FOR OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Expansion pharyngoplasty (EP) is a surgical procedure used in the treatment of obstructive sleep apnea (OSA). This surgical technique mainly target velopharyngeal structures, which play an important role in deglutition and nasalance scores. The aim of this study is to assess the swallowing pattern through nasofibrolaryngoscopy (NFL) and fiberoptic endoscopic examination of swallowing (FESS) of patients undergoing EP.

Materials and methods: Eighteen consecutive patients with OSA were submitted to PO (postoperative group) were evaluated after a minimum of 6 months after surgery by NFL and FESS. These patients were compared to seven subjects of a control group (CO). In order to avoid evaluation bias, three different teams were organized to follow up the subjects. A medical team was responsible for the diagnosis, surgical indication and surgical procedure. Another team followed the outpatient clinic and documented the clinical and endoscopic evaluations of patients postoperatively in digital files. A third team composed of three *otolaryngologists with expertise* in dysphagia, independently analyzed and blinded the images of the endoscopic evaluations. The results obtained by the analysis of these three evaluators were organized in a database from which the statistical analysis of each one of the studied variables was carried out. Initially all variables were analyzed descriptively. Absolute and relative frequencies were calculated for the qualitative variables. Fisher´s exact test was used to test the homogeneity between the proportions. Kappa index was used to study agreement among observers.

Results: The NFL evaluation showed statistically significant difference between the PO and CO groups for velopharyngeal closure (p = 0.019). In the study group, 72.2% (n = 13) presented coronal velopharyngeal closure and 27.8% (n = 5) circular closure, while in the CO group 42.9% (n = 3) presented coronal velopharyngeal closure, 3% (n = 1) circular and 42.9% (n = 3) circular closure with Passavant ring. Regarding FESS, during the evaluation with 10 ml of liquid, in the PO group there was liquid stasis in 50% of the patients (n = 9) and 28.6% (n = 2) in the control group (p = 0.018). It was also observed oropharyngeal reflux in 50% (n = 9) of patients in the PO group, which did not occur in any patient in the CO group (p = 0.027).

Conclusions: We observed functional deglutition differences in patients submitted to EP when compared to the control group. Such diferences, however, are not associated with patients´ complaints of dysphagia.

Acknowledgements: No

THERAPY FOR OBSTRUCTIVE SLEEP APNEA (OSA) IMPROVED RATINGS OF REFRESHING SLEEP, LEADING TO LESS DAYTIME SLEEPINESS, REDUCED COGNITIVE DIFFICULTIES AND WORK-RELATED BURNOUT

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Introduction: Treatment for OSA has a positive effect on sleep-related outcomes and daytime functioning. Less is known about the effects of OSA treatment on work-related outcomes such as cognitive difficulties and burnout. We hypothesized that receiving treatment for OSA would improve sleep quality, feeling refreshed and consequently daytime sleepiness with improvement in burnout, emotional regulation and cognitive difficulties within three months on therapy.

Materials and methods: We recruited 131 adults referred to a mid-sized hospital's sleep laboratory with possible OSA to participate in this study. All participants completed questionnaires before their overnight sleep study, at one month and three months thereafter. Questionnaires included the Epworth Sleepiness Scale (ESS), Karolinska Sleep Questionnaire, Wong and Law Emotional Intelligence Scale, Shirom-Melamed Burnout Measure, and the Cognitive Difficulties Scale. Therapy for OSA was either positional therapy or by continuous positive airway pressure (CPAP). The mean apnea-hypopnea index (AHI) for 89 participants in the treatment group was 31/hr (SD= 32) and for the 42 participants in the non-treatment group 5/hr (SD= 3). The average age of the participants was 45 years (SD= 10), 57% were men, and work hours per week averaged 43.

Results: Daytime sleepiness and not waking feeling refreshed correlated with cognitive difficulties at all time points for all participants. With treatment for OSA, ratings for not waking refreshed improved at one month and three months. Using HAYES Process to predict mediation, improvement in ratings of waking feeling refreshed at one-month predicted a parallel improvement in daytime sleepiness (b = -.143, SE = .062, CI [-.280, -.035]), and less cognitive difficulties at three months (b = -.156, SE = .083, CI [-.338, -.019]). We have previously reported on less work-related burnout at three months with improved daytime sleepiness. There was no effect of treatment up to three months on emotional regulation.

Conclusions: Treatment for OSA was associated with a reduction in unrefreshing sleep and with less daytime sleepiness; subsequently cognitive difficulties and work-related burnout were improved at three months, while there was no impact on emotional regulation.

Sleep Breathing Disorders
Board #003 : Poster session 2

EDUCATIONAL VIDEO TO IMPROVE CPAP USE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA AT RISK FOR POOR ADHERENCE: A RANDOMISED CONTROLLED TRIAL

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Introduction: Suboptimal adherence to CPAP limits its clinical effectiveness in patients with obstructive sleep apnoea (OSA). Although rigorous behavioural interventions improve CPAP adherence, their labour-intensive nature has limited widespread implementation. Moreover, these interventions have not been tested in patients at risk of poor CPAP adherence. Our objective was to determine whether an educational video will improve CPAP adherence in patients at risk of poor CPAP adherence.

Materials and methods: Patients referred by clinicians without sleep medicine expertise to an urban sleep laboratory that serves predominantly minority population were randomised to view an educational video about OSA and CPAP therapy before the polysomnogram, or to usual care. The primary outcome was CPAP adherence during the first 30 days of therapy. Secondary outcomes were show rates to sleep clinic (attended appointment) and 30-day CPAP adherence after the sleep clinic visit date.

Results: A total of 212 patients met the eligibility criteria and were randomised to video education (n=99) or to usual care (n=113). There were no differences in CPAP adherence at 30 days (3.3, 95% CI 2.8 to 3.8 hours/day video education; vs 3.5, 95% CI 3.1 to 4.0 hours/day usual care; p=0.44) or during the 30 days after sleep clinic visit. Sleep clinic show rate was 54% in the video education group and 59% in the usual care group (p=0.41). CPAP adherence, however, significantly worsened in patients who did not show up to the sleep clinic.

Conclusions: In patients at risk for poor CPAP adherence, an educational video did not improve CPAP adherence or show rates to sleep clinic compared with usual care.

CAN STOP-BANG QUESTIONNAIRE PREDICT OBSTRUCTIVE SLEEP APNEA IN LESS SYMPTOMATIC CARDIOVASCULAR PATIENTS?

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Introduction: STOP-BANG is a validated questionnaire for screening of outpatients for Obstructive sleep apnea(OSA),with some studies showing a sensitivity as high as 90% for detecting OSA. Some reports have shown the prevalence of OSA in Cardiovascular surgical patients to be as high as 73%.
We sought to study the utility of STOP-BANG questionnaire as a screening tool for OSA in cardiovascular patients awaiting cardiac surgery,with no significant sleep complaints,validating it with ambulatory level 2 polysomnography.
Materials and methods: Patients admitted for Coronary artery bypass surgery(CABG) between August 2017-February 2019 were recruited.Clinical data, including sleep symptoms were extracted. All the patients were screened with STOP-BANG questionnaire.53 patients underwent overnight Level 2 polysomnography using Apnea-Link .Correlations were made between clinical symptoms, STOP-BANG score and OSA severity, measured using Apnea hypopnea index(AHI).
Results: We had 120 patients in the study ,103 males,median age 60 years.Snoring and nocturia were the commonest sleep complaints.Our cohort had a high prevalence of vascular risk factors(DM 72.3%,Hypertension 59.2% and Dyslipidemia 60%).54.2% were overweight(BMI>25) and 11.7% were obese(BMI>30).60% had abnormal neck circumference.
Median STOP-BANG score was 3(IQR 2) with 83 having scores ≥3. Median AHI was 5.6 with AHI ≥5 in 28 patients and AHI 15 or above in 14 patients.
We found that STOP-BANG score ≥3 did not show any positive correlation with the presence of OSA-AHI ≥5 or 15 in our cohort of cardiovascular patients. Among the clinical parameters,arousals with respiratory difficulty at night,higher neck circumference(≥ 38 cm in men and ≥ 35 cm in women) and higher grades of tonsillar hypertrophy showed a significant association with PSG proven OSA.
Conclusions: Our study shows that in cardiovascular patients less symptomatic for sleep complaints,STOP-BANG questionnaire is not highly predictive of presence of OSA.Probably high prevalence of vascular risk factors and metabolic syndrome in this cohort makes it a less sensitive tool for predicting OSA.
Acknowledgements: Authors would like to thank ResMed Foundation,California for providing financial grant for performing diagnostic polysomnography in the patients.

Sleep Breathing Disorders
Board #259 : Poster session 3
AWARENESS FOR OSA DIAGNOSIS IN A TERTIARY CARDIOLOGY CENTER: A TEMPORAL SURVEY

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Introduction: Despite the advancements on the evidence pointing the high frequency and potential cardiovascular (CV) impact of Obstructive Sleep Apnea (OSA), the sub diagnosis and overall acceptance of OSA among cardiologists may vary. This scenario may be exacerbated by the poor accuracy of sleep questionnaires in the Cardiology setting and the neutral CV results of OSA treatment from recent randomized controlled trials (RCTs) in patients with high CV risk (SAVE Study, NEJM 2016). Here, we addressed the awareness about OSA among cardiologists evaluated in 2014 (simultaneous with the previous evaluation of OSA frequency in patients with CV diseases - Costa et al. HEART 2015) and five years later (after the publications of important RCTs in this area). We hypothesized that the awareness and relevance of OSA as a CV risk factor decreased overtime.

Materials and methods: We applied a survey for staff physicians and physicians in training (residents) from the Cardiology Division at the Heart Institute (InCor). This survey was applied twice for the medical staff and once for each residence team that rotated in 2014 and 2019 in our Institution and comprised questions addressing the availability of sleep medicine classes during medical graduation, importance of OSA as a CV risk factor, number of consultations per month vs number of diagnostic suspicious of OSA as well as knowledge and clinical applicability of OSA screening methods (Berlin Questionnaire).

Results: We applied the survey twice for 77 physicians. Of them 32.5% were staff physicians and 67.5% were residents. On average, the Cardiologists reported a mean number of consultations in the last month of 153±89 and 176±118 patients per month but only a mean number of suspected diagnoses of OSA of 6±9 and 6±8 in 2014 and 2019, respectively. Interestingly, the vast majority of them considered OSA a CV risk factor and the percentages did not significantly change overtime (from 97.4% in 2014 to 94.7% in 2019, P=0.44). Regarding the questions about sleep, we found that 14.3% of them asked about snore in 2014 vs 76.3% of them in 2019 (p< 0.001). In contrast, we observed a significant decrease in using OSA screening questionnaires (from 80.5% in 2014 to 23.7% in 2019, P< 0.001). We did not find any difference through the years regarding their self-evaluation about knowledge of sleep medicine: most of them still consider unsatisfactory (79.2% vs 69.7%, 2014 and 2019, respectively. P=0.19). Similar results were observed in staff and residents.

Conclusions: Contrary to our hypothesis, the vast majority of the Cardiologists consider OSA as a CV risk factor but the sleep medicine field still remains largely unknown among them. We observed a significant decrease in the use of sleep questionnaires in the last five years (probably reflecting evidence showing low accuracy of these tolls in screening OSA in the Cardiology setting).

THE RISK OF SLEEP-DISORDERED BREATHING IN PATIENTS WITH EPILEPSY

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Introduction: We know that epilepsy has a strong correlation with sleep-disordered breathing. However, there is still a lot of controversy as to which one is responsible for the cause. The Taiwan Health Insurance database has collected data for more than a decade. It contains information on tens of thousands of epilepsy patients. We hope to confirm the relationship between sleep-disordered breathing and Epilepsy by the time sequence of the patient´s diagnosis. And further understand which patients with epilepsy are more prone to sleep-disordered breathing. Most previous studies on the relationship between sleep-disordered breathing and Epilepsy point to sleep-disordered breathing leading to seizures. Our research hypothesis is the opposite. We hypothesized that epilepsy increases the incidence of sleep-disordered breathing. We hope that with a huge database, we can find out what we want to know. We understand the correlation between sleep-disordered breathing and Epilepsy through three questions. These three questions are (1) Is people with epilepsy more likely to have sleep-disorder breathing? (2) Is sleep-breathing disease leading to seizures or epilepsy increasing the incidence of sleep-disordered breathing? (3) What kind of epilepsy patients is more likely to develop sleep-disordered breathing?

Materials and Methods: We identified the exposure of epilepsy: The patients diagnosed with the ICD-9: 345.x for at least 2 out-patient visit and 1 admission records from 1997 to 2013, and the index date was the date of epilepsy diagnosis. n= 14,320.
We exclude the patient with 3 criteria 1. Epilepsy before 2000, n= 4,339. 2. SDB before Epilepsy, n= 2,863, 3. Non-matched, n=5.Then we have Exposure group, n= 6,796.
The Controls include age-sex matched controls, who were never diagnosed with epilepsy between 1997 and 2013.The 1:4 age-sex matched controls, n=27,184. The main event is Sleep-disordered breathing, ICD-9: 780.5.

Results and conclusions: 1. The proportion of patients with epilepsy who have sleep-disordered breathing is higher than that of the control group.2. Patients with epilepsy have a longer hospital stay in patients with sleep-disorder breathing3. Patients with a higher incidence of sleep disorders in both groups are less than 50 years old4. Among patients with sleep-disordered breathing, the comorbidity rate of the epilepsy group is higher than that of the control group. These co-morbidities include Dementia, DM, Heart failure, ischemic stroke, cancer, Parkinson's disease and CKD.Our study showed higher incidence rate of sleep-disordered breath in epilepsy patient who never have history of sleep-disordered breath before. It means epilepsy happen before sleep-disordered breath in those patients. And those people most are younger than 50 years old. This can rule out some chronic diseases in the elderly that cause sleep disordered. But we still observe that the comorbidity rate of patients with epilepsy group is relatively high.Of course, there are many limits of our study such as 1. We do not know central or obstruct breathing disorder in this study. 2. we can't exclude other risk may induce sleep-disordered breathing such as obesity. However, those bugs may decrease due to lots of case number. But we still need more study for this topic

DOES CLINICAL CARE FOR OSA DIFFER BETWEEN CANADIAN JURISDICTIONS WITH AND WITHOUT GOVERNMENT FUNDING FOR CPAP? RESULTS OF AN ONLINE PATIENT SURVEY

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Introduction: Obsructive sleep apnea (OSA) is common yet underdiagnosed in Canada, with an estimated 26% of adults being at high risk and only 6.4% reporting having received a diagnosis from a healthcare provider. Although Canada has a universal health care system provincial and territorial coverage of OSA treatment varies. We sought to explore potential differences in diagnosis and treatment between jurisdictions with full or partial public funding for CPAP therapy compared to those without.
Materials and methods: We developed an anonymous online survey exploring the clinical pathways taken by Canadian adults to receive a diagnosis and treatment of OSA and the impact of OSA on daytime function; the survey also inquired about wait times, costs of diagnosis and treatment. The survey was distributed to a market research panel and via social media and patient-facing medical associations in Canadafrom March 1-April 30, 2019.
Results: We received 600 responses, representing a broad national sample; 181 respondents lived in one of three provinces or territories with government funding for CPAP (Ontario, Saskatchewan, Manitoba) and 419 respondents lived in the remaining 10 jurisdictions without CPAP funding. The age distributions of the two groups were similar as was self-reported disease severity and time since diagnosis. There was a higher proportion of men in the jurisdictions with CPAP funding.
In jurisdictions without CPAP funding, there was much greater use of home monitoring to diagnose OSA (69% vs 20%, p< 0.05); fewer patients reported waiting less than 3 months for a test in these jurisdictions. The majority of respondents in both groups did not pay out of pocket for diagnostic testing, and those that did rarely paid more than $500. The distribution of treatment types (CPAP, oral appliance and weight loss) was similar between the two groups. 23% of respondents in regions without CPAP funding reported that cost was the most important factor in selecting a treatment, compared to 11% in jurisdictions with government funding (p< 0.05). Despite coverage for CPAP in 3 provinces, 48% reported out of pocket expenses for therapy, compared to 60% in regions without CPAP funding (p< 0.05). Over half of respondents in both groups reported the need to use third party insurance to cover costs (52% and 54% respectively). Finally, the proportion of cases reporting physician follow-up was smaller and there was a higher rate of vendor follow-up in provinces without CPAP coverage.
Conclusions: Across Canada there appears to be very little direct patient expense for testing for OSA, although home monitoring is used more frequently in provinces and territories without CPAP funding. In jurisdictions without funding, cost is a more important consideration in the selection of therapy, likely due to higher out of pocket expenses. However, the distribution of treatment modalities used was similar between the provinces with and without CPAP coverage.

Sleep Breathing Disorders
Board #173 : Poster session 1
RELIABILITY OF QUEPEDS IN THE SCREENING OF PEDIATRIC SLEEP DISORDERED BREATHING

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Introduction: The diagnosis of sleep disordered breathing (SDB) in children is conditioned by the undervaluation, mostly justified by non-specific symptoms. The questionnaires can help to screen the patients who need further investigation.
Aim: To evaluate the reliability of a questionnaire developed by a Pediatric Sleep Laboratory - Pediatric Sleep Questionnaire (QuePedS) - in the diagnosis of SDB.
Materials and methods: Retrospective, descriptive and cross-sectional study (January 2014-December 2016). Children under ventilation oxygen therapy or inconclusive PSG were excluded. Questionnaires were completed by parents on the night of the polysomnography (PSG). PSG variables: snoring, apnea/hypopnea index (AHI), oxygen desaturation index, sleep efficiency and wakefulness index. Questionnaires variables: respiratory distress, snore, breath-holds, nocturnal awakenings and nocturnal sweating, diurnal oral breathing, headache, irritability, excessive daytime sleepiness and difficulty concentrating. The replies to the questionnaires were grouped into never/rarely; frequent/always. Comparative analysis between PSG data and questionnaires was performed ($\alpha = 5\%$).
Results: Two hundred and thirty seven children (58.2% male) were included, with median age of 7 (0.1-18.4) years. Snore frequent/always was associated with higher nocturnal awakenings ($p = 0.019$), AHI ($p = 0.004$), oxygen desaturation index ($p = 0.001$) and snoring ($p = 0.001$). Oral breathing was associated with snoring ($p = 0.001$) and respiratory distress was associated with a higher wakefulness index ($p = 0.001$). Nocturnal awakenings, breath-holds, nocturnal sweating, headache, irritability, excessive daytime sleepiness and difficulty concentrating were not associated with PSG data.
Comments: This was a pilot study for the validation of QuePedS. History of snoring, oral breathing and respiratory distress in the child were indicators of SDB. Further work will be done in order to construct a more simple and reliable questionnaire.

WHICH CENTRAL APNEA INDEX MUST SUPPORT FURTHER INVESTIGATION? 5-YEARS AT A PAEDIATRIC SLEEP LABORATORY

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Introduction: Central Sleep Apnea (CSA) can occur in healthy children, however more commonly it is the manifestation of an underlying disease. A CSA index (CSAI) up to 5/h has been reported in healthy children, being this the cut-off that must authors preconize for further investigations. There is controversy about the significance of a CSAI between 1 and 5. We describe the cases of CSAI between 1/h and 5/h at a Paediatric Sleep Laboratory.

Methods: Retrospective, descriptive review of children > 1 year of age with CSAI 1-5/h during a 5-year period (January 2014 - May 19); polysomnographies (PSG) were reviewed, and demographic and clinical data were analysed. The PSG with total sleep time (TST) < 4h were excluded.

Results: From 1079 PSG, 25 children were included (12 males). The median age was 5(1-16)years. The median CSAI, oxygen desaturation index (ODI) and respiratory disturbance index (RDI) were 1.4(1.1-4.5)/h, 4.3(1.5-81.8)/h, 2.9(1.2-85.6)/h, respectively. The global apnea-hypopnea index (AHI) was 2.9(1.2-84.1)/h. Three children of 16 children who underwent $TcCO_2$ monitorization (18.8%) presented hypoventilation. Regarding diagnosis, 10 (40.0%) had obstructive sleep apnea (OSA) related to hypertrophy of adenoids and tonsils, 4 (16.0%) had neurogenetic disorders (2 Prader-Willi syndrome, 1 Rett syndrome, 1 mucopolyssacaridosis), 2 (8.0%) had OSA related to obesity, 2 (8.0%) had neuromuscular disease (Duchenne Muscular Dystrophy), 1 (4.0%) had hypochondroplasia, 1 (4.0%) had laryngomalacea. From five children (20.0%) whose diagnosis was uncertain, four had developmental delay (CAI< 2/h) and one had a normal psychomotor development, without snoring (CAI 2.9/h); a cranial magnetic resonance was performed in latter case and a Chiari-Malformation type I (CM-I) was detected.

Conclusions: Unlike described in literature, in our Laboratory most children with CAI 1-5/h has other sleep disordered breathing conditions, as OSA. Although the CAI 5/h is the most consensual cut-off to start investigation, in our series a CM-I was diagnosed in a previously healthy child. More studies should be done to define the significance of CSAI between 1 and 5.

IS ADHERENCE TO PAP TREATMENT FOR APNEA ASSOCIATED WITH IMPROVED INSOMNIA-RELATED SYMPTOMS?

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Introduction: Poor sleep quality and difficulties with daytime functioning, frequently characterized as symptoms of insomnia, are common among patients with obstructive sleep apnea (OSA). The goal of this investigation was to explore changes in sleep quality and daytime functioning in PAP adherent and nonadherent primary care patients diagnosed with OSA.

Methods: Participants (mean age = 56, SD = 11.66, range 23-83) recruited from family practice clinics completed the Sleep Questionnaire (Libman et al., 2000) at Time 1 and shortly thereafter underwent polysomnography. Here we present data for those 44 individuals diagnosed with OSA who were either adherent (n= 20, 13 female, 7 male) or nonadherent (n=24, 15 female, 9 male) to prescribed PAP treatment, according to self-report 1-1/2 years after diagnosis (Time 2). Traditional adherence criteria were used. Adherence data determined by the PAP machine chip were available for 20 participants. Adherence results for self-report and chip are consistent: Pearson correlations show high and significant correlations for mean weekly number of hours of PAP use, $r(18)=.713$, $p< .01$, and for mean weekly percentage of days of PAP use, $r(18)=.801$, $p< .01$.

Results: A series of 2 Groups (Adherent/Nonadherent) x 2 Time (Time 1/Time 2) ANOVAs were conducted on night-time and daytime functioning items on the Sleep Questionnaire. Significant interactions of Group x Time were found on the following: distress related to difficulty initiating and/or maintaining sleep, non-refreshing sleep, sleep quality, sleep satisfaction, daytime sleepiness, and difficulty concentrating. Overall, scores for adherent participants were slightly, but not significantly, worse than those of nonadherent participants at Time 1. Scores for nonadherent participants generally did not change over time, while those of adherent participants improved and were significantly better than those of nonadherent participants at Time 2.

Conclusions:

- PAP-adherent individuals had worse scores on a range of symptoms at Time 1 than nonadherent individuals, but the differences were not significant.
- PAP-adherent individuals improved by Time 2; in many cases their symptoms improved significantly relative to nonadherent individuals.
- The symptoms of nonadherent individuals did not improve from Time 1 to Time 2.

In summary, the findings show that compared to their nonadherent counterparts, at Time 2 PAP-adherent individuals were less distressed about initiating and/or maintaining sleep, experienced less non-refreshing sleep, reported better sleep quality, experienced greater satisfaction with their sleep, felt less sleepy during the day, and had less trouble concentrating during the day.

PAP treatment, which targets obstructive sleep apnea, appears to improve symptoms that are similar to those of insomnia - i.e. nocturnal sleep quality and daytime quality of life,

References: Libman. E., Fichten, C. S., Bailes, S., & Amsel, R. (2000). Sleep questionnaire vs. sleep diary: Which measure is better? *International Journal of Rehabilitation and Health, 5,* 205-209.

THE ACCURACY OF AN AMBULATORY LEVEL III SLEEP STUDY COMPARED TO A LEVEL I SLEEP STUDY FOR THE DIAGNOSIS OF SLEEP-DISORDERED BREATHING IN CHILDREN WITH NEUROMUSCULAR DISEASE

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Introduction: Polysymnography (PSG) surveillance recommendations are not being met for children with neuromuscular disease (NMD) because of limited diagnostic facilities. We evaluated the diagnostic accuracy of an ambulatory level III device as compared to a level I PSG.
Materials and methods: A cross-sectional study was conducted at a tertiary pediatric institution. Eligibility criteria included: (1) children with NMD; (2) age 6 to 18 years; (3) booked for a clinically indicated overnight level I PSG. Participants were randomized to an overnight level I PSG followed by an ambulatory level III study with end tidal carbon dioxide ($etCO_2$) monitoring or vice versa. Sensitivity and specificity of the ambulatory level III device to diagnose sleep-disordered breathing (SDB) at an apnea-hypopnea index (AHI) cutoff of >1.0 events/h was the primary outcome.
Results: Moderate to severe SDB was found in 46% of participants (13/28). The device´s sensitivity and specificity to detect SDB was 61.5% and 86.7%, respectively. The positive predictive value of the level III study was 80.0% and the negative predictive value was 72.0%. Fifty percent of the cohort were either missing or had incomplete or falsely low ambulatory $etCO_2$ data.
Conclusions: A level III device with $etCO_2$ monitoring is not yet able to be implemented in clinical practice as a diagnostic tool for SDB in pediatric patients with NMD.

THE IMPACT OF OBSTRUCTIVE SLEEP APNEA ON CHRONIC KIDNEY DISEASE INCIDENCE AFTER ACUTE CARDIOGENIC PULMONARY EDEMA: A SUB-ANALYSIS OF OSA-CARE STUDY

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Introduction: Recent evidence suggests that obstructive sleep apnea (OSA) is associated with higher rate of acute cardiogenic pulmonary edema (ACPE) recurrence but whether OSA may impair the renal function in these patients is not clear.
Materials and methods: We recruited consecutive cases with confirmed ACPE from the Emergency Unit Department at Heart Institute (InCor). After usual treatments for ACPE and clinical stabilization (~30 days), all patients were invited to perform a portable sleep monitoring (Embletta Gold^{TM}). OSA was defined by an apnea-hypopnea-index (AHI) ≥15 events/hour. We estimated the glomerular filtration rate (eGFR) using the Chronic Kidney Disease: Epidemiology Consortium (CKD-EPI) equations. We calculated the incidence of chronic kidney disease (CKD), defined by an eGFR < 60mL/min/1.73m^2 after one year follow up.
Results: A total of 55 patients were studied in this sub-analysis (40% males, mean age: 67±11 years and body mass index [BMI] 27.1(24.6-31.2) Kg/m^2. The frequency of OSA was 63.6%. Compared to the baseline, the eGFR presented a strong trend for higher decrease in the OSA versus no OSA subjects (-5.4 ±15.9 *vs.* -2.03±21.3 mL/min/1.73m^2; p=0.053). The incidence of CKD was higher in the OSA group (from 82.9 to 91.4%) as compared to no OSA (from 62.2 to 65%; p=0.05).
Conclusions: OSA is associated with higher CKD incidence in patients who recovered from an ACPE episode. This finding may partially explain the poor prognosis of patients with OSA who recovered from a previous ACPE.

LONG-TERM EFFECTS OF BARIATRIC SURGERY ON OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH GRADE 1 AND GRADE 2 OBESITY: A SUB ANALYSIS FROM GATEWAY STUDY

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Introduction: Obesity is a well-established risk factor for obstructive sleep apnea (OSA). Weight loss is associated with OSA severity improvement. In this scenario, bariatric surgery may be an effective therapy for OSA in obese patients. Previous evidence (most observational) is limited by short-term analysis in obese grade 3. Here, we hypothesized that Roux-en-Y gastric bypass (RYGB) surgery has a long-term effect in the OSA severity in obese grade 1 or 2 patients.

Materials and methods: This is a sub analysis of the GATEWAY study (Schiavon et al. Circulation 2018), a randomized controlled clinical trial addressing the cardio metabolic impact of RYGB in obese patients with body mass index (BMI) < 40Kg/m2. Patients were randomly allocated to receive either RYGB plus optimized clinical treatment (OCT) or OCT treatment alone. During the ongoing trial, a subsample of patients was invited to perform portable sleep monitoring (Embletta Gold) before and after 3 years follow-up. OSA was defined in mild (apnea-hypopnea-index, AHI 5-14.9 events/h), moderate (15-29.9 events/h) and severe (≥30 events/h) forms. We also evaluated excessive daytime sleepiness by Epworth Sleepiness Scale. All analyses were performed in a blinded fashion.

Results: A total of 37 patients (n=24 allocated in the RYGB group and n=13 in the OCT group) were studied in this sub-analysis (83.7% female, mean age: 42±8 years and BMI: 36.7 (35.8-38.5) Kg/m^2. Compared to the OTC group, RYGB presented a significant decrease in BMI (1.7 (-1.9 to 2.7 vs -10.6 (-12.7 to -9.2) Kg/m^2; p< 0.001), neck circumference (-1.5 (-2.5 to 2) vs. -7.5 (-10.5 to -4.8 cm; p< 0.001), waist circumference (3 (-3 to 9) vs. -25 (-30.8 to -20) cm; p< 0.001) and AHI (5 (-4.2 to 12.7) vs. -13.2 (-22.7 to -7) events/h; p=0.001).The frequency of moderate to severe OSA (AHI (≥15 events/h) at baseline was 62.5% in the RYGB group vs. 46.2% in the OCT group; p=0.175. After the procedure, only 8.3% has moderate OSA (none with severe OSA) in the RYGB group vs 69.3% in the OCT group; p< 0.001. Consistently, the frequency of excessive daytime sleepiness did not showed significantly differences at baseline but lower rate in the RYGB group (20.8 vs. 69.2%); p< 0.006 .

Conclusions: In this sub analysis from Gateway study, bariatric surgery is an effective strategy for decrease long-term OSA severity in patients with obesity grade 1 or 2.

URINARY MATRIX METALLOPROTEINASE-2 (MMP-2) ACTIVITY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Upper airway collapse in obstructive sleep apnea (OSA) is characteristically associated with intermittent hypoxia, resulting in oxidative stress. Matrix metalloproteinase-2 (MMP-2) contributes to the pathophysiology of oxidative stress and to ischemia/reperfusion injury resembled in OSA by repetitive episodes of hypoxia-reoxygenation. Although nocturnal hypoxia has been shown to increase the risk of accelerated loss of kidney function, there is no data about MMP-2 levels in the urine of OSA patients. Apart from increased risk of loss of kidney function due to OSA co-morbidities, oxidative stress often seen in OSA patients might directly contribute to kidney injury in OSA. Urinary neutrophil gelatinase-associated lipocalin (NGAL) has been proposed to be early biomarker of renal tubular injury. Albumin-to-creatinine ratio (ACR) is a marker of glomerular damage and can predict adverse renal and cardiovascular events. The objective of this study was to determine if urinary MMP-2 activity correlates with the severity of OSA and/or kidney injury.
Materials and methods: The study is a part of a multi-center Canadian trial performed through the Canadian Sleep and Circadian Network (CSCN). OSA subjects (n=123) were recruited from the Sleep Disorders Center (Saskatoon City Hospital, Saskatchewan, Canada) after in-lab polysomnography. Controls (n=27) were subjects referred to the Center who did not have OSA. Severity of OSA was categorized according to American Academy of Sleep Medicine criteria. Urine samples were collected from OSA and control subjects in the morning after polysomnography. Urine samples were centrifuged at 4000 rpm for 10 minutes at 4°C, collected without sediment, aliquoted and frozen at - 80°C until analysis. Gelatin zymography was performed to measure MMP-2 activity (expressed in arbitrary units per 20μl). NGAL was measured using ELISA. Albumin-to-creatinine ratio in urine was calculated. Mann-Whitney U and Kruskal-Wallis tests were used for statistical analysis.
Results: The cohort was divided into four groups: non-OSA (n=27; AHI 2.7±1.4), mild (n=43, AHI 9.3±2.9), moderate (n=33, AHI 22±4.6) and severe OSA (n=47, AHI 63.7±26.1). MMP-2 activity in the urine of OSA patients was 2.8 times higher compared to non-OSA (p=0.09; 25th-75th percentile: 0.01-0.32 and 0.01-0.11, respectively). Mean urinary MMP-2 activity increased as the severity of OSA increased (p-value for trend 0.06). NGAL did not differ between non-OSA and severe OSA patients (6.0±6.2 and 6.7±7.0 ng/ml, respectively) (p=0.92). ACR was greater in severe OSA patients (5.0±14.6 mg/mmol) than in other groups (1.0±1.4 mg/mmol) (p=0.06). eGFR did not differ between groups (p=0.408). Urinary MMP-2 activity-to-creatinine ratio was five times higher in patients with moderately to severely increased albuminuria (ACR≥3) compared to those with normal to mildly increased (ACR< 3 mg/mmol) (p=0.04).
Conclusions: Urinary MMP-2 activity increased in accordance with OSA severity. The increase was associated with glomerular proteinuria. There was no evidence of tubulointerstitial damage (as measured by NGAL) in the OSA cohort.

WAKE-UP STROKE IS ASSOCIATED WITH DECREASED PERCENTAGE OF INDIVIDUALS WITH LOW RESPIRATORY AROUSAL THRESHOLD

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introduction: The sleep related factor associated with wake-up stroke (WUS) was unclarified yet. Despite respiratory arousals play an important role in the face of danger during sleep, no researchers have studied WUS from the perspective of respiratory arousal. We aimed to compare the respiratory arousability in individuals of WUS with non-WUS, mainly evaluated by a clinical tool to predict a low respiratory arousal threshold (ArTH).

Materials and methods: We enrolled 119 patients with acute ischemic stroke, divided into 2 groups: WUS (n=34) and non-WUS (n=85). Clinical characteristics of the population were recorded on admission. All participants underwent a standard overnight polysomnography in the acute phase of the stroke. A low respiratory ArTH was determined by an ArTH score of 2 or above (one point for each: apnea-hypopnea index (AHI) < 30/h, nadir oxygen saturation (SaO2) >82.5%, fractions of hypopneas >58.3%).

Results: We observed significantly lower values of REM latency (85 vs.112.3, p=0.038), $F_{hypopneas}$(30.9% vs.43.2%, p=0.025) and significantly higher values of AHI (24.6 vs.12.9, p = 0.006) in WUS compared to non-WUS. After excluding 19 participants with five or more central respiratory events per hour of sleep, there was a significantly lower percentage of WUS with OSA (AHI ≥ 5) who had a low respiratory ArTH (34.8% vs.68.1%, p = 0.008). Low respiratory ArTH (OR: 6.082, 95%CI: 1.494-24.755, p = 0.012) was the only independent variable significantly associated with WUS in binary logistic regression model.

Conclusions: We believe that the reduced nocturnal arousability to stimuli of respiratory events, expressed by the decreased percentage of individuals with low respiratory ArTH may be pathophysiological mechanisms, or at least predisposing factors, for the occurrence of stroke attacks during sleep.

Sleep Breathing Disorders
Board #279 : Poster session 2
WHAT ARE THE DETERMINANTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) ADHERENCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)?

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Introduction: Continuous positive airway pressure (CPAP) is the first-line treatment for patients with obstructive sleep apnea syndrome (OSAS). However effective treatment is not always achieved because of poor adherence. The aim of this study is to identify the determinants of CPAP adherence in OSAS patients who have been regularly followed up with an interval of one or two months under the Japanese medical care system in our outpatient sleep clinic located in an urban area of Japan.

Materials and methods: 63 OSAS patients（Men/Women: 61/2, mean age±standard deviation(SD):63.1±11.2）who have been treated at our sleep clinic with CPAP for more than 12 months at the time of July 2018 were enrolled (mean CPAP use duration±SD: 5.3±2.7 years). They were diagnosed with OSAS by full-night polysomnography(PSGs) and treated with CPAP for at least one year as of July 2018. All PSGs were manually scored by registered polysomnographic technologist® (RPSGT) according to the 2007 American Academy of Sleep Medicine (AASM) criteria. Adherence was defined as average nightly use between July 2017 and July 2018. Objective measures of CPAP use were obtained from a downloadable monitoring device when they were followed up. A multiple linear regression was calculated to predict adherence based on age, body mass index (BMI), Epworth sleepiness scale(ESS), sleep time (weekdays/holidays), smoking amount, presence of habitual drinking, medical history of ischemic heart disease or/and cerebrovascular disease, apnea hypopnea index (AHI(total/REM/non-REM)), lowest SpO_2, % time in $SpO_2 < 90\%$ /$SpO_2 < 80\%$, arousal index(ArI), sleep efficiency, sleep latency, presence of auto mode and humidification and average device pressure $<=90\%$ of time. Anthropometrics and medical history were obtained from the record of initial sleep consultation. Polysomnographic data were obtained from diagnostic PSGs. Outlier was defined as outside the mean±3SD and excluded. The statistical analyses were performed using IBM SPSS® Statistics V24.0(SPSS Japan INC., Tokyo, Japan) and JMP Pro 14.0.0(SAS Institute Japan, Tokyo, Japan).

Results: A significant regression equation was found ($p < 0.001$). Multiple correlation coefficient was 0.588 and adjusted coefficient of determination was 0.311. Significant predictors of adherence were age($\beta=0.413$), lowest SpO_2($\beta=-0.351$), sleep efficiency($\beta=-0.226$).

Conclusions: Age and lowest SpO_2 and sleep efficiency were significant predictors of CPAP adherence in our patients.

Sleep Breathing Disorders
Board #262 : Poster session 3

TEMPORAL TRENDS IN POLYSOMNOGRAPHY REQUEST BY SPECIALTIES IN A LARGE PRIVATE SERVICE IN BRAZIL: THE IMPORTANCE OF CARDIOLOGY IN OSA DIAGNOSIS

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Introduction: In the last decades, Obstructive Sleep Apnea (OSA) has gained growing interest in the cardiovascular field by the evidence linking OSA with hypertension, atrial fibrillation, coronary artery disease, congestive heart failure and stroke. The translation of the scientific evidence into clinical practice is challenging, especially in nontraditional sleep-related areas such as in Cardiology. The lack of formal training in sleep medicine, medical inertia and the recent neutral results from large randomized trials addressing the impact of OSA treatment on cardiovascular disease may influence the OSA awareness in the Cardiology setting. Here, we tested this concept evaluating the temporal trend (11 years) of polysomnography (PSG) requesting from different specialties from a large private service of sleep medicine in Brazil.

Materials and methods: This is a retrospective study conducted by the Fleury™ group from 2008 to 2018. We revised all PSG performed at this 10 years period checking the medical specialty (based on the medical license number and database from the service) who requested the sleep study. For each year, we measured the percentage of PSG exams requested by each specialty.

Results: During this period, a number of 16.670 PSG were performed at the Fleury™. Beyond the expected role of a sleep-related specialty in requesting PSG (Otorhinolaryngology was the top one with 29% of the total requests), Cardiology was surprisingly the second most PSG requesting (16%), followed by Neurology (8%), Endocrinology (8%) and Internal Medicine (5%). In the temporal trend analysis, we observed a huge increase of PSG requesting by Cardiologists from 2009 to 2013 (2009:+7%, 2010: +22%, 2011: +59%, 2012: +11%, 2013: +30% as compared to 2008). From 2014 to 2018 we observed an oscillatory pattern, but Cardiology specialties remained in the second position during the whole period.

Conclusions: Despite the aforementioned barriers for OSA awareness in the Cardiology setting, Cardiologists in Brazil may have an important role for triggering sleep studies for OSA diagnosis. Considering the huge frequency of OSA among the cardiovascular diseases, continuous efforts for provide formal training in sleep medicine in Cardiology may be useful for decreasing OSA underdiagnosis in clinical practice.

Sleep Breathing Disorders
Board #174 : Poster session 1

PROSPECTIVE EVALUATION OF OBSTRUCTIVE SLEEP APNEA SYNDROME, NASAL FLOW AND SYSTOLIC PRESSURE OF THE PULMONARY ARTERY IN CHILDREN WITH TONSILLAR HYPERTROPHY

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Introduction: Obstructive sleep apnea syndrome in childhood has aroused great interest due to its cardiovascular
repercussions and its adverse effects on the quality of life of the affected individuals. However, fundamental aspects of the syndrome remain unknown.

Objective: Herein we prospectively assessed pulmonary artery systolic pressure (PASP) and nasal flow in children with obstructive oral breathing with an indication for adenoidectomy and/or tonsillectomy and their relation- ship to the obstructive apnea and hypopnea index (OAHI).

Materials and methods: Twenty-one children were evaluated at the time of the surgical indication (T0) and 18 months later (T1). Polysomnography, and rhinomanometry data were collected when we evaluated PASP.

Results: Among the 21 children, 13 (61.9%) presented an altered OAHI at T0. Fourteen children (66.7%) un- derwent surgery. Of these, nine (64.3%) had an altered OAHI at T0 and seven (50.0%) at T1. Of the seven non- operated children, four (57.1%) had an altered OAHI at T0 and two (33.3%) at T1. Mean nasal flow increased in both groups independently of surgery (p- ≤ 0.001). PASP exhibited a significant reduction between T0 and T1 in the operated group (p ≤ 0.001). OAHI of the operated group did not show a significant decrease over time (p = 0.074). In the non-operated children, the average nasal flow increased (p < 0.001), the PASP values did not reduce (p = 0.99), and the OAHI increased and then decreased over time (p = 0.025).

Discussion: The present study stands out for the inclusion of a study group composed of children who did not undergo surgical treatment. It also included a lengthy follow-up (18 months) that allowed for a thorough investigation of OAHI changes over time. Indeed, the follow-up prac- ticed herein was much longer than those of previous studies (maximum of 7 months). The change in cardiovascular parameters after surgery indicates signs of early cardiovascular dysfunction in patients with OSA. It is not yet known whether these early alterations will be reflected in the future cardiovascular morbidity. We found that, in contrast to the findings regarding the operated patients, the OAHI of the non-operated group tended to normalize and PASP levels remain stable (p = 0.99). These findings must be taken with caution given the small sample size of the non-operated group. It is not known whether elevated blood pressure levels in child- hood, even within normal limits, may contribute to future cardiovascular morbidity. Knowledge of the progression and the factors involved in the pa- thophysiology of OSA is important to identify the appropriate time to intervene and to determine which patients can benefit from the intervention. Isolated adenotonsillectomy, contrary to what was previously thought, is often insufficient to achieve complete resolution of sleep breathing problems and normalization of OAHI.

Conclusion: PASP decreased significantly and OAHI did not normalize in the operated group. Mean nasal airflow increased in the operated and non-operated groups.

PROSPECTIVE COMPUTED TOMOGRAPHIC DIMENSIONAL PARAMETERS AND MEAN NASAL FLOW IN CHILDREN WITH SUSPECTED OBSTRUCTIVE SLEEP APNEA.

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Introduction: Residual obstructive sleep apnea (OSA) in children after adenoidectonsilectomy corroborates the complex and multifactorial nature of the pathogenesis of upper airway obstruction. Obstructive sleep apnea is a dynamic process. Better identification of the degree and site of upper airway obstruction in this process can contribute to improving the management of OSA in this population.

Objective: we prospectively assessed nasal flow, obstructive apnea and hypopnea index and anatomical properties of the upper airway using computerized 3D models derived from computed tomography (CT) scans

Materials and methods: Twenty-one children were evaluated at the time of the surgical indication (T0) and 18 months later(T1). Polysomnography, rhinomanometry and CT scan data were collected at T0 and T1. Parametrized Upper airway volume and the minimum pharyngeal cross-sectional area (retropalatal or retrolingual) in oral breathers with adenoidectomy and/or tonsillectomy indications were analysed.

Results: Mean nasal flow increased in both groups independently of surgery (p-≤0.001). Parametrized Oropharynx volume exhibited a significant reduction between T0 and T1 in the operated group (p≤0.001). The prevalence of minimum pharyngeal cross sectional area at retrolingual region increased (p =0,041) in this group. OAHI of the operated group did not show a significant decrease over time(p=0.074).

Discussion: This work evaluated the volumes of three different segments of the upper airways and the location of the minimum cross-sectional area. We observed that at T0 there was a predominance of obstruction localization in the retropalatal region, although with a small difference. However, at T1, of the 18 reassessed children, 14 presented narrower localization in the retrolingual region. It can be hypothesized that surgery tends to better resolve the obstructive factor in patients with retropalatal region obstruction. One possible factor associated with this result may be tongue retro position after adenotonsillectomy. This repositioning of the structures could be one of the factors associated with oropharyngeal volume reduction in operated patients. Another hypothesis, considering the parameterization of the data, would be the preponderance of height growth in relation to the increase in the volume of the oropharynx. Recently, the promising results of oromiofascial therapy in adjunctive treatment of OSA have shown the importance of working the muscle function involved in the dynamics of the upper airway. An increase in the space through adenotonsillectomy does not appear to be sufficient for complete normalization of sleep-disordered breathing. Alteration of orofacial muscle tone has also been cited as one of the maintenance and relapse factors of childhood sleep-disordered breathing. The result of increased upper airway space must be accompanied with restructuring muscle function. Better results might be obtained by associating space gain with specific work of the circumscribed musculature

Conclusion: Parametrized Oropharynx volume decreased significantly and OAHI did not normalize in the operated group. The prevalence of minimum pharyngeal cross sectional area at retrolingual region increased in the operated group. Mean nasal airflow increased in the operated and non-operated groups.

PROSPECTIVE RANDOMISED CONTROLLED TRIAL TO COMPARE FIXED PRESSURE CPAP AND AUTO ADJUSTING PRESSURE CPAP AMONG SYMPTOMATIC OBSTRUCTIVE SLEEP APNOEA SUBJECTS IN A TERTIARY CARE CENTRE MALAYSIA

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Introduction: In Malaysia, the cost of Continuous Positive Airway Pressure (CPAP) machine is substantial. However, Fixed Pressure CPAP (Fixed CPAP) machine is relatively cheaper compare to Auto Adjusting Pressure CPAP (APAP) machine. The objective of this study is to compare the effectiveness of Fixed CPAP and APAP in the composite criteria of reducing Apnoea Hypopnea Index (AHI) and improvement of Epworth Sleepiness Scale (ESS) among symptomatic Obstructive Sleep Apnoea (OSA) subjects. CPAP device mode preference was determined at the completion of study. We hope this research contribute to the local pioneer data in Malaysia for the better cost-effective management of OSA.

Materials and methods: This is a prospective, randomised, crossover, single-blinded (subjects blinded) study conducted at Respiratory unit UKM Medical Centre (UKMMC). This study approved by the UKMMC Research Ethics Committee (Ethic code: FF-2018-207). We included newly diagnosed symptomatic OSA subjects aged 18 years old to 70 years old, with AHI more than 5/hour and ESS more than 10. We excluded subjects with the following comorbidities: symptomatic Congestive Cardiac Failure (CCF) or CCF with ventricular ejection fraction less than 40%, severe chronic obstructive pulmonary disease with FEV1 less than 50%, ischaemic or haemorrhagic stroke, parkinsonism, neuromuscular diseases, psychiatry disorders, central sleep apnoea, craniofacial abnormalities and Pickwickian syndrome. All subjects were prescribed the same model of CPAP (DREAMSTATION). Subjects were randomised into Fixed CPAP or APAP trial for 2 weeks followed by 1 week washout period. They were then crossed-over to the next mode of CPAP for another 2 weeks. AHI and ESS changes of the respective CPAP mode were compared with baseline. Device preference was determined at completion of study. Statistical analysis was performed by using IBM SPSS, version 25.

Results: Forty-six subjects were recruited with 27 males (58.7%). Mean age 54 ($\pm$11) year old. Baseline median Body Mass Index (BMI) 34.2 kg/m^2 (Interquartile Range IQR: 30.8 kg/m^2 -41.7 kg/m^2). Baseline median AHI 28.8 /hour (IQR 21.2/hour-54.0/hour). Baseline median ESS 15 (IQR 13-16).
After intervention, the median AHI was 5.0 / hour (IQR 4.2/hour-6.0/hour) at Fixed CPAP arm; APAP arm was 5.5/ hour (IQR 4.2/hour-6.3/hour); *p< 0.01*. The median ESS at Fixed CPAP arm was 2 (IQR 0-3); APAP arm was 2 (IQR 1-3); *p < 0.01*. Those preferred APAP, 22 subjects (47.8%) had median optimal CPAP pressure 13.0 cmH$_2$O (IQR 12.0 cmH$_2$O -13.5 cmH$_2$O) and 24 subjects (52.2%) who preferred Fixed CPAP had median optimal CPAP pressure of 8.0 cmH$_2$O (IQR 6.3 cmH$_2$O -8.7 cmH$_2$O); *p< 0.01*. Median baseline BMI was 37.6 kg/m^2 (IQR 30.8 kg/m^2 -43.0 kg/m^2) for those preferred APAP and 32.3 kg/m^2 (IQR 30.8 kg/m^2 -38.4 kg/m^2) for subjects preferred Fixed CPAP; *p=0.03*.

Conclusions: Fixed CPAP and APAP were equally effective in treating symptomatic OSA. Subjects preferred fixed CPAP had lower optimal CPAP pressure and BMI compared to those preferred APAP. Fixed CPAP may consider as first line therapy for symptomatic moderate and severe OSA with titrated optimal CPAP pressure less than 8 cmH$_2$O and BMI less than 32.3 kg/m^2.

CB1 RECEPTOR ANTAGONIST RIMONABANT PROTECTS AGAINST CHRONIC INTERMITTENT HYPOXIA-INDUCED BONE METABOLISM DISORDER AND DESTRUCTION IN RATS

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Introduction: To investigate whether the cannabinoid receptor 1 (CB1R) antagonist rimonabant alleviates bone metabolism abnormalities and bone destruction induced by chronic intermittent hypoxia (CIH).
Materials and methods: Forty-eight male healthy SD rats were randomly divided into 6 groups: hypoxic exposure for 4 or 6 weeks intermittent hypoxia groups (IH), hypoxic exposure groups with vehicle treatments (control groups, ON), hypoxic exposure groups which daily intraperitoneal injection of rimonabant 1.5 mg/kg/d (hypoxia intervention groups,HI). Serum TRAP levels were determined by ELISA. HE staining was performed to observe the changes of bone microstructure. Expression of CB1R in bone tissue was determined by immunohistochemistry.
Results: TRAP levels were higher in the 4W and 6W-IH groups than in the 4W and 6W-ON groups; TRAP levels were lower in the 4W and 6W-HI groups than in the 4 and 6W-IH groups. HE staining showed that the morphology of bone cells in the ON group was normal; 4IH group had mild edema of bone cells, the number of trabecular bone was missing, and the structure was destroyed. The 6IH group was more severe than 4IH, and the 4HI group was slightly improved compared with the 4IH group. The 6HI group was relieved compared with the 4HI group. The results of immunohistochemistry showed that the expression of CB1R in IH group was significantly higher than that in ON group. The expression of CB1R in the HI group was lower than that in the IH group. With the prolongation of hypoxia, the expression of CB1R in bone cells of IH group increased. The expression level of CB1R in HI group decreased with the prolongation of intervention time. Correlation analysis showed that the expression rate of CB1R in bone cells was positively correlated with the level of TRAP in serum.
Conclusions: CIH cause ECs disorder and abnormal serum TRAP, triggers bone metabolic disorder by activating bone CB1R, and serum TRAP is closely related to bone CB1R. Intervention with CB1R antagonist (rimonabant) can reduce CIH rat model developed ECs and disorders of bone metabolism.

MECHANISM ANALYSIS OF CATATHRENIA (NOCTURNAL GROANING) FROM THE PERSPECTIVE OF STOMATOLOGY

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Introduction: Catathrenia is a rare disease in the field of sleep, observed as monotonous vocalization in a protracted expiration preceded by a deep inspiration. Its pathogenesis and treatment remain debated. We found that Catathrenia had distinct orofacial characteristics, and intend to carry out exploratory research.

Materials and methods: Thirty-five patients (18 males, 17 females; age 16 to 67 years) with catathrenia diagnosed by audio polysomnography participated in this study. The patients' mean age was 31 years and body mass index was 21.5 ± 2.6kg/m2. Among them, 22 Catathrenia were matched with 66 OSA in a ratio of 1:3 by age and gender. Both Catathrenia group and OSA group underwent cephalometric measurements and dental casting analysis. All the 35 Catathrenia were accepted oral appliance. Their groaning index(GI) and apnea-hypopnea index(AHI) (if accompanied) were assessed before and after treatment.

Results: Decreased soft palate thickness, tongue length and mandibular plane angle, increased superior upper airway size, incisor inclination and Hyoid level, were observed in catathrenia group compared to normal values. Compared with OSA group , the differences were more obvious. In addition, increased arch lengths and upper inter-first molar widths, decreased overbite and PAR index, were found in catathrenia group. In line with the OSA´s experience, the therapeutic effect was as follows: GI from 10.37 ± 12.01 to 7.48 ± 8.38(p=.055) and AHI from 3.44 ± 4.16 to 1.46 ± 2.45(p=.004). According to the anatomical characteristics of catathrenia, some patients with poor results were repositioned, and the curative effect was improved.

Conclusions: Catathrenia has different oral and maxillofacial characteristics from sleep disordered diseases, as following as a wide airway, large skeleton, extended dental arch and shallow overbite. The mechanism study guided the clinical improvement of oral appliance therapy on Catathrenia.

USING RESPIRATORY EFFORT AND SPO$_2$ TO DETECT RESPIRATORY EVENTS

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Introduction: We aimed to detect respiratory events by using the combination of SpO$_2$ and respiratory effort signals. The respiratory effort was measured by the combination of abdomen and thorax respiratory inductance plethysmography (RIPSum). By using only RIPSum and SpO$_2$ for the detection of respiratory events, it has the advantage of compatibility with level III sleep devices with no airflow sensor.

Materials and methods: This study, as approved by the appropriate ethical committees, included sixty patients (41 men and 19 women) with suspected sleep apnea. The median age of patients was 56.5 (range 25 - 80) and the median body mass index was 29.0 kg/m2 (19.5 - 47.9). All patients underwent full polysomnography (PSG) at the sleep laboratories of Advanced Sleep Research GmbH (Berlin, Germany) and Department of Neurology 2 of Kepler University Clinic (Linz, Austria). Our proposed algorithm detects respiratory events when there is a decrease in respiratory effort for at least 10 seconds followed by a 4% desaturation in SpO$_2$. The algorithm outputs the timestamp and duration of the respiratory events. And together with sleep/wake information, it calculates the apnea-hypopnea index (AHI). In our study, the hypnogram of the PSG provided sleep/wake periods in order to calculate the AHI. The algorithm's predicted events were validated by Intraclass Correlation Coefficient (ICC) r to assess the level of agreement and correlation to events that were manually annotated by sleep experts (manualPSG) and events automatically annotated by the PSG systems (autoPSG). The manualPSG annotations were scored according to the American Academy of Sleep Medicine (AASM) scoring manual with rule 1B for hypopneas. In addition, the predicted AHI was also compared to AHIs of manualPSG and autoPSG by ICC.

Results: The ICC r of the predicted events compared to manualPSG events were 0.98 (0.94 - 0.99 upper and lower bounds 95% confidence interval, $p = 0.001$) and 0.96 (0.93 - 0.98, $p = 0.001$) when compared to autoPSG events. The ICC r of the algorithm's predicted AHI compared to manualPSG-AHI was 0.98 (0.95-0.98, $p = 0.001$) and 0.94 (0.90 - 0.96, $p = 0.001$) compared to autoPSG-AHI. All ICC r scores indicated excellent agreement and correlation with annotations performed using conventional PSG systems.

Conclusions: The combination of respiratory effort measured by respiratory inductance plethysmography and SpO$_2$ can be used to detect respiratory events with significant agreement and correlation compared to complete PSG scoring methods. The benefit of this method is that scoring of respiratory events can be performed without utilizing oronasal sensors disturbing the patients.

AN INSIGHT ON THE MAGNITUDE OF OBSTRUCTIVE SLEEP APNEA IN EGYPT: PREVALENCE, GENDER DIFFERENCES AND FACTORS AFFECTING APNEA HYPOAPNEA INDEX SEVERITY

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Introduction: Obstructive sleep apnea (OSA) is a common and chronic condition in the general population. Predictor factors of OSA include obesity, male gender, upper airway anatomical abnormalities and hormonal influences. The prevalence of OSA in western populations is 34% in men and 17% in women. In Egypt, only one small sample sized study (n=420) reported that 54% of men and 46% of women were diagnosed with OSA. Further, OSA remains largely under diagnosed and data on its current magnitude in Egypt is very scarce. Additionally, obesity rates in Egypt are also known to be high (37% in men and 51% in women), but no published literature explored the effect of obesity on the severity of OSA. Also, previous studies evaluated gender differences in patients with OSA and showed that Body Mass Index (BMI) correlated to the severity of OSA in both sexes. In addition, the apnea-hypopnea index (AHI) was significantly higher in men. Thus, the aim of this study is to explore the prevalence of OSA in a large sample sized clinical cohort. We also seek to determine the effect of gender, BMI and neck circumference (NC) on the severity of the disease.

Materials and methods: This retrospective study included 1012 patients referred for polysomnography at the Cairo Center for Sleep disorders (Cairo, Egypt), between January 2012 and December 2016. Medical data were reviewed by sleep specialist(s). Patients were categorized into mild (AHI 5-15), moderate (AHI 15-30) and severe (AHI > 30) OSA. Gender differences were analyzed. Also, the correlation between age, gender, BMI, NC and the Epworth Sleepiness Scores (ESS) with the AHI and other sleep parameters were explored.

Results: A total of 838 patients (81% males, 19% females) were diagnosed with OSA. Patients with mild, moderate and severe OSA were 204 (24 %); 146 (17%) and 488 (58%) respectively. Females were older than males (p = 0.001) and BMI was not significant between both sexes (p = 0.07) but NC was higher in men (p = 0.001). ESS and total sleep time were similar between males and females (p = 0.304 and 0.270 respectively). AHI was significantly increased in men compared to women (p = 0.001) and severe OSA was commonly diagnosed in men than women (p = 0.001). Hypertension coexisted in 41% (n=344) patients, 80% (n=277) of these patients were men and 20% (n=67) were women. A positive significant correlation was found between BMI, NC, ESS with the AHI, arousal index, average SpO2 and desaturation index (p = 0.0001). Linear regression analysis showed that the severity of the AHI was highly associated to the BMI and NC (p = 0.002 and 0.0001 respectively).

Conclusions: This study showed that the prevalence of OSA is higher than previously reported. Additionally, the effect of gender on disease severity was not significant. Contrarily, the BMI and NC were observed to independently aggravate the severity of the AHI in our population. Our results suggest that further multicenter studies are needed to confirm the magnitude of OSA in Egypt.

TWO CASES OF ROHHAD WITH AN UNUSUAL PRESENTATION IN THE SECOND DECADE OF LIFE

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Introduction: Rapid-onset obesity with hypothalamic dysfunction, hypoventilation, and autonomic dysfunction (ROHHAD) is a rare disorder. The common presentations of ROHHAD include sleep-related hypoventilation, obesity after two to three years of age, hypothalamic dysfunction, severe emotional or behavioral disturbances, and tumor of neural origin. In this study, we present two cases of ROHHAD with an unusual presentation.

Materials and methods: The first patient was an eight-year-old boy with obesity after two years of age, hypoventilation, hypersomnolence, and hypothalamic dysfunction (borderline basal growth hormone without response to the stimulation test). He showed pulmonary hypertension on echocardiography. After performing full-night polysomnography, severe hypoventilation was detected, besides obstructive sleep apnea and hypopnea. He was then treated with bilevel positive airway pressure (BiPAP), which improved his condition. After five years, he developed thrombosis in the superior sagittal sinus, without any obvious etiology. The results of laboratory tests showed no mutations in factor V Leiden, prothrombins, protein C, or protein S.

The second patient was a ten-year-old girl, who had started to gain weight at three years of age. She also had an early puberty at eight years of age, along with hypersomnolence, hyperthermia of unknown origin. She underwent polysomnography, revealing severe hypoxia and hypoventilation with obstructive sleep apnea and hypopnea. She was treated with BiPAP. Based on the findings, the level of 8-AM serum cortisol increased, cortisol was not suppressed on the dexamethasone test. In addition, the level of serum prolactin was increased. The results of brain magnetic resonance imaging (MRI) were found to be normal. Similar to the first case, she had recurrent thrombosis in the superior sagittal sinus and left transverse sinus, as well as deep vein thrombosis with normal coagulation tests.

Evaluation of *PHOX2B* genetic mutation indicated negative results in two cases.

Both patients had thrombosis of unknown etiology and normal coagulation tests.

Results: ROHHAD syndrome is recognized as a rare disorder, associated with dysfunctions in the central control of ventilation. According to the International Classification of Sleep Disorders (ICSD-3), the diagnostic criteria for this syndrome include sleep-related hypoventilation and at least two of the following presentations: obesity, abnormalities of hypothalamic-endocrine origin, severe emotional or behavioral disturbances, and tumor of neural origin.

Moreover, absence of *PHOX2B* mutation is an indicator of ROHHAD syndrome. These children usually have normal development until two to three years of age and then present with severe obesity, central hypoventilation, and hypothalamic dysfunction. Nevertheless, the underlying causes of this disease have not been fully explained.

We presented two cases of suspected ROHHAD due to weight gain starting in early childhood. The clinical and laboratory findings, including alveolar hypoventilation, hyperprolactinemia, central precocious puberty, and autonomic dysfunction, matched the diagnostic criteria for ROHHAD syndrome. However, both patients presented with recurrent thrombosis, which is not a usual finding in this syndrome.

Conclusions: The aim of this case report was to raise awareness of this unusual presentation of ROHHAD syndrome. Because of the low incidence of this syndrome, further

studies are warranted to collect more information about its pathophysiology and symptoms.

Sleep Breathing Disorders
Board #258 : Poster session 1
ASSOCIATION OF SALT INTAKE WITH OBSTRUCTIVE SLEEP APNEA: DATA FROM THE ELSA-BRASIL COHORT

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Introduction: Previous studies suggested that increased salt intake and fluid retention in some specific clinical conditions (such as resistant hypertension and heart failure) may contribute to the pathophysiology of obstructive sleep apnea (OSA) by rostral fluid shift during sleep. This fluid displacement may lead to edema and reduction of the transverse area of the pharynx, which may ultimately contribute to the severity of OSA. However, it is unclear whether this potential mechanism can be applied to all patients with OSA.
Materials and methods: This was a cross-sectional study that recruited adults of both genders, participants from the São Paulo center of the ELSA-Brazil cohort. All participants performed a home portable polygraphy (Embletta Gold™). OSA was defined by an apnea-hypopnea index (AHI) ≥ 15 events/h. A 12-hour urine collection at night was obtained from all participants to measure sodium excretion. Daily salt intake was estimated from a previously validated method by dividing the 12-hour urinary sodium excretion by 0.47 and then by 0.393 (related to the sodium concentration in the salt). Participants were allocated to two groups according to the presence or absence of OSA. We performed a sub-analysis stratifying the participants in normotensive and hypertensives. All analyzes were performed without access to the OSA status data.
Results: A total of 1,870 participants were studied (mean age of 49 ± 8 years, 42.3% men, body mass index of 26.9 ± 4.7 kg / m^2). One-third of the sample had OSA. Participants with OSA were older, had higher values of adiposity parameters, higher blood pressure, increased frequency of comorbidities and use of medications. Compared to participants without OSA, those with OSA had higher salt intake (8.6 vs. 10.2 g/day, p < 0.001). After adjustments for potential confounding factors (age, sex, race, body mass index, income, diabetes mellitus, estimated glomerular filtration rate and use of diuretics), we did not find significant associations of salt intake with OSA (OR 1.010; CI 0.984 - 1.037, p = 0.458). However, when we stratified the sample according to hypertension, salt consumption among hypertensive participants was higher than normotensive subjects (hypertensive: 9.9 g / day (6.9-13.2 g / day) vs. normotensive: 8.9 g / day (6.3-12.3 g/day)) regardless of OSA status. In the multivariate analysis, we found an independent association of salt intake with OSA only in participants with hypertension (OR 1.051, CI 1.002 - 1.103, p = 0.043).
Conclusions: Our results underscore that the role of sodium in the pathogenesis of OSA may not be applied to OSA in general, but limited to participants with higher salt intake and hypervolemic profile, such as observed in those with hypertension

CONTINUOUS POSITIVE AIRWAY PRESSURE - A POTENTIAL CURE FOR ARRHYTHMIA IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA?

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Aims: Premature ventricular complexes (PVCs) are abnormal electrocardiogram findings that indicate potential cardiac disease and are associated with increased mortality. Obstructive sleep apnea (OSA) is a known risk factor for cardiovascular disease and individuals with OSA may have increased PVC burden. We investigate if continuous positive airway pressure (CPAP) therapy has the potential to reduce PVC burden in individuals with OSA.

Methods: Polysomnography studies of individuals with OSA who had pre and post CPAP studies over a 4 year period were retrospectively reviewed. PVCs in 3 lead ECG tracings during these studies were manually calculated and validated by a senior consultant cardiologist specializing in electrophysiology. A PVC index (PVC count/hour) was then calculated for each of the studies. Patient demographics, cardiovascular disease, risk factors, echocardiography, routine sleep study and body measurements were also collected. R statistics was used for univariate and linear mixed model analysis of the data. The study was approved by the institution ethics review board.

Results: Polysomnography studies of 546 individuals with OSA (RDI/AHI>5) were reviewed, of which, 63 individuals had PVCs noted on their initial studies. 44 (69.8%) of these were male, with a median age of 60 (range 28-87).

Linear mixed model analysis revealed that as expected, mean AHI and RDI decreased by 47.5% and 48.6% post CPAP respectively when compared to pre CPAP treatment data (p< 0.001). Mean PVC index decreased by 22.3% with all other variables being constant (p=0.125) when compared with pre-CPAP treatment. In a proportion of cases, n =15 (23.8%), PVCs were no longer noted post CPAP treatment.

Conclusions: Our study revealed that with CPAP therapy, mean PVC index is reduced by a notable and clinically significant value. Although this result was not statistically significant, it does show promise of the efficacy of CPAP therapy in reducing PVC burden and further studies should be conducted to confirm this hypothesis. Furthermore, there are a subset of individuals who may benefit greatly from CPAP therapy as it has the potential to eradicate PVCs completely and potentially reduce cardiovascular morbidity and mortality in patients with OSA.

INSPIRATORY FLOW LIMITATION IN NORMAL AND UARS PATIENTS IN A GENERAL POPULATION SAMPLE

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Introduction: Inspiratory flow limitation (IFL) is defined as a "flattened shape" of inspiratory airflow contour detected by nasal cannula pressure during sleep and can indicate increased upper airway resistance especially in mild Sleep Related Breathing Disorders (SRBD). It is commonly caused by narrowing of a hypotonic upper airway in response to the negative intrathoracic pressure developed during inspiration. However IFL cut-off value for SRBD is not established yet. The objective of the study was to determine the cut-off value of IFL in potential Upper Airway Resistance Syndrome (UARS) subjects considering clinical outcomes in a general population sample. **Materials and Methods:** The baseline sample was derived from a prospective population-based study designed to assess the prevalence of sleep disorders in Sao Paulo, Brazil. A total of 1,042 subjects completed all the study assessments in 2007 and, from July 2015 to April 2016, 712 from these participants were reassessed and underwent a second examination. Full night polysomnography (PSG) at both baseline and follow-up was performed in the Sleep Institute´s sleep laboratory (São Paulo, Brazil). IFL was scored based on nasal cannula recording if there were at least four consecutive breaths with flattening of the airflow curve in a 30 second epoch. We manually scored each participant and calculated their total time spent in IFL during sleep. The receiver operating characteristic (ROC) curve was determined in order to verify the percentage (%) of total sleep time (TST) in IFL in relation to clinical outcomes in no OSAS subjects (normal individuals and potential UARS patients). Fatigue (according to Chalder Fatigue Scale) and excessive daytime sleepiness (according to Epworth Sleepiness Scale) were the clinical outcomes selected. Other outcomes were evaluated but their sensibility and accuracy were lower. **Results:** From the 712 participants evaluated, 487 presented an AHI of > 5 events/hour (OSA group) and were not included in the analysis. The analysis of IFL in 225 subjects without OSAS indicated a cut-off value of equal to or greater than 5% of TST based on the ROC curve when fatigue and excessive daytime sleepiness were considered as outcomes. The results demonstrated a sensibility of 78.6% and a specificity of 26.4% (AUC = 0.6 and p = 0.1). **Conclusion:** In a general population sample, the cut-off value of IFL in normal subjects and in potential UARS patients when fatigue and excessive daytime sleepiness were considered was of equal or greater than 5% of TST. Further studies in different populations should be performed to confirm if this results are replicable and the impact of these findings in clinical outcomes. **Acknowledgements:** The authors would like to thank for the support by grants from Associaçao Fundo de Incentivo a Pesquisa (AFIP), Fundaçao de Amparo a Pesquisa do Estado de Sao Paulo (FAPESP), Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

HOW MUCH MATTERS? EXPLORING THE MINIMUM IMPORTANT DIFFERENCE FOR SLEEPINESS IN SPINAL CORD INJURY

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Introduction: Sleep disorders are highly prevalent and poorly recognized in people with spinal cord injury, with obstructive sleep apnea (OSA) the most common. Efficacy of continuous positive airway pressure (CPAP) therapy for people with acute tetraplegia and OSA has recently been investigated in a multicentre randomised controlled trial (the COSAQ trial). The CPAP group experienced significantly greater improvements in subjective daytime sleepiness, as measured by the Karolinska Sleepiness Scale (KSS), a 10 point scale measuring state sleepiness. Furthermore, weekly changes in the KSS were sensitive to CPAP use that week, demonstrating that the KSS is responsive to change in this population. However the Minimal Important Difference (MID) has never been formally established for the KSS in any population. Establishing the MID is essential for future research investigating treatments for sleep disorders in people with spinal cord injury. This exploratory study aimed to investigate the MID for the KSS in people with acute tetraplegia who had undergone CPAP treatment for OSA.

Materials and methods: This study involved secondary analysis of data from the COSAQ trial, using KSS scores collected in the CPAP group at baseline and three months. Distribution and anchor-based methods were used to determine the MID of the KSS. For the distribution-based method, the effect size (mean change/SD at baseline) was calculated to estimate the MID. For the anchor-based method, sensitivity and specificity were calculated for KSS change scores to discriminate between participants who improved on a global utility scale (Assessment of Quality of Life, AQoL) by the published MID (0.06) versus those who did not. A receiver operating characteristics (ROC) curve was plotted and the MID was the cut-off point with the best balance of sensitivity and specificity, defined as the point on the ROC curve nearest to the upper left corner of the graph.

Results: The mean change in KSS in those randomised to the CPAP group (n=73) was 1.4 (SD=2.7). The distribution method identified a MID of 0.6 points. The mean improvement in KSS score was larger in those who improved on the AQoL vs those who did not (improved mean (SD) vs not improved mean (SD), p=0.06). The optimal cut-point for the KSS on ROC curve analysis was 1, however sensitivity and specificity at this cut-point was 28% and 87% respectively (area under the curve of 0.59, 95% CI=0.46-0.72).

Conclusions: Exploratory analysis of existing data suggests that the MID for the KSS may lie between 0.5 and 1. Future studies should consider using an anchor that is specific to the changes that people with tetraplegia experience with CPAP therapy, to increase the precision of the MID estimate for this frequently used outcome measure in spinal cord injury research.

Sleep Breathing Disorders
Board #267 : Poster session 3

RELATIONSHIP BETWEEN SLEEP APNEA AND PROGNOSIS OF PATIENTS WITH TOTAL ANTERIOR CEREBRAL INFARCT

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Abstract: Sleep-disordered breathing is an increasingly recognized disorder that is particularly prevalent among stroke patients. Sleep apnea, a form of sleep-disordered breathing, is an independent risk factor for stroke but is also associated with poor functional prognosis after stroke.
Study Objectives: to estimate the possible relationship between Sleep Apnea (SA) during acute phase of ictus and clinical, vital and functional prognosis in patients with total anterior cerebral infarct (TACI).
Methods: A study in 35 adult patients with TACI was made in a stroke unit in the Arnaldo Milián Castro Hospital between March of 2017 and March 2018. Polysomnography was obtained within 72 Hours of symptom-onset. National Institutes of Health Stroke Scale (NIHSS), Barthel Index and modified Rankin Scale (mRS) were used for establishing clinical and functional prognosis. Favorable prognosis patients included: who meet at least one of the following criteria: ≤2 complications, NISHH < 20, IB> 20 or mRS≤4 at 3 months after the infarction. Not favorable prognosis patients included: who meet the following four criteria: ≥3 complications, NISHH ≥20, IB≤20 and mRS = 5 at 3 months after infarct. The data was processed using 15.0 version of SPSS software and was presented in tables and statistical graph. From the inferential statistics was applied the Independence Test based on the Chi-square distribution and the Student´s t-test. Multivariate analysis was performed using Logistic regression.
Results: 81.82% (9/11) of the patients between 75 and 85 years old evolved unfavorably, there was a higher probability of having a worse prognosis in the longest-lived patients (X2 = 10.59, p = 0.007). Patients with higher blood pressure (BP) values and longer time with O_2 saturation of less than 90% (T90) during sleep were more likely to have an unfavorable final prognosis. Tenth out of 12 (83,33 %) patients with severe SA and any one of patients with a normal AHI expired (X^2=13,24; p=0,003). 75% (9/12) of patients with severe SA had three or more complications (X^2=10,18; p=0,015). Significant and positive correlation was found between AHI and, NISHH (r=0,405; p=0,016) and Ranquin score (r=0,546; p=0,016) respectability, but negative correlation was found between AHI and Barthel Index score (r=-0,526; p=0,021). Patients with post stroke severe SA had a higher probability of death (X2=13,24; p=0,003), as well as a worse clinical prognosis (X2=10,18; p=0,015) and a poor functional prognosis at 3 months of follow-up (X2=5,63; p=0,015). AHI was very significantly associated with the unfavorable overall prognosis (X2 = 19.55, p = 0.000).The logistic regression model showed that each increase of one unit in AHI increased the risk of unfavorable prognosis by 1.13 (OR = 1.13).
Conclusions: SA may be considered an independent prognostic factor related to fatal outcome after TACI, due by a poor clinical, vital and functional prognosis.
Keywords: Total anterior cerebral infarct, Sleep Apnea, Polysomnography, Prognosis.

IS THE OBSTRUCTIVE SLEEP APNEA PHENOTYPE IN STROKE DIFFERENT FROM THAT IN REFRACTORY HYPERTENSION?

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Introduction: Obstructive sleep apnea (OSA) is highly prevalent among the patients with stroke and refractory hypertension(RH), yet, no proposed pathogenic mechanisms like adrenal axis activation, inflammation and hypercoagulability have been established for the same. Recently, different phenotypes have been described for obstructive sleep apnea and each phenotype has different symptomatic and cardio-vascular complication profiles. The objective of this study was to assess if there is any dominance of different polysomnographic phenotypes of the OSAHS in stroke versus RH patients and if any specific inflammatory and sympathetic activation markers are associated with the OSAHS in these two groups.

Materials and methods: Patients with clinical diagnosis of ischemic or haemorrhagic arterial stroke presenting to Neurology services (Group 1) and patients with clinical diagnosis of RH to cardiology out-patient Department (Group 2), at our center between 2011 to 2015, were recruited in the study. Detailed clinical and polysomnography (PSG) evaluation were conducted. PSG studies were scored by experienced sleep technologists and sleep physicians. All PSG studies were classified into three phenotypic sub-groups for patients with stroke (group 1) and RH (group 2) according to distribution of respiratory events- subgroup A (1A and 2A) - respiratory events equally distributed throughout the study, sub-group B (1B and 2B - REM dominant (REM AHI / NREM AHI > 2), subgroup C (1C and 2C) = NREM dominant (NREM AHI/ REM AHI > 2).Serum CRP, IL-6, VEGF and TNF-α were estimated as inflammatory markers and early morning nor-adrenaline and 24 hours urinary nor-adrenaline were estimated as markers for sympathetic activation for all included subjects.

Results: A total 99 subjects (79 males, mean age 51.82±9.7) were enrolled in group 1 and 44 (29 males, mean age 48.54±14.7) in group 2. There was a significantly higher number of patients having hyperlipedimia in group 1 [39(39.4) vs. 7(15.91), p = 0.006]. On PSG, NREM dominant sleep apnea was significantly more frequently observed in group 1 compared to group 2[38(38.4%) vs 3(6.8%), p = 0.02] while REM dominant obstructive sleep apnea was significantly more frequently seen in group 2 [15(15.2%) in group 1vs 25(56.8 %) in group 2, p = < 0,001] . No significant difference was found as pertains to other sleep parameters and the biochemical markers of inflammation and sympathetic activation. There were significantly more patients with hyperlipedimia in subgroup 1C and mean early morning nor-adrenaline levels were significantly higher in sub-group 2B.

Conclusions: Polysomnographic phenotypes are significantly different among stroke patients with OSA compared to resistant hypertension patients and OSA, with a majority in the latter group having REM dominant OSA. Some biochemical markers could also significantly differ between these two groups.

Acknowledgements: We acknowledge the valuable contributions of Jyoti Katoch, Bhatat Bhatia, Nikhil and Tukaram in acquiring and scoring polysomnography studies and managing data.

THE EFFECT OF ELEVATED EVENING BLOOD PRESSURE ON OBSTRUCTIVE SLEEP APNEA-RELATED MORNING BLOOD PRESSURE ELEVATION: DOES SEX MODIFY THIS INTERACTION EFFECT?

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Introduction: Obstructive sleep apnea (OSA) can lead to increased morning blood pressure (BP). We hypothesized that elevated evening BP may aggravate OSA-related morning BP elevation. Additionally, this interactional effect may be modified by sex.

Materials and methods: This retrospective, cross-sectional study included newly diagnosed OSA patients with an apnea-hypopnea index (AHI) ≥ 5 per hour on a full-night polysomnography. An analysis of covariance (ANCOVA) was used to determine whether severe OSA (AHI ≥ 30) was associated with higher morning BP than non-severe OSA (5 ≤ AHI < 30) and whether there was a severe OSA-elevated evening BP interaction on morning BP. To identify the sex effects, analyses were performed separately in each sex group.

Results: A total of 1445 patients with an average age of 51.9 years (SD 11.7) (1126 males, 319 females; 323, elevated evening BP group, 1122 normal BP group) were included in the study. Based on the ANCOVA, patients with severe OSA had significantly higher morning systolic BP (SBP) ($p = 0.001$), diastolic BP (DBP) ($p < 0.001$), and mean BP (MBP) ($p < 0.001$) than the non-severe group among male subjects only. A significant severe OSA-elevated evening BP interaction was identified on morning DBP and MBP in male subjects. However, there were no differences in morning BP between severe and non-severe OSA groups in female subjects.

Conclusions: In male subjects, severe OSA contributed to higher morning BP than non-severe OSA, and OSA associated morning DBP/MBP elevation was more prominent in patients with elevated evening BP than those without elevated evening BP.

THE ASSOCIATION OF RESPIRATORY DURATION AND ANTHROPOMETRIC MEASURES IN A PEDIATRIC POPULATION WITH OBESITY

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Introduction: Obstructive sleep apnea (OSA) is characterized by a partial or complete upper airway obstruction during sleep, causing decreases in oxygenation, increased arousals and sleep fragmentation. However OSA severity markers the apnea hypopnea index (AHI) does not fully characterize physiological disturbances. The objective of this study is to evaluate the relationship between respiratory event duration, anthropometric measures and neurocognitive function in an obese children with OSA.

Materials and methods: This was a prospective study of children with obesity aged 8 to 18 years who had a baseline polysomnogram (PSG). OSA was defined as obstructive AHI ≥ 5 events per hour. Mean event duration was categorized into quartiles. Neurocognitive function was evaluated using the Conner's Rating Scale Revised: Long Version Global Index (GI) T score and the Behavior Rating Inventory of Executive Function (BRIEF) Global Executive Composite (GEC) T score. Statistical analysis was performed using the Mann Whitney U test for independent samples.

Results: Of the 114 children with obesity referred for PSG, 45(39%) had OSA (mean age 14.2 ± 2.5, BMI 38.1 ± 7.4, 71 % male) while 69 (61%) did not have OSA (mean age 14.0 ± 2.7, BMI 37.0 ± 8.5, 41 % male). Subjects with OSA were divided into 2 groups; those with a shorter event duration as represented by the Q1 + Q2 quartile (Group 1, mean event duration: 5.1-11.83 seconds, n=23) and those with a longer event duration quartile Q3 + Q4 (Group 2, mean event duration: 11.84-21.83 seconds, n=22). The mean obstructive AHI of subjects in Group 1 versus Group 2 was 12.82 ± 6.07 events/hour and 27.91 ± 26.95 events/hour respectively. Subjects in Group 1 had a significantly higher body mass index (BMI) (p=0.01), waist to height ratio (p=0.015), neck to height ratio (p=0.027) and were older in age (p=0.028) as compared to subjects in Group 2. No statistically significant results were found in OAHI (p=0.238), arousal index (p=0.243), Conner's T score (p=0.156) or BRIEF T score (p=0.181) between groups.

Conclusions: In this study we observed that subjects with a shorter respiratory event duration had a higher BMI, increased abdominal obesity and increased neck to height ratio. Future research is needed to identify the pathophysiological role of respiratory event duration in obese children with OSA.

Sleep Breathing Disorders
Board #262 : Poster session 1
COOPERATIVE THERAPEUTIC APPROACH OF PHYSICIANS AND DENTISTS TO PATIENTS WITH SLEEP APNEA IN JAPAN

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Introduction: Oral appliance (OA) is one of major therapeutic approaches to obstructive sleep apnea (OSA). OA is prepared by dentists based on the result of first over-night polysomnography (PSG), prior to the titration PSG which defined the therapeutic effectiveness of the prepared OA. This needs a cooperation of sleep physicians and dentists. The aim of the study is to elucidate how they cooperate between their clinics.

Materials and methods: OSA patients of Tokorozawa Respiratory Clinic (Saitama, Japan), between 1 January 2012 and 31 December 2017, were enrolled. Among them, OA was prescribed to those whose apnea hypopnea index (AHI) were $5 \leq$, < 20/hr, or those whose adherence to CPAP was poor for some reasons, according to insurance system in Japan. The cooperation between physician and dentists were estimated by the number of their communications found in their chart.

Results: Physicians consulted 409 OSA patients to dentists to prescribe OA, while the dentists initially informed the physicians regarding 78 cases (19.1%) visiting their dental clinic. In comparison, physician-physician cooperation is more successful, as the referred physician informed the visit in more, 73.3% (N=177) of the whole referral cases (N=235) (p< .05).
Dentists consulted back to the physicians for titration PSG only in 50 cases (12.2%). Of them, OA treatment was scarcely successful as few as in 22 cases (44%). These suggested that physician-dentist cooperation was not well established in Japan, and that the effect of OA should be initially assessed by full-PSG.

Conclusions: For appropriate treatment of OSA patients with OA, therapeutic approach based on physician-dentists cooperation needs to be established and furthermore should be encouraged in Japan.

Sleep Breathing Disorders
Board #263 : Poster session 1
ASSOCIATIONS BETWEEN SLEEP AND THE ORTHOSTATIC BLOOD PRESSURE RESPONSE IN PEOPLE WITH UNTREATED SLEEP DISORDERED BREATHING

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Introduction: It is well established that sleep disordered breathing is a risk factor for hypertension. Orthostatic hypertension, an abnormal increase in blood pressure when transitioning from the supine to upright posture, often precedes hypertension. Sleep loss has previously been found to alter the orthostatic response in good sleepers, but little is known about this relationship in people with sleep disordered breathing. The purpose of the present study was to evaluate how the orthostatic response in heart rate (HR), systolic and diastolic blood pressure (SBP and DBP) may relate to sleep disturbances linked to untreated obstructive sleep apnea (OSA) or upper airway resistance syndrome (UARS).

Materials and methods: A sample of 39 participants with untreated OSA or UARS (70% female; 31% with a history of depression; mean age $\pm$ SD: 50.1 + 14.1 y.o.; mean body mass index (BMI) $\pm$ SD: 30.5 +7.2) were recruited from a sleep clinic shortly after polysomnography-based diagnosis. All participants underwent HR, SBP and DBP measurements: i) after 20 minutes of rest in the supine position, ii) straight after standing up (0min) and iii) 5 minutes after standing up (5min). Ambulatory sleep monitoring was conducted using actigraphy in the week following HR and blood pressure measurements. Partial correlations were applied to explore relationships between sleep variables and indices of the orthostatic response in HR, SBP and DBP while controlling for body mass index and depression status.

Results: Shorter total sleep time correlated significantly with a higher increase in heart rate straight after transitioning from the supine to the standing position (supine-0min; $r = .48$, $p=.002$), and a more pronounced subsequent decrease in heart rate in the 5min following standing-up (0min-5min; $r = -.44$, $p=.006$). Shorter total sleep time also correlated with a higher rise in SBP and DBP as measured 5min after standing up relative to supine measurements (supine-5min; $r = .34$, $p=.041$ and $r = .34$, $p=.039$ respectively). Poorer sleep efficiency correlated with a higher increase in DBP in the 5min following the positional change (0min-5min; $r=.37$, $p=.025$).

Conclusions: These preliminary findings suggest that shorter sleep durations in people with sleep disordered breathing are associated with an accentuated orthostatic HR response; characterized by an immediate increase in HR straight after standing up and a pronounced decrease 5 minutes later. Shorter and more fragmented sleep, two common features of OSA and UARS, were also related to more pronounced rises in blood pressure after standing up. These results indicate that there may be a link between poor sleep and abnormal daytime cardiovascular regulation in people with untreated sleep disordered breathing. Whether chronic sleep disturbances could increase the risk of orthostatic hypertension in the long term remains to be investigated. Further work should also assess whether these abnormalities persist following the initiation of PAP therapy.

POLYSOMNOGRAPHIC ASSESSMENT OF THE PREVALENCE OF OBSTRUCTIVE SLEEP APNOEA IN CHILDREN AND YOUNG PEOPLE WITH EPILEPSY LIVING IN SCOTLAND

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Introduction: Epilepsy is a common condition characterised by recurrent seizures, affecting approximately 1 in 220 children in the UK. Obstructive sleep apnoea (OSA) is a sleep-related breathing disorder present in up to 6% of children. An observational pilot study conducted within our department using the sleep-related breathing disorders scale of the Pediatric Sleep Questionnaire (PSQ-SRBD) found that 55% of children with epilepsy had symptoms suggestive of OSA, compared with 7% of typically-developing controls. The aim of the current study is to further test this association, assessing whether objective OSA prevalence, as measured by polysomnography, is higher in children with epilepsy than controls.
Materials and methods: Ethical approval was granted by the local research ethics committee (REC#16/SS/0195). Written informed consent was obtained from the participant and/or their caregiver as appropriate. Children aged 5-18yr with epilepsy and a control group of age- and sex-matched children without epilepsy were recruited in Edinburgh, Scotland between March 2017 and March 2019. Children with significant comorbidities were excluded. A single night of level I attended polysomnography was undertaken and scored in accordance with the AASM Manual for the Scoring of Sleep and Associated Events Version 2.3 (2016). Anthropometrics measures were collected on the night of the polysomnography. Subjective sleepiness was recorded using the children's Epworth Sleepiness Scale (ESS), completed by the child in association with their caregiver. OSA was defined as an OAHI$\geq$1/hr in line with International Classification of Sleep Disorders (ICSD-3) guidelines. Standard statistical analyses were undertaken using IBM SPSS Statistics for Windows Version 25 (IBM Corp., Armonk, NY, USA). Results are presented as mean$\pm$SD or median(IQR) as appropriate. Significance was set at $p < 0.05$.
Results: Forty-four children underwent polysomnography: 29 children with epilepsy (62% male), 15 controls (60% male). Groups did not differ significantly in mean age (11$\pm$3yr epilepsy, 11$\pm$3yr controls, p=0.943) or mean body mass index (20.8$\pm$5.7kg/m^2 epilepsy, 19.3$\pm$4.0kg/m^2 controls, p=0.376). Children with epilepsy were significantly sleepier than controls (mean ESS 6.1$\pm$5.0/24 epilepsy, 3.5$\pm$2.8/24). Mean AHI was 0.5(0.2-1.5)/hr in children with epilepsy and 0.8(0.4-1.0) in controls (p=0.652); OAHI 0.1(0.0-0.7) epilepsy, 0.1(0.0-0.4) controls, p=0.640; 0.2(0.0-1.0); CAHI epilepsy, 0.4(0.0-0.4) controls, p=0.594. Mean SpO_2 was 96$\pm$2% in children with epilepsy and 96$\pm$1% in controls (p=0.791); SpO_2 nadir 93$\pm$3% epilepsy, 93$\pm$3% controls, p=0.535; $\geq$3% ODI 0.3(0.1-1.3) epilepsy, 0.2(0.0-0.7) controls, p=0.194. No significant differences were noted in terms of sleep architecture, arousals or PLMs (data not shown). A diagnosis of OSA was observed in 17% of children with epilepsy and 14% of controls (p=0.552).
Conclusions: Children with epilepsy were significantly sleepier than controls but did not exhibit a higher prevalence of OSA, though participant numbers were small. The percentage with OSA in children both with and without epilepsy is higher than the reported prevalence in the general population. Sleepiness may be related to anti-epileptic medication. This study is ongoing.

MAGNETIC RESONANCE IMAGING MARKERS OF CEREBRAL SMALL VESSEL DISEASE IN ADULTS WITH MODERATE/SEVERE OBSTRUCTIVE SLEEP APNEA IN SCOTLAND

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Introduction: Obstructive sleep apnea (OSA), affecting ~4% of adults, is associated with cardiovascular dysfunction and may contribute to development of dementia. Cerebral small vessel disease (SVD) causes 20% of strokes and half of all cases of dementia. SVD can present as gait/balance problems, depression, cognitive impairment, or may be clinically "silent". Characteristic brain changes on magnetic resonance imaging (MRI) include white matter hyperintensities (WMH) and enlarged perivascular spaces (PVS). A systematic literature review demonstrated associations between OSA and SVD. We tested this hypothesis by assessing MRI markers of SVD and their relationship with objective sleep measures in adults with moderate/severe OSA.

Materials and methods: As part of a multicentre study, we recruited symptomatic, treatment-naïve patients aged ≥18yr with moderate/severe OSA (AHI≥15/hr + ODI≥10/hr) in Edinburgh, UK. Ethical approval was granted by the local research ethics committee and written informed consent was obtained. We collected anthropometric measures and baseline demographics including vascular risk factors. Level IV sleep studies were undertaken using WatchPAT200 (Itamar Medical Ltd, Caeseria, Israel). All patients had baseline MRI scans (T1, T2, FLAIR, proton density sequences). Segmentation was performed using a validated multispectral method, implemented in MATLAB R2018b (The MathWorks, Inc., Natick, MA, USA), prior to manual correction of the WMH and intracranial volume (ICV). PVS were assessed computationally in the centrum semiovale on T2-weighted images using a previously published method.Standard statistical analyses were undertaken using IBM SPSS Statistics for Windows Version 25 (IBM Corp., Armonk, NY, USA), with significance set at p< 0.05. Results are presented as mean±standard deviation or median(interquartile range) as appropriate. Linear regression modelling was used to explore associations between sleep and MRI outcomes, with results presented as β(95%CI).

Results: Forty-one participants (66% male) were recruited: mean age 50.4±9.2yr, mean BMI 35.1±6.0 kg/m2. One participant withdrew post-baseline. Two-thirds of participants reported ≥1 cardiovascular risk factors, including hypertension (37%), high cholesterol (24%), ex-smoking (22% ≥1yr; 5% < 1yr), current smoking (12%), type II diabetes (10%) and previous stroke (2%). No significant sex differences were evident.At the time of analysis, sleep, WMH and PVS data were available for 36 (88%), 22 (54%) and 17 (41%) participants respectively. Mean pAHI was 53.4±24.7/hr; mean pODI 40.2±25.7/hr; mean SpO2 nadir 76.6±9.3%; WatchPAT-derived OSA severity: 3% mild, 26% moderate, 71% severe.

WMH burden was low: WMH volume 1.1(0.7-2.1)ml. WMH/ICV ratio was 0.08(0.05-0.14)%. Mean ICV was 1477.1±185.1ml, total PVS count 585±239, PVS volume 6.2±3.3ml. Men had a higher ICV (p=0.011), PVS volume (p=0.023) and PVS count (p=0.050).

Multivariate regression analysis showed a significant association between severity of WatchPAT-derived OSA severity and PVS count (β155.660(10.717-300.603), p=0.035) when controlling for age, sex and hypertension. No significant associations between OSA severity and WMH measures were evident (data not shown).

Conclusions: In an interim analysis of this ongoing study, the burden of SVD was low in

patients with OSA. OSA severity was significantly associated with PVS in this small group. Full data will be presented.

BEYOND THE APNEA HYPOPNEA INDEX (AHI): IMPORTANCE OF SLEEP QUALITY MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA (OSA) AND RELATED MORTALITY IN PATIENTS WITH CARDIOVASCULAR DISEASE

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Introduction: Obstructive sleep apnea (OSA) is associated with increased cardiovascular risk, including hypertension. Mechanisms underlying cardiovascular-sequale of OSA are thought to include sympathetic activation, oxydative stress and inflammation. Suceesful Continous Positive Airway Pressure (CPAP) treatment improves cardiometabolic risk. Cardiopulmonary Coupling (CPC), is ECG-based Software as Medical Device(SaMD), providing information on cardio-respiratory health during sleep, displaying FDA-cleared Sleep Quality Index (SQI).We hypothesized that the software generated SQI offers relevant clinical information additional to the Apnea Hypopnea Index (AHI) in management of hypertension in OSA patients that may reduce CVD morbidity and mortality.

Materials and Methods: CPC-analysis of ECG signals extracted from polysomnography studies (PSG) in the HeartBEAT database (https://clinicaltrials.gov/ct2/show/NCT01086800), studying patients with well managed cardiovascular risk factors and undiagnosed moderate-severe OSA (AHI;15-50), randomly assigned to: 1) healthy lifestyle with sleep education (HLSE) 2) supplemental nocturnal oxygen (NSO) or 3) CPAP-therapy.

In this analysis the cohort was: 1) Stratified based on sleep quality at baseline, into good-(GSQ:SQI ≥55) and compromised sleep quality group (CSQ;SQI< 55) and 2) Changes in sleep categories during the study period, Improved-SQI (transitioned from $CSQ^{Baseline}$ to $GSQ^{Follow-Up}$), No-Change-SQI, or Decline-SQI (transitioned from $GSQ^{Baseline}$ to $CSQ^{Follow-Up}$). Sleep-quality categories were evaluated using multilevel mixed-effects linear regression model and analysis of covariance (ANCOVA) to compare effects of sleep quality at start of therapy and sleep quality changes on blood pressure (BP; mm/Hg).

Results: PSG- and BP-data with sufficient ECG-signal quality was analysed. Baseline data was availablefor 254 participants, 241 of which had both baseline and follow-up data. Age 45-76 (mean 63.2, ±7.19), 73.5% male with 34% in the CPAP-therapy arm.The most significant effects were observed in patients with compromised sleep quality at baseline (CSQ; $SQI^{Baseline}$< 55) receiving CPAP-therapy with greatest decrease observed during sleep, Mean Arterial Pressure (MAP^{Sleep}) -5.14 (p=0.001), Systolic Blood Pressure (SBP^{Sleep}) -4.95 (p=0.027) and Diastolic Blood Pressure (DBP^{Sleep}) -5.24 (p< 0.001), respectively. Smaller decrease was observed in 24-Hour Mean Arterial Blood Pressure (MAP^{24}) -3.13 (p=0.023); DBP^{24}-3.63 (p=0.001) and DBP^{Wake}-2.89 (p=0.025). Patients with CSQ receiving HLSE-therapy increased in both MAP^{Sleep}+2.27 (p=0.035) and DBP^{Sleep}+2.39 (p=0.008). NSO-therapy did not differ when comparing effect on blood pressure in patients with $GSQ^{Baseline}$and $CSQ^{Baseline}$.

When stratified based on changes in SQI during the study period ($SQI^{Baseline}$to $SQI^{Follow-up}$), comparing the group that improved ($SQI^{Baseline}$< 55, $SQI^{Follow-up}$≥ 55) in sleep quality (CPAP 31% / NSO 43% / HLSE 26%) to the group that declined ($SQI^{Baseline}$≥ 55, $SQI^{Follow-up}$< 55) in sleep quality (CPAP 48% / NSO 36% / HLSE 16%), greatest improvements are observed in blood pressure during wake, MSP^{Wake}-8.01 (p=0.035), MAP^{Wake}-6.52 (p=0.011), DBP^{Wake}-5.77 (p=0.007) respectively, but as well as in MAP^{24}-5.00 (p=0.003) and DBP^{24}-4.56 (p=0.017).

Conclusions: Improving sleep quality as part of therapy in patients with OSA and multiple cardiovascular risk factors including high blood pressure is important.

EVALUATION OF SKELETAL FACTORS IN UPPER AIRWAY STIMULATION PATIENTS

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Introduction: Obstructive sleep apnea (OSA) is characterized by repeated episodes of upper airway collapse leading to oxygen desaturation during sleep. CPAP is the first line of treatment, but for patients with low adherence, upper airway stimulation can be a surgical treatment option. Obesity is the phenotype most commonly associated with OSA and variations in craniofacial structure are also associated with the condition. When OSA is caused or influenced by a variation in anatomy, the obstruction may originate from either soft tissues (including musculature) or from skeletal components. The skeletal morphology of a patient can be done by looking at their skeletal classification, dental classification, maxillary width, overbite, and overjet.

Materials and **Methods:** A retrospective study of patients that were referred to a single surgeon for OSA and received upper airway stimulation from a single center from 2016 to 2019 was done. Data from patients with pre- and post- operative full overnight PSG were collected. Basic demographics such as age, BMI, sex, as well as sleep related AHI, LSAT, and skeletal morphology were investigated.

Results: Of the 28 patients that received UAS, 12 patients (2 female, 10 male) with complete titration were included in the study. The average age of the patients was 62.4 years, BMI 27.68 (kg/m^2), AHI 49.17 (events/hr), and LSAT 81.92 (%). 7 patients had C1 dental occlusion, 6 patients had C1 skeletal morphology. 6 patients had normal overjet and overbite. 6 patients had normal maxillary width and 6 patients had narrow maxillary width. The average AHI change in the narrow maxillary width group was less significant than the normal group.

Conclusions: Skeletal morphology such as maxillary width can affect the efficacy of UAS.

COMPUTATIONAL FLUID DYNAMIC STUDY IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Obstructive sleep apnea(OSA) is a common disorder which may need surgery to widen the airway. However the success rate of surgery is variable. Thus it is necessary to predict the outcome of the surgery preoperatively. The purpose of this study is to evaluate the mechanical parameter of upper airway airflow in OSA patients using computational fluid dynamics(CFD) method.

Materials and methods: We conducted a study on 12 patients who visited the sleep center for snoring, who underwent the full night polysomnograpny(PSG) and paranasal sinus computed tomography(CT).

Three-demensional reconstructions of the upper airway were created in the medical imaging software Mimics using paranasal CT. The reconstructions extended from nasopharynx to hypopharynx. Steady-state, turbulent , inspiratory airflow simulations were conducted with software(Fluent). The mechanical parameters were calculated in the three levels of nasopharynx, retropalatal, retrolingual area.

Results: The maximum wall shear stress values were shown at the retropalatal plane in most patients.

In general, The higher the AHI, ther greater the wall shear stress values in retroplatal plane.

Conclusions: Thus, the palatal surgery might help the OSA patients.

The further study about many cases is needed to evaluate upper airway character.

GENDER DIFFERENCES IN THE EFFECTS OF SLEEP DISORDERED BREATHING IN CHILDREN ON BLOOD PRESSURE, SLEEP, QUALITY OF LIFE, EXECUTIVE FUNCTION AND BEHAVIOUR

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Introduction: In adults there is a distinct gender difference in the prevalence of sleep disordered breathing (SDB), however there have been limited studies examining the effects of gender in children with SDB. We compared the effects of gender on severity of SDB, blood pressure, sleep, respiratory characteristics, and behaviour in a large group of children referred for assessment of SDB and non-snoring control children recruited from the community.

Material and methods: We recruited 533 children aged 3-18 years between 2004-2016, who underwent overnight polysomnography, using standard paediatric techniques. Blood pressure was recorded whilst seated quietly prior to each study. Behaviour, executive function and quality of life were assessed with the CBCL, BRIEF and OSA-18 questionnaires. Children were grouped by gender and SDB severity based on their obstructive apnoea hypopnoea index (OAHI) into non-snoring controls, Primary Snoring (PS) (OAHI≤1 event/h), Mild OSA (OAHI>1-≤5 events/h) and moderate/severe (MS) OSA (OAHI>5 events/h) and compared data with 2-way ANOVA.

Results: 298 boys and 235 girls were studied: controls (M=61; F=70), PS (M=110; F=71), Mild OSA (M=72; F=45) and MS OSA (M=55; F=49). Mean age was 7.2 ± 0.1 years (mean ± sem) and BMI z-score (0.66 ± 0.07). There were no differences in age or BMI z-score between groups. There was also no difference in SDB severity, sleep characteristics, blood pressure, behaviour, executive function or quality of life between boys and girls in each of the SDB severity groups.

Conclusions: In contrast to studies in adults, our study did not identify any gender differences in the severity or consequences of SDB in children.

Sleep Breathing Disorders
Board #264 : Poster session 1

A VALIDATION STUDY OF AN ESOPHAGEAL BASED POLYGRAPH AGAINST MANUALLY SCORED POLYSOMNOGRAPHY

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Introduction: Home sleep apnea testing (HSAT) has become an ever more established practice during workup for sleep disordered breathing. The role of respiratory effort related arousals (RERA) is of interest, but currently only full polysomnography (PSG) can, by definition, identify cortical arousals. However, several manufacturers of HSAT devices provide indices based on estimated arousals in their automated scoring algorithms. The aim of this study was to validate the performance of automatically scored indices from an oesophageal probe based HSAT device (Apneagraph, Spiro Medical) with manually scored indices from obtained from PSG (A1, NoxMedical).

Materials and methods: The respiratory event index from the apneagraph (REIagr) was compared with the event index scored with American Academy of sleep medicine 2012b criteria (REIpsg). Moreover, the oxgen desaturation index from the apneagraph (ODIagr) was compared with the ODIpsg. Finally, an estimated apnea hypopnea index (AHIagr) was compared to the AHIpsg defined by the REIpsg + RERAs manually scored.

Results: 83 consenting, consecutive patients (71%male, mean BMI:31) receiving workup for suspected sleep disordered breathing slept over night with both devices recording simultaneously. Sensitivity and specificity were calculated for diseased states defined as polysomnography index scores over 5, 15 or 30. Sensitivity of the REIagr at comparable scores was 100%, 83% and 57% respectively. Specificity was 63%, 95%, and 98% respectively. Sensitivity of the ODIagr was 100%, 97% and 96% while specificity was 19%, 74% and 95%. Sensitivity of the AHIagr was 100%, 100% and 91% while specificity was 0%, 9% and 44%. Scatterplots and Bland Altman plots indicated that all three indices over scored in mild sleep disordered breathing- and underscored in moderate to severe disease.

Conclusions: Results indicated that the REI and the ODI from the Apneagraph Spiro may be useful for the detection of sleep disordered breathing. However, the index consisting of the REI plus RERAs identified by the oesophageal manometer were only to some degree related to cut off values of 5, 15 and 30 of manually scored AHI.

Acknowledgements: We would like to acknowledge all staff at the otorhinolaryngology department at Akershus University Hospital and Spiro Medical.

COMPUTER AIDED SURGICAL SIMULATION IN MAXILLOMANDIBULAR ADVANCEMENT FOR OBSTRUCTIVE SLEEP APNEICS

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Introduction: Maxillomandibular advancement(MMA) has become the most effective surgical option for patients with obstructive sleep apnea(OSA) in order to reduce apnea-hypopnea index(AHI). MMA is a specific type of orthognathic surgery, which involves maxillary and mandibular osteotomies, telegnathic advancement of maxillomandibular complex, precise positioning of jaw bone and rigid fixation to secure the accurate occlusion. Eventually, the expanded pharyngeal airway could improve the OSA. Computer aided surgical simulation(CASS) is a modern technology, which can assist a surgeon to achieve accurate prediction of surgical outcome, good communication with patients, and reduce the difficulty in surgical conduction. This is a retrospective study to evaluate the accuracy, efficacy, and clinical outcomes of CASS in MMA for OSA.
Materials and methods: Sixty-seven (24 female) patients, aged 18 to 63 years, who underwent MMA with CASS application were included. Superimposition of 3DCT images before and two weeks after surgery was used to evaluate the accuracy of surgery. Clinical records including hospitalization days, operation time, blood loss, complications, and polysomongraphic data were collected to evaluate the efficacy and the outcome in sleep disordered breathing.
Results: The superimposition of 3DCT images shows transitional errors less than 1mm, and angular errors less than 1 degree. AHI improved from 34 ±25/hr to 5± 4/hr. The operation time was 5.4 hours with blood loss 480 cc in average. The patients were admitted in hospital for three days in average. Minor complications such as transient trigeminal third nerve hyposthesia was noted.
Conclusions: CASS in MMA is an accurate and effective treatment modality for patients with OSA.

THE SLEEP BOARD: IMPACT OF A MULTIDISCIPLINARY ASSESSMENT MODEL IN CPAP FAILING OSA PATIENTS

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Introduction: IntrObstructive sleep apnea is a complex disease at the crossroads of multiple medical and surgical fields of expertise. Previous published guidelines have acknowledged the need for multidisciplinary management of this complex disease. Yet, to this day very little data exists in the literature regarding means to establish this multidisciplinary care team. Also, virtually no objective data exists on such care teams. Historically in our institution, CPAP failing/intolerant patients have been evaluated in a multidisciplinary consultation where the patient is simultaneously evaluated by a pneumologist, an ENT surgeon, a Maxillofacial surgeon, and a stomatologist. The purpose of this study was to present our multidisciplinary care model and report on its outcomes.
Materials and methods: We performed a retrospective chart review of all patients assessed at the multidisciplinary obstructive sleep apnea clinic at our institution between December 2015 and December 2017. Descriptive statistics were used to analyze our data.
Results: Patients are met by all 4 health professionals at once and the relevant history and prior treatment attempts are presented by the pneumologist. The relevant examination and imaging is reviewed by the team in the presence of the patient and a focused physical examination is performed by each specialist. An explanation of each possible treatment option is made. The patient is given time to ask questions and a decision for the new treatment is made in consultation with all specialist and the patient.
183 patients were evaluated. 63% had severe OSA and 35% had moderate OSA. The mean BMI was 27 kg/m^2. The mean age was 52.8 years. Patients had been diagnosed on average 2.4 years prior to consultation and were followed up for an average of 15 month. 56% of patients were referred due to primary treatment modality intolerance, while 20% of patients were looking for an alternative to their present treatment, and 20% of patients were consulting a sleep specialist for the first time in order to choose the appropriate treatment. 90 % of patients were offered a new treatment following consultation with the multidisciplinary team. 73 % of treatment offered were oral appliances, 10% where treatment plans based on combined modalities, 7% were offered CPAP alone, 6% bimaxillary advancement surgery, 3% ENT surgery, and 1% was referred for polysomnography. The average time from referral to assessment by the multidisciplinary board was 23.7 weeks.
Conclusion: The presented multidisciplinary care model is an integrated care team that allows for alternative treatment to be offered to most patients. This can decrease the number of patients who would remain otherwise untreated due to lack of compliance to their initial prescribed treatment. This model allows for decreased delays in subspecialist assessment and decreases duplication of appointments and redundancy that patients have to endure when being cared for by multiple specialists. It improves communication between the specialists and allows for the integration of the patient's input in the treatment plan.

ORAL APPLIANCE THERAPY FOR MODERATE TO SEVERE OSA PATIENTS: THE CASE FOR A WIDER USE IN CPAP FAILING PATIENTS

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Introduction: Oral appliances(OA) are widely considered as superior to no treatment in CPAP failing patients. In France, OA are considered second-line treatment for severe OSA after refusal or discontinuation of CPAP, and the first-line treatment of moderate OSA with clinical signs and symptoms. Yet there remains a barrier to promoting OA in patients with higher AHI, higher BMI, or those considered to have a poor mandibular protrusion potential. The Primary objective of this study was to evaluate the efficacy of OA in a real-life community hospital setting in moderate to severe OSA patients. The secondary objective was to evaluate OA tolerance and compliance.

Materials and methods: Retrospective chart review of all moderate to severe OSA cases treated by OA in a single ENT unit over a 2-year period from 2016 to 2018. The absolute and relative AHI reductions were analyzed and univariate analysis of demographic and clinical characteristics of patients was performed.

Results: 473 patients were treated by OA of which 333 could be analyzed. The mean AHI reduction was 14.9 event/h (p< 0.0001) and the success rate (defined as an AHI reduction >50 %) was 65.2 %. Age did not influence OA efficacy. A higher baseline BMI was associated to a higher relative AHI reduction (p=0.005) while a higher baseline AHI was associated to both a higher absolute and relative AHI reduction (p=0.001 and p=0.008 respectively). A greater mandibular protrusion at baseline was not statistically associated to higher AHI reduction. Tolerance issues were reported by 7 patients (1.5 %) while OA was discontinued by 37 patients (7.8 %) over our follow up period.

Conclusions: In this study OA allowed a significant AHI reduction and a high success rate in moderate to severe OSA patients. Although it is not effective in every patient, it should be considered as a treatment option without preconceived idea of success of failure according to age, BMI, initial AHI or maximal protrusion.

Acknowledgements: To Dr. B Navailles for the development of oral appliances in our ENT unit and the interest he has been able to elicit in all members of the team.

SCREENING OF PEDIATRIC OSA USING VIDEO MONITORING

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Introduction: According to ICDS-3 criteria, overnight polysomnography(PSG) is the gold standard tool for the diagnosis of pediatric obstructive sleep apnea(OSA) and adenotonsillectomy is the first line treatment for whom confirmed it. However, in Japan, the many of the patients are not able to access the specialized sleep medical facilities for PSG due to less availability and cost issues. Purpose of this study is to examine whether combination of video monitoring and other clinical examinations can reliably predict the severity of pediatric OSA compared with PSG.
Materials and Methods: Between April 1, 2012 and March 31, 2018, total of 135 children (3-12 years of age, boy 93, girl 42) with Sleep Related Breathing Disorder (SRBD) were enrolled in individual prospective-cohort study. Video monitoring was performed during PSG. Nocturnal oximetry(nSpO2) data was extracted from each PSG data with other clinical examinations which include ENT examinations, cephalogram, and rhinomanometry for all patients. Using multiple logistic regression analysis, AHI 5/hr and AHI 10/hr were set as dependent variable and examined the accuracy of the predictor model.
Results: Regarding as above AHI 5/hr, the independent predictors were the continuous inspiratory noise after 2 hours of sleep onset, nocturnal oximetry result (ODI 3% >3/hr), rhinomanometry (NR>0.5 Pa/cm3/sec), with an accuracy of predictive statistic model was 82.2% (sensitivity 73.3%, and specificity 86.7%) which is much higher comparing with the combination of objective investigation alone. For the severity above AHI 10/hr, the video scoring parameters were whole night inspiratory noise (loud), chest retraction, and awaking episode (even though unclear episode) contribute to predict with Cephalogram parameter (Fx>85°) and Oximetry (ODI 3% >3/hr) with the sensitivity 82.2%, the specificity 83.9% and the accuracy 83.0%. Both results are much high accuracy comparing the one without video monitor scoring.
Conclusion: Video monitor scoring parameters contributed to predict both AHI 5/hr and 10/hr with good overall sensitivity, specificity and overall accuracy compare with the combination of objective results alone. Instead of PSG, the combination of video scoring system and multiple clinical examinations could potentially provide reliable diagnostic approach for pediatric OSA especially for those may need early medical intervention/ surgical indication (i.e. adenotonsillectomy) with high accuracy. These results will support to establish more efficient diagnostic strategy for both patients and physicians.

Sleep Breathing Disorders
Board #285 : Poster session 2

AGE-STRATIFIED SEX DIFFERENCES IN POLYSOMNOGRAPHIC FINDINGS AND PHARYNGEAL MORPHOLOGY AMONG CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Childhood obstructive sleep apnea (OSA) has important implications for growth, learning, behavior, cognition and cardiovascular health as well as snoring and OSA in adulthood. In this study, we elucidated the sex differences in polysomnographic (PSG) findings and pharyngeal radiographic data in pediatric OSA patients.

Materials and methods: Sixty three children (age between 3 and 15 years old) with OSA [defined as apnea-hypopnea index (AHI) ≥1/h by polysomnography] were enrolled. Lateral neck radiographs were obtained from the patients. All subjects were separated by age: pre-adolescent group (3-8 years old) and adolescent group (9-15 years old).

Results: Overall, 45 patients in the pre-adolescent group (33 boys and 12 girls) and 18 patients in the
adolescent group (10 boys and 8 girls) were enrolled, and sex differences were compared in each group. We found sex differences in craniofacial features and severity of OSA in the adolescent group, in which girls with OSA had more upper airway space, in addition to lower AHI, lower 3% oxygen desaturation index (ODI), higher minimum SO2 and better sleep efficiency than the boys.

Conclusions: The present study found revealed sex differences in pediatric OSA patients in the adolescent group. Girls in the adolescent group had more upper airway space in addition to lower AHI, lower 3% ODI, higher minimum SO2 and better sleep efficiency than boys.

Sleep Breathing Disorders
Board #286 : Poster session 2

PROGNOSTIC IMPACT OF SLEEP-DISORDERED BREATHING IN HOSPITALIZED PATIENTS FOLLOWING ACUTE DECOMPENSATED HEART FAILURE

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Introduction: Identifying hospitalized patients at a high risk for worse long-term clinical outcomes following acute decompensated heart failure (ADHF) is important. However, limited data regarding influence of sleep-disordered breathing (SDB) and its treatment by positive airway pressure (PAP) on post-discharge clinical outcomes in hospitalized patients following ADHF are available. The aim of this study is to investigate relationship between SDB, its treatment by PAP and long-term clinical outcomes.

Materials and methods: After the initial improvement of ADHF, overnight polysomnography was performed on consecutive hospitalized patients whose left ventricular (LV) ejection fraction ≤45% between May 2012 and January 2015. In the present study, SDB was defined as an apnea-hypopnea index ≥15. Patients with SDB were subdivided as those with or without PAP treatment. The risk for composite of all-cause mortality and rehospitalization due to heart failure (until May 2019) were assessed by stepwise multivariable Cox proportional model.

Results: Overall, 120 patients were enrolled. Among them, 72% had SDB and 33% were initiated into PAP. At a median follow-up of 1.7 years, 77 patients had clinical events (64%). In the stepwise multivariable analysis, SDB was associated with increased risk of clinical events (hazard ratio [HR], 2.64; P=0.001). Among SDB patients, stepwise multivariable analysis showed that PAP treatment was associated with reduced risk of clinical events (HR 0.52; P=0.025).

Conclusions: In hospitalized patients following ADHF, presence of SDB was associated with worse long-term clinical outcomes, which may be reversible by PAP therapy. Thus, following ADHF, hospitalized patients with LV systolic dysfunction should be evaluated whether they have SDB and considered for SDB treatment before discharge.

Acknowledgements: I am affiliated with endowed department by Philips, Fukuda Denshi and ResMed.

Sleep Breathing Disorders
Board #275 : Poster session 3

TWENTY-FOUR-HOUR CONTRACT-FREE UNCONSTRAINT RECORDINGS OF RESPIRATION AND PHYSICAL ACTIVITY OF TERMINAL CANCER PATIENTS RECEIVING OPIOIDS

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Introduction: Terminal cancer patients in palliative care unit receive opioid for relief of cancer pain and dyspnea. These symptoms are generally believed to stimulate breathing and increase apneic threshold, and relatively large amount of opioid is prescribed based on clinical symptoms and manual respiratory-rate (RR) measurement. Vital sign (VS) monitoring which restricts patient's activity is not recommended in palliative care patients. We recently developed a contact-free unconstraint VS monitor using load cells under the bed legs (Bed Sensor System: BSS). Accuracy of RR measurement with BSS is confirmed in healthy volunteers (Isono S, et al. J Appl Physiol 2019; 126:1432-1441). In this observational study, we aimed to reveal twenty-four-hour VS with the BSS in terminal cancer patients receiving opioid without contact and restricting their daily activity.

Materials and methods: Thirty terminal cancer patients (age: 66±14 yrs, BMI: 20.5±4.2 kg/m^2) participated in this study. Various types and amount of opioids were prescribed (oral morphine-equivalent: 1.88±2.4 mg/kg/day). BSS VS recording was started on the day of admission. BSS continuously provides 10Hz VS data measured from a composite BBS waveform from four load cells. Daily VS data were divided into 3 periods (AM: 6am to 2pm, PM: 2pm to 10pm, Night: 10pm to 6am) and a median VS value for each period was obtained. Except the activity index reflecting magnitude of body movement on the bed, VS data were only calculated from the data with minimum body movements. Friedman Repeated Measures Analysis of Variance on Ranks was performed to assess statistical differences between the periods. P< 0.05 considered to be statistically significant.

Results: Patients were on bed most of the time (AM:96.3%, PM:98.1%, Night:98.1%, P=0.003) with few time spent outside the bed (AM:0.25 hour^{-1}, PM:0.25 hour^{-1}, Night:0.25 hour^{-1}, P=0.966). Body movements on the bed were significantly smaller during the night (AM:0.026, PM:0.027, Night:0.017, P< 0.001). RR was measurable approximately one-third of the time in bed (AM:32%, PM:36%, Night:36%, P=0.099). RR excluding apneas varied among the patients but decreased during the night (AM:12.9 min^{-1}, PM:11.9 min^{-1}, Night:11.9 min^{-1}, P=0.029). Night-time RR instability defined as a ratio to the preceding breath was indirectly and directly associated with nocturnal RR and bradypnea rate defined as percentage of RR< 10 min^{-1}, respectively. Opioid dose was significantly associated with RR, instability of RR and tidal volume, and bradypnea rate.

Conclusions: BSS successfully assessed vital signs of terminal cancer patients without contact and activity restriction. Use of opioid affects respiratory rate and respiratory stability

SLEEP DISORDERED BREATHING AND SMALL VESSEL DISEASE IN MILD TO MODERATE STROKE: ACUTE AND SIX MONTHS FOLLOW-UP

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Introduction: Sleep disordered breathing (SDB) is a risk factor for stroke and affects up to 2/3 of all stroke patients. SDB is associated to poor functional outcome and increased mortality after stroke. The association between stroke etiology, especially small vessel disease (SVD), and SDB as well as development of SDB over time after a stroke is uncertain.
Materials and methods: We conducted an observational prospective study including stroke patients within seven days from symptom onset, and re-tested, following the same protocol, after six months. The patients had an overnight polysomnography and the apnea hypopnea index (AHI) was calculated. Sleepiness was scored by Epworth sleepiness scale (ESS) and sleep quality by Pittsburgh Sleep Quality Index (PSQI). The ischemic strokes were classified according to the TOAST classification and a total SVD score was calculated based on MRI. Age, sex and stroke severity were included as confounders.
Results: A total of 101 patients were included and 58 patients had follow-up. Median age was 68 years (range 36-88), 57% were men, 90% had ischemic strokes and median NIHSS was 2 (range 0-16). SDB, defined as an AHI >15, was found in 57% of patients in the acute state and in 50% of patients at follow-up. AHI decreased over time, median change 3.9, 95% confidence interval (CI): 0.7-8.3; p=0.012. Sleepiness (ESS) decreased over time: median change 1.5, 95% CI: 0.5-3.0; p=0.01, but sleep quality (PSQI) was unchanged: median change 0.5, 95%CI: -1.0-1.5; p=0.59.
AHI was not associated with stroke severity, stroke type (ischemic/hemorrhagic), or the TOAST classification.
The total SVD score was associated to AHI at follow-up (ANOVA: p=0.033),but not in the acute state (p=0.08). The odds for patients to need treatment for SDB (AHI>15) at both the acute state and follow-up was higher for those with a SVD score of 3 (odds 43, 95%CI 4-1281) and 4 (odds 42, 95%CI 3-1566) than a SVD score of 0.
Conclusions: SDB and sleepiness improved during the first six month after stroke but are still highly prevalent. AHI and treatment-requiring SDB in both the acute state and follow-up were associated with increased SVD score, but not the TOAST classification groups. SDB in stroke is common why we recommend awareness of identification of this risk factor, and further investigation of the implication of stroke etiology.

CLINICAL RISK FACTORS FOR OBSTRUCTIVE SLEEP APNEA IN A KOREAN SLEEP CLINIC

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Introduction: Sleep apnea is a common sleep disorder. Since polysomnography is essential for the diagnosis of sleep apnea, patient screening or selection is an important issue in the sleep clinic. The purpose of this study was to investigate the clinical risk factors of sleep apnea in a representative sleep clinic in South Korea.

Materials and methods: The medical records of the 7874 adult patients who visited the sleep clinic from 2009 to 2018 were reviewed. We investigated the demographic data, the results of the sleep questionnaires and polysomnography to come up with clinical risk factors of sleep apnea for sleep clinic. Apnea-hypopnea index over 15 was regarded as clinically significant sleep apnea.

Results: A total of 4581 patients were finally analyzed. Age (OR=1.224 from 50 to 65, p=0.027; OR=1.858 in 65 or more, p< 0.001), male (OR=5.900, p< 0.001), BMI (OR=2.833 from 25 to 30 kg/m^2, p< 0.001; OR=9.388 over 30kg/m^2, p< 0.001) and hypertension (OR=1.537, p< 0.001) were independent risk factors of sleep apnea.

Conclusions: In the sleep clinics in South Korea, it is necessary to specify the risk factors of sleep apnea according to the characteristics of Koreans. Further research to develop new instruments for screening sleep apnea in Korean sleep clinics is needed.

RAPID-EYE-MOVEMENT RELATED OBSTRUCTIVE SLEEP APNEA-HYPOPNEA SYNDROME: DEMOGRAPHIC, ANTHROPOMETRIC AND POLYSOMNOGRAPHIC FEATURES

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Introduction: To explore the demographic, anthropometric, and polysomnographic features of rapid-eye-movement (REM) related obstructive sleep apnea-hypopnea syndrome (OSAHS).

Materials and methods: This was a retrospective study of 957 patients (737 males) with either REM-related OSA (REM-OSAHS group) (n=157) or non-rapid-eye-movement (NREM) related OSA (NREM-OSAHS group) (n=800). The patients diagnosed with REM-OSAHS were classified as the wide definition (REM1 group), the traditional definition (REM2 group) and the strict definition (REM3 group). The differences in demographic and polysomnographic characteristics were compared in three groups.

Results: The REM-OSAHS group was lower than the NREM-OSAHS group in terms of the Body Mass Index (BMI), the neck circumference, and The Epworth Sleeping Scale (ESS). The NREM-OSAHS group was significantly higher than of the REM-OSAHS group in terms of the overall mean AHI (combined in all sleep stages), the oxygen desaturation index (ODI) and the mean AHI in the supine position (s-AHI). The SpO2 < 90% time (T90) was also significantly higher in the NREM-OSAHS group than that of the REM-OSAHS group. The REM1, REM2 and REM3 groups were statistically different in terms of AHI, ODI and T90.

Conclusions: These data suggest that frequency and severity of sleep apnea is lower in REM related OSAHS patients, and they are presenting with specific characteristics in demography, anthropometry. Furthermore, the more apnea hypopnea events associated with REM sleep, the less severe the condition.

EVALUATION OF THE EFFECT OF THE MANDIBULAR ADVANCE DEVICE IN THE UPPER AIRWAY USING MRI

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Introduction: Currently, mainstream therapies for Obstructive Sleep Apnea Symdrome (OSAS) include weight loss in obese patients, conservative treatment using continuous positive airway pressure (CPAP) and Mandibular Advancement Devices (MAD). The use of MAD has proven to be useful in reducing the Apnea Hypopnea Index (AHI) and symptomatology in patients with Obstructive Sleep Apnea. Because the upper airway extends from the nose to the larynx, its relationship with the MAD is complex and the changes that occur with its application can occur at anatomical or physiological levels.
Materials and methods: Fourteen subjects who had polysomnographic diagnosis of Obstructive Sleep Apnea Syndrome associated with a tongue base obstructive were taken. A personalized MAD was made for each patient and MRI was performed with and without the MAD in awakened patients in dorsal position. Three anteroposterior measures (retropalatine, retrolingual and retroepiglottic) were taken evaluating their differences in a sagittal cut in the midline. MRI study was performed in a 3 Tesla device, Philips, Achieva, using a 3D Fast Field Echo pulse sequence weighted at T1, SENSE, with a 256x256 matrix, TR = 15ms TE = 2.303ms. The measurements were made in a cutting thickness of 2mm, NSA = 2 and using the OSIRIX MD software.
Results: It was found that, of the 14 patients, the space that was enlarged in more patients was the retroepiglottic space (N = 9), followed by the retropalatinal space (N = 5) and the retrolingual space (N = 4). However, when performing the statistical analysis, there was no significant difference (p> 0.05) in any of the 3 spaces with respect to measurements with and without the application of MAD. However, a significant change was found in the volumetric measurements made at the level of the upper airway studied, a two-tailed T-student statistic with a value of 0.4266 was applied.
Conclusions: It is believed that the effect of MAD on OSAS is due to the increase in the upper airway space. However, in our study there are no significant increases in the spaces, so this improvement could be caused not only by anteroposterior increments of the upper airway, but by a volumetric effect as shown by the magnetic resonance imaging. We consider the need to increase the sample of patients and in sleeping conditions monitored during the acquisition of MRI in future research
Acknowledgements: The entire team of the sleep disorders clinic of the National Autonomous University of Mexico, the National Center for Imaging and Medical Instrumentation and the Imaging Department of the Federico Gómez Children´s Hospital of Mexico

OBSTRUCTIVE SLEEP APNEA AND ITS INFLUENCE ON INTRACRANIAL ANEURYSM

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Introduction: Obstructive sleep apnea (OSAS) is a well-known risk factor for cardiovascular morbidity and frequently causes vascular instability and inflammation during sleep. So, we tried to investigate the relationship between OSAS and the development of intracranial aneurysm (IA).
Materials and methods: We enrolled 564 patients who visited health promotion center and undertook polysomnography and screening brain Magnetic Resonance Angiography (MRA). The prevalence and size of IA were investigated about the association with OSAS and the possible risk factors.
Results: The mean age 55.6±8.5 years and 82.3 % were male. The prevalence of IA was 10.5% and significantly higher in the patients with OSAS ($P=0.02$) or family history of cerebrovascular disease ($P=0.03$). After adjusting all possible confounding factors for IA and OSAS, presence of OSAS were still significantly associated with the presence of IA. Furthermore, OSAS group had significantly larger aneurysm size compared with the non OSAS group ($P=0.013$).
Conclusions: We found suggestive association between OSAS and intracranial aneurysm.

COMPARISON OF OVERNIGHT OXIMETRY DOWNLOAD WITH POLYSOMNOGRAPHY IN CHILDREN

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Introduction: The diagnosis of obstructive sleep apnoea (OSA) in children is challenging given the high prevalence (2-3%), the significant associated morbidity and the resource intensity of the Polysomnography (PSG) which remains the gold standard. The aim of this study is to evaluate the reliability of the overnight oximetry download as a screening tool for the diagnosis of OSA in children.

Materials and methods: A retrospective analysis of all children with clinical suspicion of OSA who underwent an oximetry download and a subsequent PSG in a tertiary Paediatric Hospital from January 2014 to April 2016.

Results: During the study period, 110 patients had overnight oximetry download as well as PSG. Sixty-one children (56%) had normal, 30 (27%) had mildly abnormal and 19 (17%) had moderately/severely abnormal oximetry. Sixty-four percent of children with normal oximetry did not have OSA in PSG. Of the children with severely abnormal oximetry, 100% had severe OSA in PSG. The overall sensitivity and specificity of oximetry for identification of OSA were 63% and 78% respectively. The overall positive and negative predictive values (PPV and NPV) were 78% and 64%, respectively. The sensitivity and specificity of moderate/severe abnormal oximetry for diagnosis of moderate/severe OSA were 59% and 100%, respectively. PPV and NPV of moderate/severe abnormal oximetry were 100% and 78%, respectively.

Conclusion: Children with moderate/severe abnormal oximetry do not need a PSG to diagnose OSA. They can be treated based on the oximetry result. However, a normal oximetry does not rule out OSA in children and they still require a PSG.

HIGHER MORPHINE ADMINISTRATION WAS ASSOCIATED WITH INCREASED CENTRAL SLEEP APNEA EPISODES AND MORE SEVERE HYPOXIA DURING SLEEP

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Introduction: Opioids are widely used for management of chronic pain. Several studies have demonstrated an association of opioids with sleep apnea. Sleep apnea is a chronic respiratory disorder caused by collapse of the pharyngeal airway (obstructive sleep apnea, OSA) or lack of ventilatory drive (central sleep apnea, CSA). According to a recent systematic review, the prevalence of CSA in patients on opioids is 24%. The aim of this study was to investigate the effect of opioids on the sleep structure.

Materials and methods: Chronic pain patients on opioid therapy with or without symptoms of sleep apnea were consented for in-laboratory overnight polysomnography (PSG) from five Canadian Pain Centers. For each subject, the opioids were converted to their morphine milligram equivalent dosage (MME). From the PSG, several parameters including the respiratory events, event duration, event related hypoxia, respiratory arousal index and nocturnal oxygen saturation were extracted. The hypoxic burden was calculated as the sum of all the respiratory-event related area under the desaturation curve from pre-event baseline divided by the total sleep time. In addition, we calculated the percentage of hypopneas for each participant as the number of hypopneas divided by the total number of events. For our analysis, the subjects were grouped into i) those diagnosed with dominant CSA and/or hypoventilation; and ii) those diagnosed with OSA or no sleep apnea. Depending on the normality, Student's *t*-test or Mann-Whitney *U* test was used for comparison.

Results: Out of 204 subjects that had a PSG, 33 were excluded due to missing information or low quality signals. Of the 171 subjects (101 females), age of 52.2±12.9 years, BMI of 29.2±6.6 kg/m^2 and apnea/hypopnea index of 16.6±22.1 events/hour; 34(19.9%) were diagnosed with dominant CSA and/or hypoventilation. The MME was significantly higher in the CSA group compared to the non-CSA group (146 [45 548] vs. 72 [25 155] mg/d, p=0.002). The CSA group had lower mean nocturnal oxygen saturation (92.7±2.6 vs. 94.6±2.1%, p=0.002). In addition, the respiratory-event related oxygen desaturation and hypoxic burden was significantly higher in the CSA group (6.6±2.9 vs. 5.0±3.1%, p=0.003; 0.92 [0.5 1.8] vs. 0.24 [0.11 0.52], p< 0.0001; respectively). The CSA group had a significantly lower percentage of hypopneas compared to the non-CSA group (26.9 [8.2 68.5] vs. 84.4 [58.5 97.8], p< 0.0001). Also, the respiratory arousal index was significantly higher in the CSA group (6.5 [2.2 19.8] vs. 2 [0.7 5.9], p=0.0006). However, there were no significant differences in the mean apnea-hypopnea duration between the two groups (p=0.28).

Conclusion: This study shows in chronic pain patients on opioids, higher MME is associated with severe CSA, hypoxia and hypoxic burden during sleep. These findings suggest that, upon validation in a larger patient population, quantification of respiratory event related arousals, hypoxia and hypoxic burden may help us identify patients on opioids at high risk of sleep apnea.

INCREASES IN THE INTENSITY OF HEART SOUNDS AT THE TERMINATION OF RESPIRATORY EVENTS ARE POSITIVELY CORRELATED WITH THE MAGNITUDE OF HYPOXIA

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Introduction: The leading cause of mortality worldwide is cardiovascular disorder. One of the independent risk factors of cardiovascular disorders is obstructive sleep apnea (OSA). According to a recent study, elderly men who experience extended episodes of pharyngeal airway obstruction during sleep together with poor blood oxygenation have a high risk of heart failure. For evaluating the pathophysiology of cardiovascular disorders in OSA patients, heart sounds have great potentials as they contain clinically relevant information regarding functioning of the heart and blood flow. Accordingly, the aim of this study was to evaluate the effect of respiratory events as well as drop in blood oxygen saturation during respiratory events on the intensity of heart sounds. We hypothesized that, due to an increase in sympathetic activity during respiratory events, there will be an increase in heart sounds' intensities from before to after the respiratory event and that this increase will be directly correlated with the drop in oxygen saturation.

Materials and methods: Subjects aged >18 years who were referred to the sleep laboratory of Toronto Rehabilitation Institute for sleep study were recruited. The subjects underwent overnight polysomnography. Simultaneously, a small wearable device was used to record tracheal sounds over the suprasternal notch, which includes respiratory sounds, snoring, and heart sounds. An automated algorithm was developed to extract heart sounds S1 and S2 from tracheal sounds. In each subject, 20 obstructive events during Non-REM stage-2 of sleep were considered. Subsequently, we extracted 10-second segments before the start of each event (pre-event), before the termination of the event or onset of arousal (pre-termination) and after the termination of the event/arousal (post-termination). For each segment the average intensities of S1 (HSI_{S1}) and S2 (HSI_{S2}) were calculated. One-way ANOVA was used to compare HSI_{S1} and HSI_{S2} during pre-event, pre-termination and post-termination segments. For post-hoc analysis, Tukey's multiple comparisons test was used. Pearson's correlation was used to investigate the correlation between drop in oxygen saturation and change in HSI_{S1} and HSI_{S2} from pre-termination to post-termination segments.

Results: Data from 77 subjects (34 females), age of 54.8±14.1 years, BMI of 30.5±6.5 kg/m^2 and apnea/hypopnea index of 29.7±28.0 events/hour (no OSA=7 subjects, mild=22, moderate=22 and severe=26) were investigated. There was a significant increase in HSI_{S1} and HSI_{S2} from pre-termination to post-termination (7.5±3.3dB vs. 11.1±3.5dB, $p < 0.0001$) and from pre-event to post-termination (9.5±2.7dB vs. 11.1±3.5dB, $p < 0.001$). Furthermore, the changes in HSI_{S1} and HSI_{S2} from pre-termination to post-termination of an event showed significant positive correlation with the drop in oxygen saturation, with and without arousal ($r > 0.9$, $p < 0.01$ for both).

Conclusions: This study shows that there is a significant association between the magnitude of hypoxia and increases in HSI_{S1} and HSI_{S2} at the termination of respiratory events. Upon validation in a larger patient population, heart sounds analysis may help identifying the mechanisms underlying the development and progression of cardiovascular disorders in OSA patients.

NOVEL WEARABLE TECHNOLOGY TO SCREEN FOR SLEEP APNEA: A PILOT STUDY

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Introduction: Over half a billion people worldwide are estimated to suffer sleep apnea, with 80% of these remaining undiagnosed. Current diagnostic reference to screen for sleep apnea is based on attended polysomnography, performed in sleep centers. This technique needs specialized instrumentation and professional medical personnel. Recently developed portable devices for home sleep-apnea testing also require technical skill and understanding that not every patient is capable of, increasing the risk of inadequate recordings and unnecessary re-testing. Further, these portable devices are not easily available in rural areas.
Thus, there is an urgent need for inexpensive and easy-to-use technology which can be used to accurately screen for sleep apnea. Here, we present results from a pilot study on using an inexpensive, wearable collar device to screen for sleep apnea and hypopnea.

Materials and methods: We collected overnight breathing recordings simultaneously with the collar device and polysomnography from 43 participants. Recordings were done in Oulu University Hospital, Oulu, Finland.
We used a mathematical method to mark an apnea or hypopnea event when recorded activity fell below a threshold for 10 or more seconds. Pulse oximeter data was not included in the method to screen for sleep apnea. The rate of apnea and hypopnea events was summarised using an AHI/REI (Apnea Hypopnea Index/Respiratory Event Index) value for each participant and compared to the AHI/REI value given by commercial software (Noxturnal, Nox Medical Ltd.) applied to the polysomnographic measurements.
We also assessed feedback on ease and comfort-of-use on 5-point rating scales, from 28 of the 43 participants, from whom feedback was available.

Results: The collar device measurements returned an average AHI/REI value of 30.5 across the 43 participants, with values ranging from 5.5 to 71. These values closely matched the AHI/REI values from the polysomnographic recordings, with a correlation of 0.84 (p< 0.001), despite pulse oximeter data from the collar device not being used in the estimation. Bland-Altman comparison gave a difference in estimated and mean AHI/REI values of 2.5 (0.3,4.7), with 95% confidence intervals of -11.9 (-15.7,-8.1) and 16.9 (13.1,20.7). Further, the user feedback evaluation revealed that each of the 28 participants from whom feedback was available, marked the highest rating for the collar's ease-of-use and 24 marked the highest rating for their comfort of sleep while using the collar device.

Conclusions: The results with the wearable collar device closely matched those with the conventional polysomnographic device. The results for collar device tended to over-estimate apnea events, especially when patients had mild apnea. This is expected to be corrected once oxymeter data is available for the algorithm. User feedback also indicated that the collar device was easy to use and comfortable to wear while sleeping. The ease-of-use and inexpensive nature of the collar device compared to the current technology makes it a promising tool for accurate and simple screening for sleep apnea and related disorders.

CLINICAL PROFILE OF OBSTRUCTIVE SLEEP APNEA AND ATRIAL FIBRILLATION AT DR. CIPTO MANGUNKUSUMO HOSPITAL, INDONESIA

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Introduction: Obstructive sleep apnea (OSA) is a common disorder that is part of a complex syndrome of sleep disordered breathing. Actually, OSA symptoms often occur but are difficult to detect. Atrial Fibrillation is the one most common supraventricular arrhythmia, characterized by an irregular and extremely rapid atrial electrical activation, found in OSA patients. There is no data from our regional population about clinical profile of obstructive sleep apnea and atrial fibrillation at our hospital.

Materials and methods: The observational hospital-based study was carried out on 50 OSA subjects who 33 subjects with electrocardiographically diagnosed Atrial Fibrillation seen at a Dr. Cipto Mangunkusumo Hospital, Indonesia from January to December 2017. OSA based on screening Indonesian validation-Berlin (Berlin-INA) questionnaire. There are many risk factors for developing AF in OSA subjects : age, sex, BMI, hypertension, history of smoking, alcohol and comorbidities such as stroke, heart failure, and coronary artery disease.

Results: Out of 33 subjects were diagnosed atrial fibrillation, 46,8% was middle age (40 - 64,9 years old); 62,7% male, 34,3 % subjects was overweight and 31,4 % was obese. In this study, 68.3% were diagnosed heart failure (HF), 72.2% were diagnosed coronary artery disease (CAD), and 13.8% were diagnosed stroke. Fifty eight percent patients smoking. Most of AF-OSA subjects did not drink alcohol (98.1%). Fifty seven percent subject get hypertension.

Conclusions: Obstructive sleep apnea is high risk for development of atrial fibrillation. OSA-AF subjects were highly found in male sex, middle age (40 - 64,9 years old), overweight, hypertension and smoking.

ASSOCIATION BETWEEN ASTHMA CONTROL AND RISK OF OBSTRUCTIVE SLEEP APNEA AT A TERTIARY HOSPITAL

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Introduction: Asthma and obstructive sleep apnea (OSA) may related affect each other. This study purpose is to know the association between asthma control and risk of obstructive sleep apnea at a tertiary hospital.
Materials and methods: An observational study with consecutive patients older than 18 years who were diagnosed of having asthma were included in this study and interviewed by Berlin Questionnaire, STOP BANG, and Pittsburgh Sleep Quality Index (PSQI). This study done between August 2017 to February 2018 at Dr. Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia. Data were analyzed using SPSS 24 statistical software package.
Results: There are 70 subjects in this study. The subjects are predominantly male 55 (78.6%) and female 15 (21.4%). Most of the subjects are in 40 - 59.9 years age group. Fifty-four subjects (77.1%) have normal BMI and 16 (22.9%) subjects are obese. Eighty-one percent subjects have history of asthma for more than five years. The result from data analysis showed association between ACT and STOP BANG (p 0.10); ACT and ESS (p 0.21); and ACT and PSQI (p 0.27) which mean there are no significant association. Analysis of questionnaires ACQ and STOP BANG showed p value 0.07;ACQ and ESS (p 0.08); and ACQ and PSQI (p 0.03).
Conclusions: No significance difference between asthma control and risk of obstructive sleep apnea in tertiary hospital. Normal body mass index influence the result.

CAROTID ARTERIAL CALCIUM SCORING USING UPPER AIRWAY COMPUTED TOMOGRAPHY ON PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: CLINICAL USEFULNESS AS A PREDICTOR OF CEREBROCARDIOVASCULAR DISEASE

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Introduction: To evaluate the clinical value of airway computed tomography (CT) in patients with obstructive sleep apnea (OSA) as a predictor of cerebrocardiovascular disease (CCVD) by quantitatively analyzing carotid arterial calcification (CarAC).

Materials and methods: This study included 287 consecutive patients aged 40-80 years who underwent both polysomnography and airway CT from March 2011 to October 2015. The carotid arterial calcium score (CarACS) was quantified using the modified Agatstone method on each upper airway CT. OSA severity was divided into four groups (normal, mild, moderate, and severe) using the results of polysomnography. Clinical characteristics, comorbid disease and lipid profiles were analyzed in each patient, and the prevalence of CCVD were investigated during the follow up period (52.2 ± 16.0 months).

Results: CCVD occurred in 27 patients (9.3%) at the end of follow-up. The CCVD (+) group showed significantly older mean age (57.5yrs vs 54.2yrs), higher prevalence of hypertension (59% vs 34%) and CarAC (51.9% vs 20.8%), whereas gender, other comorbid diseases, and the severity of OSA were not significantly different with that of CCVD (-) group. A univariate analysis showed age, hypertension, incidence of CarAC, and CarACS were risk factors for CCVD events. In a multivariate analysis, the incidence of CarAC was the only independent risk factor for CCVD.

Conclusions: CarAC is an independent risk factor for CCVD whereas the severity of OSA is not a contributory risk factor in patients with OSA. Therefore, additional analysis of CarACS based on airway CT scans may be useful for predicting CCVD.

CIRCULATING EXOSOMES IN OBSTRUCTIVE SLEEP APNEA INCREASED THE GROWTH AND PROLIFERATION OF LUNG CANCER CELLS THROUGH ACTIVATION OF ERK/C-MYC AXIS AND DECREASED CYTOTOXICITY OF CISPLATIN IN LUNG CANCER CELLS

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Introduction: Obstructive sleep apnea (OSA) is associated with increased cancer incidence and metastasis. Recently, exosomes have been reported to be enhanced the progression of tumor cells. We evaluated whether exosomes of OSA patients lead to affect the progression of cancer and anti-cancer chemotherapeutic response of lung cancer cells.

Materials and methods: Serum samples from 12 patients diagnosed with OSA by overnight polysomnography were classified into 3 groups according to severity of apnea-hypopnea index (AHI). Exosomes from 5 health volunteers and from 12 patients with OSA were co-cultured with lung cancer cells lines. Tumor properties such as proliferation and migration were assessed, and the response against anticancer reagent was evaluated in lung cancer cells treated with OSA-derived exosomes.

Results: OSA derived-exosomes increased the growth and proliferation of A549 cells (but not in H226 and H460 cells) compared with the control. Severe OSA-derived exosomes increased the migration ability of lung cancer cells (all of A549, H226 and H460 cells) compared to the control. Also, OSA derived-exosomes increased invasion ability of A549 cells. Severe OSA derived-exosomes promoted the ERK/c-Myc signaling in A549 cells and increased the expression of cell cycle related proteins (Cyclin A2 / Cyclin D1 / BCL2 / Survivin) compared to other groups and controls.

To investigate the effect of exosomes on the anticancer reagent cytotoxicity of lung cancer cell lines, cisplatin and OSA-derived exosomes were co-cultured with lung cancer cells and evaluated for cytotoxicity. As a result, cytotoxicity of low-dose of cisplatin in lung cancer cells was attenuated by OSA-derived exosomes.

Conclusions: Our results show that severe OSA-derived exosomes promote the ERK / c-Myc pathway in A549 cells and regulate cell cycle progression thereby promoting cell growth and proliferation. It also shows that OSA-derived exosomes can inhibit the low-dose chemotherapy response of lung cancer thus maintaining survival of tumor cells. These findings suggest that OSA-derived exosomes can promote target molecules involved in the growth and proliferation of lung cancer and that it is necessary to consider about OSA as a disease associated with the prevention and treatment of lung cancer.

THE EFFICACY OF SPLIT-NIGHT POLYSOMNOGRAPHY IN WOMAN

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Introduction: The American Academy of Sleep Medicine (AASM) suggest that, if clinically appropriate, a split-night study, rather than a full-night diagnostic protocol for polysomnography (PSG) be used for the diagnosis of obstructive sleep apnea (OSA). Previous studies showed efficacy of split-night PSG including cases of male predominance. The primary objective of this study is to investigate the diagnostic accuracy of split-night PSG in woman.
Materials and methods: The PSG data of 133 female with OSA (Apnea-hypopnea index [AHI] $\geq$ 5/h) were collected. 11 subjects were excluded from the study because they showed prolonged sleep latency over 90 minutes. Total 122 data of patients were analyzed.
Results: There is no significant difference between the value of AHI in 90 minutes of recording time (T90) and full-night recording (Pearson's coefficient, 0.78; $p < 0.001$) The value of AHI in 120 minutes of recording time (T120) showed no significant difference compared with the value of AHI in full-night recording, also. (Pearson's coefficient, 0.80; $p < 0.001$).
Conclusions: Both values of AHI in T90 and T120 showed strong correlations with the value of AHI in full-night PSG in female patients. Further studies for evaluation of diagnostic accuracy of AHI in T90 and more studies for woman will be needed.

HIGHER SLEEP EEG SPECTRAL POWER IN BETA AND DELTA BANDS DURING NREM SLEEP IN OSA GROUP THAN IN SIMPLE SNORING GROUP

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Introduction: Patients complaining of simple snoring (SS) often report poor sleep quality despite normal apnea-hypopnea index (AHI). The aim of this study was to identify the difference of sleep electroencephalography (EEG) spectral power in polysomnography between patients with obstructive sleep apnea (OSA) and SS.
Materials and Methods: Power spectral analysis was performed using SpectralTrainFig program which was developed by the National Sleep Research Resource. The absolute power values in standard frequency bands of the EEG spectra during the first Non-Rapid Eye Movement (NREM) sleep period were compared between OSA (n = 129) and SS (n = 42) groups after controlling age and sex. We also analyzed the partial correlation between AHI and absolute spectral power density in EEG frequency after controlling age and sex.
Results: The absolute spectral power in beta (15-20 Hz; p corrected = 0.036) and delta (1-4 Hz; p corrected = 0.006) bands during NREM sleep was higher in OSA group than in SS group. The AHI was positively correlated with absolute beta power in the OSA group (p corrected = 0.027) and total participants (SS + OSA; p corrected < 0.001).
Conclusions: Higher beta power in OSA group and positive correlation between beta power and AHI were as expected, since OSA is considered as more severe sleep disorder than SS. However, higher delta power in OSA than in SS is somewhat unexpected. The lower delta power in SS group is presumed to be the cause of subjective sleep quality deficits in these patients.

Sleep Breathing Disorders
Board #271 : Poster session 1
NON-CONTACT RESPIRATORY MONITORING USING IMPULSE-RADIO ULTRA-WIDEBAND RADAR AGAINST NOCTURNAL POLYSOMNOGRAPHY

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Introduction: Polysomnography (PSG) is a gold-standard test for the diagnosis of obstructive sleep apnea (OSA). Respiratory events such as apnea and hypopnea are measured with oronasal thermistor and nasal air pressure transducer coupled with breathing effort signals obtained from chest and abdominal belts. Therefore, PSG provides accurate and reliable data on respiratory function but requires multiple skin sensors and overnight observation by a sleep technician. In this study, we developed a non-contact device (impulse radio-ultra wideband: IR-UWB) radar and evaluated its ability to measure apnea hypopnea index (AHI) by comparing with the PSG.

Materials and methods: During full-night PSG (Alice 5, Respironics, Phillips, Amsterdam, Netherlands), the raw data was obtained from an IR-UWB radar sensor (XK300-VSA; Xandar Kardian, Delaware, USA) mounted on the roof of sleep laboratory. In this study, 14 healthy volunteers and 46 patients with suspected OSA were enrolled and written informed consents were obtained from all participants. Abnormal breathing was defined by IR-UWB software algorithm and calculated their numbers per hour of sleep (ABI) which was compared with AHI measured by PSG.

Results: The ABI from the radar showed excellent agreement level ([ICCR] 0.962 [0.939-0.978]) with AHI from the PSG. And the result showed a good agreement when diagnosing the severity of OSA (overall accuracy 85%). In specific, radar-based diagnosis of OSA showed high degree of sensitivity (100%) and good specificity (78%) when the cutoff value of OSA was AHI ≥ 5 events/h. In addition, the radar sleep study showed both high degree of sensitivity (92% and 91%, respectively) and specificity (94% and 100%, respectively) when the cutoff value of OSA was AHI ≥ 15 and AHI ≥ 30.

Conclusions: In this study, we found a good performance of IR-UWB radar to detect the presence of OSA in noncontact manner. Moreover, IR-UWB radar could classify the severity of OSA from mild to severe. Therefore, IR-UWB radar can be a useful to screen the OSA.

THE ASSOCIATION OF RS10830963 POLYMORPHISM IN MTNR1B WITH MELATONIN LEVEL AND THE RISK OF OBSTRUCTIVE SLEEP APNEA SYNDROME DEVELOPMENT

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Introduction: Melatonin is the main regulator of sleep-wake cycle. Recent research has shown the changes in circadian rhythmicity of melatonin synthesis in patients with obstructive sleep apnea syndrome (OSAS). The effects of melatonin are mediated by two homologous receptors connected with G-proteins: MT1 ($MTNR_1A$) and MT2 ($MTNR_1B$). It is instructive to investigate the association of $MTNR_1B$ rs10830963 variants with the patterns of melatonin production in patients with OSAS. To study the prevalence of various polymorphic variants of $MTNR_1B$ (rs10830963) in patients with OSAS and to analyze their association with melatonin level and the risk of OSAS development. The aim of our work was to study the prevalence of various polymorphic variants of $MTNR_1B$ (rs10830963) in patients with OSAS and to analyze their association with melatonin level and the risk of OSAS development.

Materials and methods: We investigated 40 patients with OSAS (52 males (61%), and 33 females (39%); mean age being 47.0±8.9 years). Controls included 46 patients without OSAS. Respiratory monitoring was performed aimed to reveal OSAS. The level of melatonin was evaluated according to 6-sulfatoxymelatonin (6-SMT) concentration in 24-hour urine and in daily and nocturnal urine separately. Genotyping of DNA samples isolated from leucocytes was performed using real-time PCR.

Results: The prevalence of C/C, C/G and G/G genotypes in patients of the index group was 29 (72.5%), 8 (20.0%) and 3 (7.5%), respectively. In controls the abovementioned genotypes prevalence was 18 (39.1%), 19 (4.3%) and 9 (19.6%). Patients with OSAS showed statistically significant increase in genotype C/C (χ^2=9.05, p=0.003) occurrence, as well as the decrease in genotype C/G (χ^2=4.51, p=0.034) incidence as compared to patients without OSAS. Genotype C/C carriers showed significantly higher level of 6-SMT in 24-hour urine (87.14 [46.62; 127.34] and 39.28 [10.83; 85.92], p=0.0040) as well as in daily urine (100.32 [49.55; 166.64] and 64.94 [24.05; 93.02], p=0.018). The presence of significantly positive association between C/C gene carrier status and the level of 6-SMT in 24-hour urine (r=0.56, p=0.00001), the level of 6-SMT in daily urine (r=0.43, p=0.0011), as well as the apnea /dyspnea index (r=0.33, p=0.01) was established.

Conclusions: Thus, C/C gene carrier status is associated with significantly higher level of 6-SMT in 24-hour urine and daily urine. The risk of OSAS in C/C genotype carriers is 4.10-fold higher as compared to carriers of C/G and G/G $MTNR_1B$ (rs10830963) (95% CI: 1.65-10.21).

Sleep Breathing Disorders
Board #282 : Poster session 3
INPATIENT VS OUTPATIENT SLEEP STUDY IS MORE PREDICTIVE OF 5-YEAR MORTALITY THAN GENERAL CO-MORBIDITY MEASURES

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Introduction: Untreated Sleep Disordered Breathing (SBD) is associated with adverse health outcomes and increased mortality. Studies have suggested that hospitalized patients are at high risk for SDB. Therefore, hospitalization could represent an opportunity for diagnosis and treatment of SDB to improve patient outcomes. In this study, we aim to assess and compare the mortality rate among hospitalized patients who received in-patient Sleep Medicine consultation and subsequently underwent in vs outpatient sleep testing
Materials and methods: We identified all adult patients over a 10-year period who had an inpatient Sleep Medicine consultation for SBD and subsequent polysomnography or home sleep apnea testing either as in-or out-patient. We obtained basic demographics, co-morbidities, sleep study results, diagnosis, discharge disposition, including follow up and therapy adherence. Overall mortality was estimated using Kaplan-Meier methodology and was compared between groups (in-vs out-patient) using the log-rank test. Univariate and multivariate Cox proportional hazards models were assessed to find predictors of mortality.
Results: Of 330 eligible patients, most were male (68%), median age was 68 (range: 22-99),and patients were mostly Caucasian (97%). In-patient sleep study was performed in 180 (55%) patients and this group had a higher Charlson Comorbidity Index (CCI) (median=4 vs 3, $p= 0.0001$). Mortality was significantly worse for inpatient group as compared to outpatient sleep testing group (5-year mortality: 65% vs. 32%; HR=2.05 (95% CI: 1.43, 2.96) $p< 0.0001$). Other significant predictors of mortality included a higher CCI (HR=1.18 (95% CI: 1.12, 1.23); $p< 0.0001$) and re-hospitalization at 3 months ((HR=2.26 (95% CI: 1.44, 3.56); $p=0.0007$). From multivariate analysis, mortality remained significantly worse for inpatient group as compared to outpatient group, even after adjusting for the CCI (HR=1.87 (95% CI: 1.28, 2.75), $p=0.0012$) and just missed statistical significance after adjusting after adjusting for both CCI and re-hospitalization at 3 months (HR=1.60 (95% CI: 0.98, 2.61), $p=0.0580$). Those patients who made follow up appointments had lower mortality vs. those who did not (HR=0.56 (95% CI: 0.39, 0.81); $p=0.0018$). This difference in mortality was not affected by PAP compliance (compliant vs. not HR=0.75; (95% CI: 0.31, 1.82); $p=0.5360$).
Conclusions: Inpatient sleep testing is commonly performed in the more severely ill patient with multiple comorbidities. Clinical factors specifically associated with sleep disordered breathing, rather than more general measures of co-morbidity, are more potent predictors of mortality. Better control of SDB may represent an opportunity to improve mortality in this ill population.

Sleep Breathing Disorders
Board #182 : Poster session 1
DOES NECK CIRCUMFERENCE PREDICT OBSTRUCTIVE SLEEP APNEA IN CHILDREN WITH OBESITY?

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Introduction: Obstructive sleep apnea (OSA) is more common amongst children and youth with obesity, affecting 10 -50% of this population. Identification of those with OSA remains challenging, however, as history, physical examination and questionnaires are poor screening tests in this population. Polysomnography, the gold standard diagnostic test has limited availability with long waiting lists. In adults with OSA, neck circumference (NC) predicts presence of OSA. In children, NC percentile and body fat distribution are associated with OSA, with preliminary data suggesting this is particularly the case in children with obesity. The primary objective of this study was to evaluate the association of NC and OSA, adjusted for age, sex, BMI, and Tanner stage, in children with obesity.

Methods: Children aged 8-17 years with obesity (body mass index > 95%ile) who were scheduled to undergo a clinically indicated diagnostic polysomnogram (PSG) to assess for OSA at Sick Kids Hospital (Toronto, Ontario) or Children's Hospital of Eastern Ontario (Ottawa, Ontario) participated in a prospective cohort study as part of the Canadian Sleep and Circadian Rhythm Network study on predictors and outcomes of OSA in children with obesity. Research ethics board approval was obtained at both institutions. This sub-study includes evaluation of anthropometric measurements including NC and body mass index (BMI); demographic information included age, sex and self-reported Tanner stage. Participants underwent PSG according to American Academy of Sleep Medicine standards and from these, obstructive apnea hypopnea index (OAHI), nadir oxygen saturation and maximum carbon dioxide level (end-tidal or transcutaneous) were derived. OSA was classified as mild: (OAHI 1-< 5 events/hr; moderate: 5- < 10 events/hr; or severe: ≥ 10 events/hr). The primary outcome was the number of obstructive apnea-hypopnea events per hour. A negative binomial multiple regression model was fitted with the following predictors: NC, age, BMI, sex, and Tanner stage (early 1, 2, 3 or late 4, 5).

Results: 67 children participated, with mean age 13.9 years (SD 3.1), 55% male, mean BMI 38.5 (SD 9.3), 52% late Tanner stage. Mean NC was 40.0 cm (SD 4.6) and 65 (97%) had NC above the 95th percentile for age and sex. Median OAHI was 4.0 (IQR 0.6, 10.2) and the mean lowest oxygen saturation was 88.5% (SD 4.9%). OSA was severe in 19 (28.4%), moderate in 10 (14.9%), mild in 17 (25.4%). 21 children (31.3%) had no OSA. In the negative binomial model, a 1 cm increase in neck circumference was associated with a 16% increase in OAHI (95% CI: 1%, 34%), a 1 year decrease in age was associated with a 25% increase in OAHI (95% CI 3%, 52%), a unit increase in BMI was associated with an 8% increase in OAHI (95% CI: 1%, 15%). As the confidence intervals for sex and Tanner stage were wide, their associations with OAHI were uncertain.

Conclusion: Neck circumference is an independent predictor of OSA in children with obesity, after adjusting for age, sex, BMI, and Tanner stage.

Sleep Breathing Disorders
Board #292 : Poster session 2
COMPARISON OF INCISOR AXIS CHANGES IN OSA PATIENTS UNDER ORAL APPLIANCE THERAPY: RIGID VERSUS FLEXIBLE ORAL APPLIANCES

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Introduction: Oral appliances (OAs) are used in the treatment to the patients with mild or moderate obstructive sleep apnea (OSA) by repositioning the mandible forward to increase the upper airway volume during sleep. The higher adherence with OA compared to Continuous Positive Airway Pressure (CPAP), allows to continuous long-term effective use of OA leading to side effects such as occlusal or skeletal changes. Those side effects might lead to a decrease in the quality of life of those patients, such as diminishing their masticatory efficiency and increasing the morbidity of periodontal disease. Consequently, it is necessary to pay careful attention to the fabrication, adjustment, and follow-up of OA therapy. In our institution, we start treating OSA patients with rigid OAs that made by hard material for a year or more, and after that patients are asked to switch to flexible OA that made by soft material for better comfort. In this study, we compared the occlusal or skeletal change and the side effect of using two different materials of OAs.

Methods: Patients with mild to moderate OSA, who use OAs, and severe OSA, who failed to use CPAP and use OAs, were included in this retrospective study. Rigid OA was made of mono-block adjustable hard material (Palapress® Vario, Heraeus Kulzer, Wehrheim, Germany) and flexible OAs was made of mono-block non-adjustable soft material （Polyolefin-based elastic material, MG-21, CGK Corp., Hiroshima, Japan). All patients started with using rigid OA and switched to soft OA after a year or more. The cephalometric radiographs were obtained at the pre-treatment and follow-up of each OA therapy. The angle of Upper Incisor line to Sella-Nasion line (U1 to SN), Lower Incisor line to Mandibular plane (L1 to MP), and Sella-Nasion line to point B (SNB) were respectively measured and the rates of change in the variables were compared using Wilcoxon signed-rank test.

Results: Totally 22 patients' records were included in this study. The mean age of participants was 62.0 ± 12.8 years, the mean BMI was 23.0 ± 1.9 kg/m^2, and the mean observation period was 1.9 ± 0.4 years. The rates of change per year of U1 to SN, L1 to MP, and SNB of rigid OA group vs flexible OA group are: $-1.15 \pm 0.41°$/year vs $-2.45 \pm 0.45°$/year ($p < 0.05$), $0.27 \pm 1.28°$/year vs $3.23 \pm 1.41°$/year ($p > 0.05$) and $-1.46 \pm 0.51°$/year vs $-0.20 \pm 0.55°$/year ($p > 0.05$) respectively.

Conclusion: The change of the angle (U1 to SN) in patients who were using flexible OA was more significant than those who were using rigid OA. It is extremely important for the clinician to consider the type of OA materials and design while providing OA therapy for OSA patients. Further studies are needed to reach the best comfortable OA design and fewer side effects.

AMONG MIDDLE-AGED ADULTS, SNORING PREDICTED HYPERTENSION INDEPENDENTLY OF SLEEP APNOEA

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Introduction:While the link between obstructive sleep apnoea (OSA) and hypertension is well established, the relationships between snoring, OSA, and hypertension remain unclear. This study aimed to evaluate the association between hypertension and snoring independently of OSA.
Materials and Methods: Adults with sleep difficulties underwent a one-night polysomnographic sleep assessment, including a thorough assessment of apnoea and snoring. Upon waking, blood pressure was measured, the measurement repeated after 15 min, in a resting position. Anthropometric data were recorded. Hypertension was defined as blood pressure ≥140/90 mmHg or the use of antihypertensive medications. **Results**: The study enrolled 181 adults (mean age 48.8 years; 119 males). Snoring, apnoea, blood pressure and anthropometric dimensions were highly associated. Patients with hypertension had higher levels of snoring and apnoea, as well as indicators of excess weight. Snoring was the most robust predictor of hypertension.
Conclusions :Snoring is a risk factor for hypertension independently of apnoea and anthropometric dimensions. While the presence of snoring is not able to replace a thorough polysomnographic evaluation of the apnoea-hypopnoea index and OSA, snoring as an acoustic signal is easily detectable. The early identification and management of snoring may reduce cardiovascular risk.

REGULATION OF CIRCULATING MICRO-RNAS AND THEIR TARGETS IN OBSTRUCTIVE SLEEP APNEA

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Background: Obstructive sleep apnea (OSA) is a sleep respiration disorder associated with several clinical conditions such as obesity, cardiovascular and metabolic disorders. Although the role of miRNAs and its targets has been well estsablished in obesity, the evidence supporting their involvement in OSA has not been well elucidated.

Materials and methods: Four miRNAs (miR-21, miR-27, miR-29 and let-7) were chosen for their documented role in obesity and their expression profile was studied in OSA as compared to healthy subjects. A hundred and twenty adult subjects (40 obese OSA, 40 non-obese OSA and 40 healthy) were selected for this study. miRNA expression (normalized with an internal control RNU48) was analyzed by SYBR Green-based real time quantitiatve PCR. miRNA expression was correlated with clinical parameters using Spearman's Correlation Test and statistical analysis was performed using IBM-SPSS, Version 22 with significance of $p < 0.05$. Prediction and validation of target genes was performed using *in-silico* analysis and miRNA-mRNA docking was performed using PatchDoc web-server. The docked complexes were visualized using Maestro version 11.8. Expression profiling of target genes was achieved using real time PCR (normalized with GAPDH).

Results: We found a significant differential expression of miR-21, miR-27, miR-29 and let-7 in OSA as compared to healthy subjects. miR-21 and miR-29 were found to have increased expression (2.5 fold and 1.5 fold respectively) in OSA compared to healthy whereas miR-27 and let-7 were negatively expressed (0.5 fold and 0.1 fold respectively) in OSA. Statistical analysis revealed significant correlation of miR-29 in OSA ($p = 0.001$). Predicted targets of miR-21 such as TGFBR2, NAMPT for miR-29, CNR1 for miR-27 and CRY2 for let-7 were differentially expressed in OSA. Molecular docking revealed hydrogen and aromatic interactions between the miRNAs and their targets whereas docking scores indicated the affinity between them.

Conclusion: Our study throws light on the relevance of miRNAs as viable contenders for biomarkers in OSA. However further studies are warranted to implicate the importance miRNAs in the pathophysiology of OSA.

POLYSOMNOGRAPHIC EVALUATION OF INHALATION BURN INJURY PATIENTS: A CASE SERIES

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Introduction: Patients with respiratory injury resulting from inhalation of thermal or other chemical irritants is present in up to 1/3 of all burn injuries. The extent of injury varies from upper & lower airway, pulmonary parenchymal injury to systemic toxicity. Although survivors of inhalation injury often manifest frequent awakening, snoring or apnea during sleep, the incidence of sleep disordered breathing or its correlation between underlying injury has not been studied yet in this group.

Materials and methods: Among the inhalation burn patients who were admitted to the burn center of Hangang Sacred Heart hospital, three patients who complained of sleep related problems such as snoring, apnea events during sleep or daytime somnolence became study candidates. Epworth sleepiness scale (ESS) was used for the screening test, and all 3 patients underwent overnight standard polysomnography (PSG) during the admission period. All of them had no history of sleep disordered breathing before the burn injury.

Results: Case 1 was a 30 years-old male who had flame burn injury of 5% of total body surface area (TBSA). Due to the inhalation injury, he was also diagnosed with laryngeal stricture, and subsequently received vocal cord adhesiolysis. Chief complain was frequent awakening during sleep because of stridor. ESS score was 8/24. Apnea-Hypopnea index (AHI) was 0.6, and respiratory disturbance index (RDI) was 0.7. He showed slight snoring at supine position. Polysomnographic diagnosis was normal.

Case 2 was a 37 years-old male who was diagnosed with flame burn of 4% TBSA with inhalation injury. He succeeded in decannulation 1 month after initial injury. Chief complain was snoring without significant daytime fatigue. ESS was 4/24. AHI was 3.0, and RDI was 3.3. Snoring was observed heavily at supine position during study period. Polysomnographic impression was simple snoring.

Case 3 was a 59 years-old male with flame burn 36% of TBSA and inhalation injury. His chief complain was severe snoring with apnea during sleep, and ESS was 14/24. Polysomnographic result revealed obstructive sleep apnea with AHI 23.84 and RDI 25.57. Continuous positive airway pressure (CPAP) was titrated with 5cmH2O, and he has been applying CPAP 7hrs/day with an average AHI 2.5.

Conclusion: Inhalation burn injury patients are vulnerable to have sleep related disorders. Although 3 patients in our study did not reveal uniform results, PSG might be considered for those with relevant symptoms or signs of sleep disordered breathing. Future follow-up study needs to be carried out targeting larger number of patients.

Acknowledgements: none

ASSOCIATION OF PERIODIC LIMB MOVEMENTS DURING SLEEP WITH EXCESSIVE DAYTIME SLEEPINESS: IS THERE A GENDER DIFFERENCE?

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Introduction: Periodic limb movement during sleep (PLMS) is a common finding in patients with obstructive sleep apnea (OSA). Recognition of the clinical impact of PLMS is increasing, but its relationship with excessive daytime sleepiness (EDS) is still unclear. The purpose of this study was to investigate the relationship between PLMS and EDS according to gender in patients with OSA.

Materials and methods: The subjects of this study were adult patients who diagnosed with OSA after polysomnography. Polysomnography data including periodic limb movement index (PLMI) were obtained and PLMS was defined as PLMI of 15 or more. Daytime sleepiness was assessed by Epworth Sleepiness Scale (ESS) in subjects and EDS was defined as when the ESS is 11 or higher. In addition, variables such as depressive symptoms (Beck Depression index, BDI), subjective sleep quality (Sleep Problem Index 2, SPI-2), and subjective sleep quantity were collected. Student t-test, Mann-Whitney, Chi-square test or Fisher's exact test was used appropriately. Multivariate logistic regression analysis with interaction term was used to analyze the relationship between PLMS and EDS according to gender.

Results: Of the total 1370 patients with OSA, 193 (14%) had PLMS (men 14.0%, women 14.3%), and 516 (37.7%) had EDS (men 38.7%, women 33.3%, p=0.111). The men had less EDS in OSA patients with PLMS than in those without PLMS (28.8 vs. 40.3, p=0.007). However, there was more EDS in the OSA with PLMS in the women (48.6 vs. 30.8, p=0.033). In univariate logistic regression analysis, PLMS in men showed a negative relationship with EDS (B=-0.509, OR=0.601, p=0.007), and PLMS in women showed positive correlation with EDS (B=0.757, OR=2.132, p=0.035). Multiple logistic regression analysis showed that EDS had significant interaction between PLMS and gender (p=0.012), after controlling for OSA severity, age, body-mass index, sleep quantity, SPI-2 and BDI. PLMS in men affected EDS negatively (B= -0.428, OR= 0.652, p=0.037). In contrast to men, PLMS in women tended to be positively associated with EDS (B=0.657, OR= 1.930, p=0.089).

Conclusions: PLMS accompanied by OSA may have different effects on EDS depending on gender. PLMS increase daytime sleepiness in men, but tends to decrease daytime sleepiness in women.

Acknowledgements: none

THE DISTINCTIVE ANATOMICAL PHENOTYPES OF PAP NON-ADHERENT OSA PATIENTS AND CLINICAL OUTCOME OF ALTERNATIVE TREATMENTS AFTER FAILURE OF PAP THERAPY

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Purpose: This study aims to evaluate the clinical and anatomic feathures of PAP non-adherent OSA patients in upper airway and to analyze the therapeutic outcome of individually-selected alternative treatments in PAP non adherent OSA patients.
Patients and method: OSA patients who were recommended PAP as 1st line treatment was collected (N=112), 48 adherent and 64 non-adherent patients. In adherent group, 24 patients failed to maintain PAP therapy and actually, a total of 88 patients were treated with alternative methods (surgery N=29, oral appliance (OA) N=32, combined therapy N=27). 24 patients of them had follow-up polysomnogram (PSG) data after alternative treatment. The medical records including demographics, sleep apnea questionnaires, PSG data were reviewed and the anatomic characteristics were evaluated through intranasal endoscope and drug-induced sleep endoscopy.
Results:
1) PAP adherent vs PAP non-adherent group
The current clinical data showed that PAP adherent group exhibited relatively higher VAS score of snoring and apnea and also had higher AHI and lower O2 saturation (%) (p=0.042, p=0.058) in PSG data prior to PAP therapy. Anatomically, PAP non-adherent OSA patients exhibited more deviated nasal septum (p=0.039) and more severe hypertrophic change of inferior turbinate (p=0.041) and Friedman's palate (p=0.028) and tonsil grading (p=0.003) was also higher in PAP non-adherent patients.
2) Alternative treatments in PAP non-adherent group: surgery, OA, and combined therapy
Based on DISE findings, we found that PAP non-adherent patients showed more significant degree of upper airway obstruction at both retropalatal and retroglossal level.
Our clinical data showed that age, sex, underlying diseases, pretreatment BMI, and AHI prior to additional treatments were not significantly different among three groups. Multilevel surgery including tongue base and nasal surgery showed further decrease of AHI than single level surgery and OA provided higher therapeutic outcome in the patients who showed dominant tongue base narrowing. However, PAP non-adherent patients who had combined therapy got more significant reduction of AHI and greater improvement of the lowest O2 saturation than only surgery or OA group. In particular, the change of AHI after combined therapy was more significant in PAP non-adherent patients with moderate and severe OSA.
Conclusion: The current study showed that adherence to PAP might be related with subjective symptoms, severity of sleep parameters prior to PAP therapy and anatomic features of upper airway. Surgical correction or OA are considered as alternative treatments in PAP non-adherent OSA patients and our data combined therapy may be more effective to improve sleep-related parameters of PAP non-adherent OSA patients.

COMPARISON FOR OPTIMAL PRESSURE BETWEEN MANUAL CPAP AND APAP TITRATION WITH OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Traditional approach to appliance of continuous positive airway pressure (CPAP) which is treatment of obstructive sleep apnea (OSA) is changing in recent years. Although auto-adjusting positive airway pressure (APAP) titration at home has several advantages over CPAP titration in terms of convenience and time saving, there are still concerns whether it will show corresponding accuracy when compared to lab-based polysomnography (PSG) and CPAP titration. To find out more evidence supporting home-based auto-titration, we performed APAP titration at home for patients who were presented OSA on lab-based diagnostic PSG followed by CPAP titration.

Materials and methods: 116 patients were enrolled. They all underwent split-night PSG with CPAP titration, and APAP titration for more than 7 days. We selected patients with successful titration at both situations. Finally, 79 patients were included in the study. We compared optimal pressure and apnea-hypopnea index (AHI) between CPAP and APAP titration.

Results: The optimal pressure for CPAP and APAP titration were 7.0 ± 1.8 cmH$_2$O and 7.6 ± 1.6 cmH$_2$O (P< 0.001), while AHI were 1.3 ± 1.5/h and 3.0 ± 1.7/h (P< 0.001). As a result, the achievement rates of optimal pressure for CPAP and APAP titration were 96.2% and 94.9% (r=-0.045, P=0.688), respectively.

Conclusions: The results of this study did not differ with regard to optimal pressure between CPAP and APAP titration. Overall, CPAP and APAP titrations should be chosen depending on a required situation.

Acknowledgements: none

PREDICTION OF OSA SEVERITY USING SOUND DATA COLLECTED BY A NON-CONTACT DEVICE

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Introduction: To determine whether apnea hypopnea index (AHI) in patients with obstructive sleep apnea (OSA) can be predicted using data from breathing sounds recorded using a non-contact device during sleep.

Materials and methods: This observational study, conducted at a sleep center of a tertiary hospital, included patients who visited the sleep center due to snoring or sleep apnea. Audio recordings during sleep were performed using an air-conduction microphone during polysomnography. Breathing sounds recorded from all sleep stages were analyzed. After noise reduction preprocessing, the audio data were segmented into 5 s windows and sound features were extracted. Estimation of AHI by regression analysis was performed using Gaussian process, support vector machine, random forest, and simple linear regression, along with 10-fold cross-validation.

Results: In total, 116 patients who underwent attended, in-laboratory, full-night polysomnography were included. Overall, random forest resulted in the highest performance with highest correlation coefficient (0.83) and least mean absolute error (9.64 events/h) and root mean squared error (13.72 events/h). Other models resulted in somewhat lower but similar performances, with correlation coefficients ranging from 0.74 to 0.79. The estimated AHI tended to be underscored as the severity of OSAincreased. Regarding bias and precision, estimation performances in the severe OSA subgroup were the lowest, regardless of the model used. Among sound features, derivative of the area methods of moments of overall standard deviation demonstrated the highest correlation with AHI.

Conclusions: AHI could be predicted using data from breathing sounds generated during sleep with good performance. The prediction model may be useful not only for pre-screening but also for follow-up after treatment in patients with OSA

DEVELOPMENT AND EVALUATION OF MYOFUNCTIONAL THERAPY SUPPORT PROGRAM (MTSP) BASED ON SELF-EFFICACY THEORY FOR PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The aim of this study is to determine the impact of myofunctional therapy support program (MTSP) based on self-efficacy theory compared to no support during myofunctional therapy (MT) in patients with obstructive sleep apnea (OSA).

Materials and methods: Thirty-one patients with OSA were randomized into two groups: 12 weeks of treatment with the MTSP developed in this study (experimental group) and one education session of MT (control group). Patients were evaluated at the beginning and the end of the study using questionnaires (self-efficacy scale, Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index, snoring intensity and frequency, dry mouth) and polysomnography.

Results: The control (n=15) and experimental (n=16) groups had similar results for all variables at study entry. The control group showed no significant change in any variables during the study period. In contrast, the experimental group showed a significant increase in self-efficacy 61.38 ± 9.50 to 65.56 ± 10.89 (p=.020), and a significant decrease in apnea hypopnea index (AHI) 19.51 ± 11.41 to 14.11 ± 9.13 (p=.039), daytime sleepiness 9.88 ± 3.84 to 7.56 ± 3.42 (p=.028), snoring intensity 5.57 ± 3.13 to 4.44 ± 2.68 (p=.008), and dry mouth 6.44 ± 3.14 to 3.63 ± 2.33 (p =.005), compared to the baseline. No significant change in lowest SaO2 (p=.969), sleep quality (p=.307) and snoring frequency (p=.321) during the study period.

Conclusions: The intensive and interactive intervention of MTSP improved the self-efficacy of OSA patients, and consequently, resulted in sign and symptom relief, such as AHI, daytime sleepiness, snoring and dry mouth. The MTSP was dedicated to the nurse practitioner to improve the way to dispense the MT. This research has implications for the successful treatment of OSA.

IDENTIFICATION OF CLINICAL PHENOTYPES IN OBSTRUCTIVE SLEEP APNEA (OSA) BASED ON CLUSTERING USING OSA SEVERITY, OBESITY, AND CRANIOFACIAL PATTERN

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Objectives: To identify and characterize the phenotypes of adult obstructive sleep apnea (OSA) patients based on clustering using OSA severity, obesity, and craniofacial pattern.
Material and methods: The samples consisted of 89 adult OSA patients whose polysomnography and lateral cephalogram were available. With cluster analysis using apnea-hypopnea index (AHI, events/hr), body mass index (BMI, kg/m^2), ANB (°), and mandibular plane angle (MPA, °), three clusters were identified. Cephalometric variables including craniofacial, soft palate, hyoid bone, and pharyngeal space compartments were compared among clusters by one-way analysis of variance or Kruskal-Wallis test. Multivariable linear regression analysis was performed to find contributing factors to OSA severity within each cluster.
Results: Cluster-1 (obesity type; 49.4%) exhibited moderate OSA, obesity, and normal sagittal and vertical skeletal pattern (AHI, 22.4; BMI, 25.5; ANB, 3.2°; MPA, 26.3°) without significant upper airway abnormality. Cluster-2 (skeletal type; 33.7%) was characterized by moderate OSA, severe skeletal Class II hyperdivergent pattern with narrow pharyngeal airway spaces, without obesity (AHI, 27.9; BMI, 23.5; ANB, 7.5°; MPA, 36.6°). Cluster-3 (complex type; 16.8%) included severe OSA, obesity, skeletal Class II hyperdivergent pattern (AHI, 52.8; BMI, 28.0; ANB, 4.5°; MPA, 32.2°), with posteriorly displaced hyoid and retroclined soft palate. The main contributing factors to AHI were obesity in Cluster-1; hyperdivergent vertical pattern with narrow pharyngeal space in Cluster-2; and hyperdivergent pattern, obesity, displaced hyoid and soft palate in Cluster-3.
Conclusion: These phenotypes provide orthodontists with a clinical guideline of differential diagnosis and orthodontic intervention in the interdisciplinary treatment for OSA patients.

CARDIO-VASCULAR DISEASE PREVALENCE WITH SLEEP DISORDERS

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Introduction: The nationwide epidemiological study on sleep disorders are only partially documented in Asian countries. We investigated the prevalence of sleep disorders and relation with cardio-cerebral disease in the Korean population.
Materials and methods: A stratified random population sample of Koreans over age 19 years was selected and evaluated using a semi-structured interview. The questionnaire included basic demographics, snoring, sleep apnea and insomnia.
Results: 1302 persons were interviewed. The snoring persons have more hypertension (18.2% vs. 8.9%), diabetes mellitus (7.3% vs. 3.7%) and hyperlipidemia (4.5% vs. 2.5%) but similar rate for cardiac disease (3.0% vs. 3.9%) and stroke (1.2% vs. 0.9%). Insomnia persons have more hypertension (18.6% vs. 12.2%), diabetes mellitus (8.1% vs. 4.5%), hyperlipidemia (9.8% vs. 2.5%), cardiac disease (7.5% vs. 2.3%) and stroke (1.8% vs. 1.0%).
Conclusions: Snoring and insomnia is related to the prevalence of metabolic diseases & cardio-vascular disorders.

P-BANG VERSUS STOP-BANG IN ASSESSING THE RISK OF OBSTRUCTIVE SLEEP APNEA

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.**Introduction:** STOP-BANG (S:snoring, T: tiredness, O: observed apneas, P: blood pressure, B: body mass index (BMI)>35 kg/m^2), A: age> 50 years old, N: neck circumference> 43 cm for males or 41 cm for females, G: male gender) is a widely accepted questionnaire to assess the low, intermediate or high risk for obstructive sleep apnea (OSA) (Chung F et al. Anesthesiology 2008; 108: 812-821, Chung F et al Br J Anaesth 2012; 108: 768-775). However, information about snoring and observed pauses of breathing may not be available, since not all subjects have a bed partner or their bed partner, if existing, may have different sleep habits from the subject. On the other hand, tiredness is a non-specific symptom and may vary from day-to-day or may depend on a variety of reasons both of disease or lifestyle conditions. Therefore, we aimed to compare STOP-BANG with the P-BANG, a partial STOP-BANG Questionnaire consisted only by objective parameters, such as blood pressure, BMI, age, neck circumference and gender.
Materials and methods: Starting from February 2019, we applied the STOP-BANG (and we derived simultaneously the P-BANG) in all subjects referred to our 2-bed Sleep laboratory. As it is known and according to STOP-BANG the subjects are categorized into low risk (yes to 0-2 questions), intermediate risk (yes to 3-4 questions) and high risk (yes to 5-8 questions or yes to 2 questions combined with male gender or BMI or neck circumference). We decided to exclude from our analysis the subjects with intermediate risk in order to avoid any inconclusive results. Concerning P-BANG, we classified the subjects as low risk (yes to 0-2 questions) and high risk (yes to 3-5 questions). For the shake of clarity of the results we considered as OSA patients those with an apnea-hypopnea index (AHI) ≥ 15 events/hour, and as non-OSA those with an AHI < 5.
Results: We present herein the results from the initial 78 consecutive subjects (age 52±16 years old; male/female 49/29) who underwent full-night diagnostic polysomnography (PSG). Forty-four patients were diagnosed with OSA (AHI ≥ 15) while the remaining 34 as non-OSA (AHI < 5). The P-BANG, as compared to STOP-BANG, presented a higher positive predictive value (PPV 83% vs 78% respectively), a higher negative predictive value (NPV 84% vs 61%), a higher sensitivity (89% vs 76%) and a higher specificity (76% vs 64%).
Conclusions: Therefore, we conclude that P-BANG seems more accurate and more reliable than the STOP-BANG to predict both the presence or the absence of OSA.

COMPLIANCE OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IN OBSTRUCTIVE SLEEP APNOEA AMONG HOSPITAL PUTRAJAYA PATIENTS

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Background: Continous Positive Airway Pressure (CPAP) is an effective treatment for Obstructive Sleep Apnea (OSA). Despite the proven benefit of CPAP, the efficacy of therapy is limited by poor compliance.
Objective: To identify the level long term compliance of CPAP use among patients treated for OSA in Putrajaya hospital.
Method: Retrospective cross-sectional study, conducted among patients diagnosed with OSA from the year 2011 to 2015 in Hospital Putrajaya. All patients who underwent a full Polysomnography(PSG) study and were prescribed CPAP and has been on follow-up for at least 12 months were recruited. Subjective compliance assessment was done via self-reported compliance questionnaire and objective determination of CPAP compliance was done via recording obtained from the micro processing devices in the CPAP machine.
Results: Two hundred and thirty three patients were prescribed with CPAP during this period but only 160 patients were recruited into the study. One hundred and eighteen patients were still using CPAP after one year for more than 4 hours a night and for at least 70% of the total days recorded. Among the 42 patients considered non compliant, 20 patients used it for 4 hours per night but fell short of the minimum 70% days used and the remaining 22 stopped using it after a period of time due to various reasons. Thus, the overall long-term compliance rate among our patients is about 73.75%.
Conclusion: We achieved a good CPAP treatment adherence via regular and close follow up, early rectification of patient's problem with CPAP machine and engaging patient with treatment plan. However there was a small subset of patients who defaulted with reasons which were not completely identified.

Sleep Breathing Disorders
Board #285 : Poster session 3
IS EPIGLOTTIS SURGERY NECESSARY FOR OBSTRUCTIVE SLEEP APNEA PATIENTS WITH EPIGLOTTIS OBSTRUCTION?

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Introduction: This study aimed to examine the effect of epiglottic obstruction during drug-induced sleep endoscopy (DISE) on the surgical results of multi-level sleep surgery without epiglottic intervention.

Materials and methods: This investigation was a cross-sectional study involving patients diagnosed with severe obstructive sleep apnea (OSA) based on preoperative polysomnography (PSG), who underwent DISE followed by a multi-level OSA surgery without epiglottic intervention at Kyung Hee Medical Center (Seoul, Korea) between March 2013 and July 2016. During DISE, obstruction patterns of the upper airway were evaluated using the VOTE classification method. A follow-up PSG was performed 3 months after surgery to determine the success rate of multi-level surgery without epiglottic intervention. A comparison was done between the group with epiglottic obstruction and the group without epiglottic obstruction.

Results: Epiglottic obstruction was observed during DISE in 43.7% of patients. After application of exclusion criteria, 54 subjects were included (27 with and 27 without epiglottic obstruction). DISE revealed an association between epiglottic obstruction and tongue base collapse (p=0.02). Comparing pre- and postoperative PSG findings, both groups exhibited improvement postoperatively. The success rate was 44.4% in the epiglottic obstruction group and 40.7% in the non-epiglottis obstruction group (p=0.80). There was no difference in surgical success rates between the two groups.

Conclusions: The prevalence of epiglottic obstruction requiring epiglottic surgery was lower than what was found during DISE. Sleep surgeons may consider staged epiglottic surgery in patients with epiglottis obstruction.

KNOWLEDGE AND ATTITUDE OF PATIENTS REGARDING OBSTRUCTIVE SLEEP APNEA (OSA) AND CONTINUOUS POSITIVE AIRWAY PRESSURE (C-PAP) THERAPY: VIEW TO DEVELOP AN INFORMATION BOOKLET

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Introduction: Obstructive Sleep Apnea (OSA) is the most common form of Sleep Related-Breathing Disorder worldwide and is characterized by frequent episodes of upper airway collapse during sleep, causing recurrent arousals, intermittent hypoxemia, sleep fragmentation and poor sleep quality (Lam J et al., 2010) ; and Continuous-Positive Airway Pressure (C-PAP) Therapy is recognized as the first line treatment. The estimated global prevalence of OSA is in the range of 1 billion people. Demographic and other factors are likely to increase the prevalence of OSA over time, which indicate the need of considerable ongoing efforts to raise awareness/knowledge regarding the disease and benefits of treatment and prevention (Benjafield A et al., 2018). It is very well known that patients' knowledge and attitudes/beliefs regarding their illnesses influence their health variables including compliance to treatment (Golay A et al., 2006). But as per the researcher's knowledge very few or possibly no studies on assessment of knowledge and attitude/belief, among OSA patients have been done so far in India and worldwide, focusing on developing an informational booklet for the patients.

Keywords: Attitude, C-PAP Therapy, Information Booklet, Knowledge, OSA

Materials and methods: It is a cross-sectional descriptive study with a sample of 100 OSA patients from Sleep Clinic, Department of Medicine, AIIMS, New Delhi, India. Data were collected from July - Dec 2018, by using Modified-Apnea Knowledge Test (M-AKT) and Modified-Apnea Belief Scale ((M-ABS). Respondents who were diagnosed as OSA via Polysomnography and had undergone C-PAP titration in sleep lab were enrolled in the study. Sociodemographic and clinical profile followed by M-AKT (Smith S et al., 2004) and M-ABS (Smith S et al., 2004) was administered, which took around 15-20 minutes. The reliability of M-AKT and M-ABS was 0.81 and 0.79 respectively.

Results: Mean knowledge score of respondents was 11.84± 3.37 and majority of respondents (80%) had fair knowledge. The highest mean percentage was "52.3%" in the Sleep Hygiene domain followed by "49.8%'' in the area of OSA and "37.7%'' in the domain of C-PAP therapy. Mean attitude score of respondents was 64.3±9.83 and the majority of respondents (57%) had a Neutral Attitude. There was a significant positive correlation between knowledge and attitude regarding OSA and C-PAP Therapy (r = 0.23, p = 0.01). A significant association was found between knowledge regarding OSA and C-PAP Therapy with the educational level of respondents (p= 0.02). A significant association was also found between attitude regarding OSA and C-PAP Therapy with the gender of respondents (p=0.03).

Conclusion: This study concluded that OSA patients had fair knowledge and neutral attitude regarding OSA and C-PAP Therapy. Therefore, the study suggested that there is a need of reinforcement among OSA patients through information booklet which will enhance the understanding of the patients regarding disease condition and its treatment.

Contribution to the society: Information booklet will impart knowledge to patients and caregivers regarding OSA and C-PAP Therapy; and will influence their practices and treatment outcomes.

SLEEP DISORDERED BREATHING AND FERTILITY HORMONES IN WOMEN: AN EARLY EXPLORATION

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Introduction: Infertility is a national health issue affecting one in seven couples. Abnormal levels of follicle-stimulating hormone (FSH) and/or luteinizing hormone (LH) have been shown to be associated with fertility problems. Yet, in approximately a quarter to a third of people affected, there is no known cause for the fertility problems. Evidence suggests a link between sleep disordered breathing and infertility issues in men, but such studies are lacking in women. Here, we aimed to examine the frequency of sleep disordered breathing in female patients with fertility difficulties and their relation to serum levels of fertility-related hormones.

Materials and methods: Fifty females (mean age($\pm$SD) = 35($\pm$4) years; mean BMI($\pm$SD) = 32.4($\pm$8.4); BMI range 17.1-47.9) with fertility problems and sleep complaints completed a routine fertility assessment, including blood tests in the early follicular phase of the menstrual cycle to quantify follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol, dehydroepiandrosterone, testosterone, thyroid-stimulating hormone (TSH) and prolactin levels. They then underwent a consultation with a sleep physician and a level 1 polysomnography recording. Partial correlations were done between fertility-related hormones and indices of sleep disordered breathing while controlling for BMI.

Results: Of this sample, 37% had an apnea/hypopnea index (AHI) suggestive of sleep apnea (i.e. > 5 apneas or hypopneas per hour of sleep). Lower FSH levels correlated with a higher AHI during REM sleep ($r = -.33$, $p = 0.021$) and a higher oxygen desaturation index during REM sleep ($r = -.38$, $p = 0.008$). Higher TSH also correlated with higher oxygen desaturation index during REM sleep ($r = .33$, $p = 0.024$). No significant correlation was found between FSH or TSH and non-rapid eye movement (NREM) respiratory indices. Lower LH levels correlated with a higher NREM AHI ($r = -.33$, $p = 0.023$) and a higher NREM oxygen desaturation index ($r = -.30$, $p = 0.039$). No significant correlation was found between LH and REM respiratory indices, nor with any other hormone and respiratory indices.

Conclusions: These preliminary results suggest elevated rates of sleep disordered breathing in women with fertility problems. Furthermore, the degree of sleep apneas/hypopneas and the resulting hypoxia were proportionally related to low levels of two gonadotropins commonly thought to be involved in fertility problems. Low FSH and LH levels are often an indicator of hypothalamic and/or pituitary dysfunction. Low LH levels can also be linked to high stress, and can inhibit ovulation. While these findings need to be replicated in larger samples, FSH, LH and TSH may be differentially sensitive to REM versus NREM breathing dysfunctions. Subsequent work is required to determine whether treating sleep disordered breathing may help to normalise endocrine profiles in women with fertility problems.

OBJECTIVE SHORT SLEEP DURATION INCREASE RISK OF HYPERTENSION IN YOUNG ADULTS WITH SLEEP APNEA

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Introduction: The short sleep duration, subjective or objecdtive, was associated with increased risk of hypertension in general population. However, the association between objective sleep duration and hypertension in patients with obstructive sleep apnea (OSA) is inconclusive. The present study aims to test if objective short sleep duration would further increased risk of hypertension in large cohort of patients with sleep disordered breathing (SDB).
Materials and methods: This cross-sectional, observational design study analyzed the dataset developed from information prospectively collected from 6,875 adults who underwent initial polysomnography (PSG) for the first time between Jan. 2009 and Dec. 2016. The total sleep time (TST) measured by PSG was categorized as < 5, 5-6, ≥6 hr, where < 6hr was defined as short sleep. Hypertension was based on the self-report or medical record or taking anti-hypertensive medication. The logistic regression was applied to identify the association between sleep duration and hypertension.
Results: Totally, 6,875 participants were included. The mean age was 47.8 y/o, 76% were men, and the mean apnea-hypopnea index (AHI) was 29.6/hr. The prevalence of TST < 5, 5-6, ≥6 hr was 27.3%, 43.5%, and 29.3%, respectively where the corresponding prevalence of hypertension was 35.1%, 26.2%, and 22.9%, respectively. After adjustment of age, gender, body mass index, smoking, alcohol consumption, and co-morbidities, compared to ≥6 hr, extreme short sleep (< 5hr) was associated increased risk of hypertension in patients of 20-30 y/o, especially those with severe OSA (AHI ≥30/hr) (odds ratio 3.00 [1.15-7.81], P=0.025). Compared to simple snorer, severe OSA was associated increased risk of hypertension in patients of 50-70 y/o across all sleep duration.
Conclusions: In young patients with SDB, extreme short sleep further increased risk of hypertension, especially in those with severe OSA. In middle-aged patients with SDB, severe OSA is associated with increased risk of hypertension which was not modified by short sleep duration.

EFFECT OF LONG TERM ORAL APPLIANCE THERAPY ON OBSTRUCTION PATTERN IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Oral appliance therapy is an alternative treatment modality for obstructive sleep apnea (OSA). However, there have been no studies to determine whether changes in the obstructive pattern occur following long-term use of oral devices. Therefore, we examined whether the obstructive pattern changes in patients with OSA who undergo long-term oral appliance therapy using drug-induced sleep endoscopy (DISE).

Materials and methods: We investigated 156 consecutive adult patients diagnosed with OSA. Seventy-nine of these patients were found to be eligible for inclusion in this study. All enrolled patients underwent two DISE examinations: before and after oral appliance use, and we performed 2nd DISE without MAD. We compared the DISE findings for each patient in terms of degree and configuration of airway obstruction at the levels of the velum, oropharynx, tongue base, and epiglottis.

Results: We found that dental problems, as assessed using the average values of overjet and overbite, were significantly decreased after 2 years of oral appliance use. Comparisons of the DISE findings revealed that there was significant widening of the upper airway structures following long-term oral appliance therapy, especially in the velum (P = 0.022) and epiglottis (P = 0.001). However, changes in the configuration of upper airway obstruction were not observed in any of the structures of the upper airway.

Conclusions: We found evidence possibly indicating decreased obstruction at the levels of the velum and epiglottis after long-term use of oral appliances. We suggest further cohort studies to confirm these findings.

Acknowledgements: This research was supported by the Hallym University Research Fund.

EFFECTIVE CPAP CHANGES RELATED TO SLEEP STAGE AND BODY POSITION IN OSA DURING UP AND DOWN-TITRATION: EXPERIMENTAL STUDY

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Introduction: The aim of this study was to investigate the influences of sleep stage and body position on the effective pressure in standard upward titration and experimental downward titration.

Materials and methods: A total of 22 patients with moderate to severe OSA who underwent successful manual CPAP titration over 3-hour (including at least 15 minutes, supine REM sleep) followed by consecutive downward titration at least 1-hour. We analysed baseline polysomnographic variables and compared effective pressure, Peff1(upward titration) and Peff2(downward titration) in non-REM vs. REM sleep and supine vs. lateral positions with paired t-test or Wilcoxon signed-rank test.

Results: During up-titration, Peff1 increased in REM sleep compared non-REM sleep (9.5 ± 2.9 vs. 8.9 ± 2.7 cmH$_2$O, Δ Peff1$_{REM-nonREM}$=0.6 ± 1.1 cmH$_2$O; P=0.024). During down-titration, Peff2 in the supine was higher than that in the lateral position (7.3 ± 1.7 vs. 4.8 ± 1.5, Δ Peff2$_{Supine-Lateral}$=2.5 ± 1.3 cmH$_2$O P=0.068). When comparing both up and down-titration conditions, we found Peff2 was significantly lower than the Peff1 in all sleep stage, especially in REM sleep (Peff1$_{REM}$ vs. Peff2 $_{REM}$; 9.5 ± 2.9 vs. 7.4 ± 3.3 cmH$_2$O) with mean difference of 2.1 ± 1.7 cmH$_2$O (P< 0.001). Peff in supine sleep decreased from 9.4 ± 3.0 cmH$_2$O (Peff1$_{Supine}$) to 7.6 ± 3.3 cmH$_2$O (Peff2 $_{Supine}$) with mean difference of 1.8 ±1.6 cm H$_2$O (P< 0.001).

Conclusions: This study revealed that collapsibility of the upper airway is influenced by sleep stage and body position. After initial effective pressure (Peff1) achievement during up-titration, lower pressure is needed in rest of sleep time. The observed pressure decline may support the auto-titration device integrating to real-time positional and sleep stage factors and lowest pressure may improve fixed pressure related intolerance.

DRUG INDUCED SLEEP ENDOSCOPY: IS THERE A DIFFERENCE IN THE DEGREE OF COLLAPSIBILITY AT DIFFERENT SEDATION LEVELS?

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Introduction: Drug induced sleep endoscopy (DISE) has become the standard of care in many sleep centres, with the aim of identifying obstructive sites that may contribute to Obstructive Sleep Apnea (OSA). However, with the exception of the European position paper on DISE, there are no established guidelines to date on how DISE should be performed, with much variation in the conduct of the procedure. This study aimed to look at one of these variables - sedation depth.

Aims: We aimed to determine if variation in sedation depth (measured by means of Bispectral Index [BIS]) affects the site(s) and severity of obstruction in OSA patients undergoing DISE.

Materials and methods: We retrospectively reviewed the clinical data and DISE results of 104 patients who have undergone DISE by the last author in a tertiary hospital in Singapore, between September 2015 and September 2018. Selection criteria included patients with moderate and severe OSA (defined by an apnea-hypopnea index [AHI] of 15 and above) diagnosed on a level 1 polysomnogram. They did not have significant comorbidities which may have predisposed them to other sleep pathologies, have rejected positive airway pressure (PAP) therapy and were considering surgical intervention. DISE was performed in the operating room, with sedation achieved via target-controlled infusion of propofol (target 3 - 5.5µg/ml). Steady states at two BIS levels were achieved: 60-70 and 71-80, during which a flexible nasoendoscopy was performed. The "sites" and severity of airway collapse were graded using the VOTE classification. There were 6 possible sites of collapse: Velum Anteroposterior (V-AP), Velum Lateral (V-Lat), Oropharynx Lateral, Tongue Base Anteroposterior, Epiglottis Anteroposterior, and Epiglottis Lateral. For the purposes of statistical analysis, Velum Concentric collapse was taken to be equivalent collapse at both the V-AP and V-Lat dimensions. A site was deemed to have significant obstruction when its VOTE Obstruction Grade was ≥1. VOTE score was calculated as the sum grade of obstruction in all sites.

Results: 51% of patients showed an increase in the number of obstructive sites when traversing from a lighter to deeper sedation state. At each of the 6 studied sites, the proportion of patients with significant obstruction increased at deeper sedation to varying degrees, with the tongue base appearing to be the most affected (34% of patients had significant obstruction at light sedation vs. 57% at deep sedation). We also analysed correlation of increased collapsibility with AHI, Body-Mass-Index (BMI), and Age, but found no statistically significant difference. By the Pearson correlation coefficient, there was a statistically significant correlation between VOTE score (at BIS60-70) and AHI: $r=0.26$ (p-value=0.004) but no statistically significant correlation with Age: $r=0.11$ (p-value=0.25) or BMI: $r=0.014$ (p-value=0.88).

Conclusions: This study revealed that a deeper sedation depth leads to an increase of both the number of obstructive anatomical sites, and severity of obstruction in patients with moderate to severe OSA, when examined by DISE. The site that appears to be most affected is the tongue base.

Sleep Breathing Disorders
Board #288 : Poster session 3
ARTIFICIAL NEURAL NETWORK ANALYSIS OF BLOOD OXYGEN SATURATION SIGNAL ENABLES ACCURATE AUTOMATIC SCREENING OF SLEEP APNEA

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Introduction: Severity of obstructive sleep apnea (OSA) is conventionally estimated using apnea-hypopnea index (AHI). Currently, accurate determination of AHI requires manual analysis of sleep recordings and complex registration setup making it expensive and labor intensive. Partially for these reasons, OSA is heavily under-diagnosed disease[1]. We hypothesize that accurate OSA diagnosis can be done faster and more cost-effectively by neural network-based analysis of blood oxygen saturation (SpO_2) signal. This hypothesis was tested in a large patient pool.

Materials and methods: A total of 3948 patients from two different datasets were included in this study. The primary dataset consisted of 1989 recordings conducted with a custom-made (type III) Unisalkku-device, from which 1692, 99, and 198 recordings were used for training, validation, and testing, respectively. To test the neural networks' generalizability, we used a second dataset consisting of 1959 Embletta-recordings as another test set. The SpO_2 signals were divided into 10-minute epochs and separate neural networks were trained to estimate AHI or ODI for each epoch. The whole night AHI and ODI values were calculated as an average of the values obtained from the 10-minute epochs. The structure of both networks consisted of three fully connected feedforward layers of sizes 60, 15, and 5 and a scaled conjugate backpropagation algorithm was used as the training function. The performance of the networks was tested in both test sets by comparing the whole night AHI and ODI values determined manually and by using neural networks. Finally, patients were classified to OSA severity categories based on estimated AHI and ODI values and classification accuracy was evaluated against OSA severity classifications defined based on manual analyses.

Results: The median absolute errors of AHI and ODI estimated by the networks were 0.78 and 0.68 events/hour, respectively, in the primary test set. In the Embletta test set, the median absolute errors of AHI and ODI were 1.35 and 0.76 events/hour, respectively. Based on the estimated AHI and ODI values, the neural networks classified 90.9% and 94.4% of patients to the correct OSA severity category in the primary test set. In the Embletta test set, 86.0% and 92.1% of patients were correctly classified to OSA severity categories using AHI and ODI, respectively.

Conclusions: AHI and ODI can be reliably estimated by neural network analysis of SpO_2 signal. The neural networks developed in this study could allow easy and affordable screening of OSA, since only SpO_2 signal, that is easily measurable with a pulse oximeter, is needed and no manual scoring is required. This automatic approach could allow more patients to be screened for a fraction of the current cost and thus, enable diagnosing those individuals who are suffering from OSA but are not aware of it.

References: [1]Young T et al. *Sleep.*1997;**20:**705-706.

EFFECT OF REM AND NREM RELATED OSA ON SLEEP ARCHITECTURE AND PROGNOSIS OF ACUTE ISCHEMIC STROKE PATIENTS

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Introduction: To investigate the effect of rapid eye movement (REM) and non-rapid eye movement (NREM) related obstractive sleep apnea (OSA) on sleep architecture and prognosis of acute ischemic stroke (AIS) patients.

Material and methods: AIS patients with polysomnography (PSG) examination from Feburary 2011 to August 2018 were included in the Second Affiliated Hospital of Soochow University. Their general conditions, emotion, cognition sleep scales and sleep data were collected. Neurological function defect was evaluated by national institutes of health stroke scale (NIHSS) on admission, 48 hours after admission and at discharge. Self-care ability was evaluated by modfied Rankin Scale (mRS) at discharge and 3 months later. According to overall apnea-hypopnea index (AHI), AHI during REM (AHI-REM) and AHI during NREM(AHI-NREM), they were divided into AIS group (AHI< 5/h), AIS+REM-related OSA group (AHI≥5/h and AHI-REM/AHI-NREM>2) and AIS+NREM-related OSA group (AHI≥5/h and AHI-REM/AHI-NREM≤2).

Results: Thirty (27.3%), fifteen (13.6%) and sixty-five(59.1%) patients were enrolled in AIS, AHI+REM-related OSA and AHI+NREM-related OSA group separately. No significant difference was found in sleep, emotion and cognition scales between three groups ($P>0.05$). The time and proportion of NREM 1 were higher [89.00(92.15) vs 41.75 (35.75), $P=0.003$; 24.10(19.40) vs 9.70(11.80), $P=0.005$] and the time and proportion of slow wave sleep (SWS) were shorter [49.29±32.48 vs 64.50±32.38, $P=0.027$; 13.00 (12.70) vs 20.45 (12.80), $P=0.008$] in AIS+NREM-related OSA than these in AIS group. Microarousal index[18.40 (23.38) vs 7.60 (9.30), $P< 0.001$], respiratory related microarousal index[6.75 (17.80) vs 2.30 (4.90), $P=0.003$], spontaneous microarousal index[5.75 (9.38) vs 2.50 (4.90), $P=0.030$] was higher in AIS+NREM-related OSA group than these in AIS+REM-related OSA group. The lesions of AIS group were mostly located in telencephalon while these of AIS+REM-related OSA group was located in brain stem, telencephalon and diencephalon ($P< 0.001$). There was no difference in mRS score at 3 months and the difference between mRS score at 3 months and that at discharge between three groups($P>0.05$). Spearman correlation analysis showed a positive correlation between mRS score at 3 months and thrombolysis or intravascular treatment on admission, NIHSS on admission, NIHSS at discharge, AHI, AHI-REM, AHI-NREM, oxygen desaturation index (ODI), respiratory related microarousal index, especially that during NREM, name in Montreal Cognitive Assessment (MoCA), while a negative correlation between mRS score at 3 months and minor stroke. The difference between mRS at 3 months and that at discharge had a positive correlation with dyslipidemia, BMI, AHI, AHI-REM, AHI-NREM, sleep efficiency, ODI, percentage of oxygen saturation < 90% of total recording time, respiratory related microarousal index, especially that during NREM and Epworth Sleep Scale (ESS), while a negative correlation with mRS at discharge. On logistic analysis, mRS score at 3 months was independently predicted by NIHSS on admission and naming in MoCA. Difference between mRS score at 3 months and that at discharge was independently predicted by sleep efficiency. If there was improvement of mRS score was independently predicted by ODI and ESS.

Conclusion: Sleep architecture of AIS is disturbed by NREM-related OSA with its characteristic of longer NREM1, shorter SWS and fragmentation. These change may result in worse prognosis of AIS.

THE UPPER AIRWAY FEATURE OF REM-RELATED OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea（OSA）during rapid eye movement（REM）sleep is a common disorder，and recent research revealed that REM-related OSA is associated with lower oxygen saturation and higher incidence of cardiovascular disease. Whether the REM-related OSA has the anatomic airway narrowing is unclear. This study aims to compared the upper airway parameters between the REM-related OSA and OSA not restricted REM.

Materials and methods: 76 patients were recruited, who had been diagnosed through whole night polysomograpy in Beijing Tsinghua Changgung Hospital. REM-related OSA was defined as a REM apnea-hypopnea index (AHI) / non-REM AHI > 2. 19 patients were recruited in REM-related OSA group and 57 OSA patients were recruited as control group, matched by age and BMI (matching proportion1:3). Upper airway measurements were detected by upper airway computed tomography (CT) scanning. The parameters were compare between groups, including retropalatal region, retrolingual region, the vertical distance between the inferior edge of the mandible and the inferior edge of the hyoid.

Results: There was no statistic difference between the REM related OSA group and OSA not restricted REM group as for the measurements of retropalatal region, retrolingual region, the vertical distance between the inferior edge of the mandible and the inferior edge of the hyoid (P >0.05).

Conclusions: Compared with the OSA not restricted to REM, the anatomic airway narrowing is also a phenotypic of REM-related OSA. The upper airway should be carefully evaluated before treatment.

OBESE CHILDREN WITH SLEEP-DISORDERED BREATHING MAY EXPERIENCE MORE SIGNIFICANT SYMPTOMS AND SLEEP DISTURBANCE THAN NON-OBESE CHILDREN

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Introduction: To investigate the association between the severity of obstructive sleep apnea (OSA) and related symptoms in Chinese children with and without obesity.
Materials and methods: This cross-sectional study included 60 children aged 6.0[5.0,9.6] yrs with obesity (BMI SDS >2) and 96 children aged 6.0[4.4,8.2] yrs with normal weight (BMI SDS ≤ 2). All subjects complained habitual snoring. In lab sleep studies were performed. OSA was defined as OAHI ≥ 1. Obstructive Sleep Apnea Questionaire-18questionnaire (OSA-18) were used to evaluate the symptoms.
Results: 43.7%(42/96) of the normal-weight group and 56.7%(34/60)of the obesity group had OSA. In subjects without OSA, obese children had higher percentage of NREM stage 1 sleep (5.8[2.6,9.9]% vs 2.5[1.4,5.3]%,p=0.007) and lower NREM stage 3 sleep (25.3[19.7,31.5]% vs 28.1[21.9,34.7]%). In subjects with OSA, the non-obese children had higher AHI (22.8[12.5,43.4] vs 6.6[2.6,24.5],p=0.021) , OAHI (22.2[13.5,41.4] vs 7.0[1.8,23.4],p=0.007) despite they had similar OSA-18 scores. Although increased OSA-18 scores were risk factors of pediatric OSA in both obese (t=3.165,p< 0.05) and non-obese children (t=3.268,p< 0.05)in logistic regression. In the subjects with OAHI>15 events/hr, the obesity group had higher scores for sleep disturbance and physical symptoms (p< 0.05) as well as higher percentage time with SaO2< 90%(p< 0.01).
Conclusions: Obese children had higher percentage of NREM stage 1 sleep compared with non-obese children even without OSA. Obese children with OSA may experience more significant symptoms with similar AHI.

INCREASED HIGH-FREQUENCY EEG ACTIVITY DURING NERM SLEEP MEDIATES THE ASSOCIATION BETWEEN SUBJECTIVE DAYTIME SLEEPINESS AND SUSTAINED ATTENTION IN SLEEP APNEA PATIENTS

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Introduction: We have previously reported that subjective excessive daytime sleepiness (EDS) is associated with poor sustained attention as measured by psychomotor vigilance test (PVT) in sleep apnea (OSA) patients. In this study we examined whether high-frequency spectral EEG activity during sleep mediates the association between subjective EDS and sustained attention in OSA.

Materials and methods: We studied 43 OSA patients (55.80±6.27, 51.2% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. We examined low-beta (15.23-25.00 Hz) and high-beta (25.39-35.16 Hz) relative power at central EEG derivations during NREM. The mean values of 2nd and 3rd nights of relative EEG power were used. Epworth scale score (ESS) was used to assess subjective EDS whereas PVT was used to assess sustained attention levels.

Results: After adjusting for age, gender and AHI, higher values of ESS were significantly associated with increased relative low-beta power during NREM sleep (standardized β=0.38, p=0.014) and lower values of median of 1/RTs (standardized β=-0.39, p=0.012). Furthermore, increased relative low-beta power during NREM was significantly associated with lower values of median of 1/RTs while adjusting for age, gender and AHI (standardized β=-0.42, p=0.007). Mediation analysis revealed that 30.6% of the association between ESS and median 1/RTs was mediated by relative EEG low-beta power during NREM sleep (P< 0.05).

Conclusions: Our findings suggest that increased high-frequency EEG activity during NREM sleep mediates the association between subjective EDS and poor sustained attention in patients with OSA. EEG activation during NREM sleep maybe one of the underlying mechanisms of the association between subjective complaint of sleepiness/ fatigue and poor sustained attention in OSA patients.

SEGMENTAL MAXILLOMANDIBULAR ROTATIONAL ADVANCEMENT FOR ADULT PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Maxillomandibular advancement is the most effective surgical treatment for obstructive sleep apnea (OSA). The specific surgical design of segmental maxillomandibular rotational advancement (SMMRA) is applied for Asian OSA patients with maxillary protrusion. A retrospective study is conducted to evaluate the surgical outcome of SMMRA for OSA treatment.
Materials and methods: Demographic, cephlometric, and polysomnogrpahic data are reviewed. The presurgical severity of disease and post-operative treatment outcome of polysomnogrpahy are recorded. Wilcoxon test was applied to the comparison of data before and after surgery.
Results: Seventy five (20 female) patients are recruited. The age at surgery was 31.9±9.5, and BMI 22.7±3.2 Kg/M2. Significant improvements were found in Apnea-Hypopnea Index (AHI) from 39.6±24.7/hr to 4.0±7.0/hr, the lowest oxygen saturation from 84.4±8.0% to 88.5±11.9%, and Epworth sleepiness score(ESS) from 12.6±5.3 to 6.0±3.4.
Conclusions: SMMRA is an effective treatment modality for Asian patient with OSA.

LONG-TERM PROGNOSIS OF PATIENTS AFTER ACUTE MYOCARDIAL INFARCTION IS DEPENDENT ON THE SEVERITY OF SLEEP APNEA

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Introduction: While sleep apnea (SA) might be a modifiable risk factor, recent data suggest that SA is severely underdiagnosed in patients after MI. There is also limited evidence about long-term prognosis of patients after MI according to SA categories. Therefore we sought to determine the relationship between SA and long-term prognosis among patients presenting with MI.
Materials and methods: We prospectively studied 782 consecutive patients admitted to the hospital with the diagnosis of acute MI. The study was conducted in two tertiary care institutions, where primary percutaneous coronary intervention (PCI) is the standard of care in the treatment of acute MI. All subjects underwent sleep evaluations using a portable diagnostic device after at least 48 hours post-admission, provided they were in stable condition. Patients were followed for median follow-up of 66 months.
Results: Almost all patients (98%) underwent urgent coronary angiography and 91% of patients underwent primary PCI. 175 (22.4%) patients had technically inadequate limited sleep studies (less than 4 h recording time or inability to score study due to excessive artifact). We therefore analyzed the data from 607 patients who had good quality sleep study records. Using a threshold of AHI > 5 events/hour, SA was present in 65.7% of patients after acute myocardial infarction. Mild SA was present in 32.6%, moderate in 20.4% and severe in 12.7%. There was a relation between the severity of SA and long-term prognosis. Patients after MI with increasing severity of SA had higher total mortality (p = 0.002, log-rank test). The Kaplan-Meier survival curves will be presented.
Conclusion: Mortality of patients after MI significantly increased with increasing severity of SA. Whether treatment of SA after MI will significantly improve outcomes in these patients remains to be determined. **Acknowledgements:** Supported by the project no. LQ1605 from the National Program of Sustainability II and FNUSA-ICRC (No. CZ.1.05/1.1.00/02.0123).

EFFECT OF TREATMENT WITH CONTINUOUS POSITIVE AIRWAY PRESSURE ON ANXIETY AND DEPRESSION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Previous research suggests a possible association between obstructive sleep apnea (OSA) and psychiatric disorders, such as anxiety and depression.Continuous positive airway pressure (CPAP) is considered as first-line treatment to OSA. In the present study we aimed to assess the effect of CPAP treatment on symptoms of anxiety and depression in patients with OSA using the Hospital Anxiety and Depression Scale (HADS). We hypothesized a decrease in HADS scores after CPAP use.

Materials and methods: 510 patients were diagnosed at a Norwegian university hospital with OSA according to standard respiratory polygraphy (type 3 portable monitor). All patients received CPAP (mean age 55.4 years (SD = 12.0), 71.2% males). Mean AHI at baseline was 28.5 (SD = 20.6). The patients completed HADS prior to CPAP treatment and at follow-up which was scheduled after about three months (mean = 5.4 months, range 1.4-11.7). Paired-samples t-tests were conducted to evaluate the impact of CPAP treatment on the anxiety (HADS-A) and depression (HADS-D) scores, respectively. Patients were also divided into CPAP compliance groups ($\geq$ 4 hours/night = compliant and < 4 hours/night = non-compliant) and analyzed separately. In addition, McNemar's tests were conducted to evaluate changes in the proportion of patients having anxiety (HAD-A $\geq$ 8) and depression (HAD-D $\geq$ 8) prior to CPAP treatment and at follow-up.

Results: Overall, there was a statistically significant decrease in HADS-A scores from baseline (mean = 4.95, SD = 3.90) to follow-up (mean = 4.43, SD = 3.67), p < 0.001. Similar results were found for HADS-D scores (mean = 4.06 (3.52) versus 3.56 (3.53)), p < 0.001. Cohen's d (.23 and .20, respectively) indicated small effect sizes. When analyzed separately, there was no decrease in HADS-D scores (mean = 4.32 (3.68) versus 4.18 (3.79), p = 0.55), whereas the decrease in HAD-A scores was still significant (mean = 5.48 (4.09) versus (4.91 (3.86), p = 0.006). McNemar's test showed that 14% (n = 54) changed HAD-A category at follow-up of CPAP treatment. Of these, significantly more participants changed their score from HAD-A $\geq$ 8 to HAD-A < 8 (n = 37), than from HAD-A< 8 to HAD-A $\geq$ 8 (n = 17), χ^2(1, N = 397) = 6.70, p < 0.05 (two sided). There was no significant change in the proportion of patients with HAD-D $\geq$ 8 after CPAP treatment, when compared with the proportion prior to treatment, p = 1.0 (two sided).

Conclusions: We found a decrease in symptoms of anxiety and depression in patients with OSA at follow-up of CPAP treatment.

EVALUATION OF OBSTRUCTIVE SLEEP APNEA SCREENING QUESTIONNAIRES IN OBESE WOMEN IN THE FIRST TRIMESTER OF PREGNANCY

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Introduction: Obstructive sleep apnea (OSA) during pregnancy is associated with several adverse outcomes, both for the mother and the fetus. Due to the growth of the obesity epidemic, there is an increasing number of obese pregnant women who concentrate important risk factors for sleep disordered breathing. The Stop-Bang questionnaire and the Epworth Sleepiness Scale (ESS) are good screening tools in the non-pregnant population. In this study we aim to evaluate the performance of these OSA screening questionnaires in obese women in the first trimester of pregnancy.

Methods: Obese pregnant women were enrolled in the study and completed an initial sleep evaluation including the STOP-Bang and Epworth Sleepiness Scale questionnaires (both ≥10 and ≥12 cut-offs were tested). A specific model proposed by Facco et al. for pregnant women based on snoring, chronic hypertension, age and body-mass index was also applied. In-laboratory polysomnography was performed for diagnosis of OSA.

Results: 34 obese women completed the protocol during the first trimester of pregnancy. Four patients had OSA (11.8%). None of the screening methods were accurate in predicting OSA. For the Stop Bang questionnaire, sensitivity and specificity were 0.25 (95%CI 0.05 - 0.7) and 0.83 (95% CI 0.66 - 0.93), with a ROC area under the curve (AUC) of 0,542. ESS showed a sensitivity of 0.50 (95%CI 0.15 - 0.85) and 0.25 (95%CI 0.05 - 0.7) for ≥10 and ≥12 cut-offs, respectively. AUC was 0.617 for ESS≥10 and 0.492 for ESS≥12. The model proposed by Facco et. Al showed a sensitivity and specificity of 0.25 (95%CI 0.05 - 0.7) and 0.35 (95% CI 0.18 - 0.57), with an AUC of 0.408.

Conclusions: Currently available questionnaires aren't appropriate for OSA screening in an obese pregnant women population. Further research is needed to provide screening tools with better performance in this population.

UTILIZING ADMINISTRATIVE DATA FOR THE IDENTIFICATION OF OBSTRUCTIVE SLEEP APNEA IN ALBERTA, CANADA

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Introduction: Obstructive sleep apnea (OSA) is a common condition with significant associated morbidity; despite this, deriving accurate estimates of the population prevalence of OSA is challenging. Population-based research has been limited due to variable access to diagnostic testing, inconsistent definitions of clinically significant disease, and complexities in diagnosis limiting the generalizability of population estimates (Laratta et al, 2017). Additionally, there are several challenges associated with data collection methods including multiple independent data systems, and reliance on healthcare practitioner reporting and health system coding as the primary data sources. The purpose of this quality improvement project was to determine if previously derived administrative case definitions could be applied to population-based data to characterize OSA prevalence in the province of Alberta, Canada.

Materials and method: The provincial hospital discharge abstract database and the physician claims database were used to identify adult cases of OSA in Alberta, Canada. Using two of the case definitions for OSA (defined by respiratory event index $\geq$5) validated by Laratta and colleagues (2017), individuals with OSA were identified within the provincial administrative files from 2002-2018. The case definition with the highest specificity (87.4%, positive predictive value 30.1%) (case definition: 1 hospitalization for OSA or 3 physician claims in the previous two years; OSA_1) was used, as well as the case definition with the highest sensitivity (46.5%, positive predictive value 75.3%) (case definition: 1 hospitalization for OSA or one physician claim for OSA in the previous two years; OSA_2). Physician claims were included if the diagnosis was in the first three diagnostic positions (ICD-9 780.5, sleep disturbance) and discharge abstract database codes from hospitalizations were included up to diagnostic position 25 (ICD-10 code G473.xx).

Results: In 2018, there were 3,611,770 adults living in Alberta. Prevalence estimates for case definitions OSA_1 and OSA_2 were 128,242 (3.6%) and 498,397 (13.8%), respectively. For comparison, previous studies have estimated that the population prevalence of OSA exceeds 25% in North America and Europe. Using case definition OSA_2, the estimated prevalence of OSA was marginally higher in males (253,192 individuals, 50.8%), and age distribution in both sexes revealed that 30.7% were aged 18-44, 41.9% were 45-64 and 27.4% were 65 and older.

Conclusion: Using validated administrative data algorithms, the prevalence of OSA in Alberta ranges from 3.6-13.8%, likely underestimating the true population prevalence. These findings highlight challenges in using administrative data to characterize the burden of OSA, which has important implications for research and policy.

EFFECTIVE MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA SCREENING AND DIAGNOSTICS FOR DRIVERS IN BULGARIA

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Obstructive sleep apnoea (OSA) is one of the most common sleep-related disorders characterized by airflow reduction while breathing during sleep and causing significant health problems. The OSA represents a major challenge for physicians and healthcare systems throughout the world. Its high prevalence oblige clinicians to offer effective and acceptable screening and diagnostic options and its timely identification is important for reduction in symptoms, cardiovascular and stroke risk. The OSA is mainly diagnosed in sleep laboratories with polysomnography, involving high costs and stress for the patients. Nowadays there are multiple systems conducting the specific examinations and analysis in the patient's home, using sensors to detect physiological signals that are examined by algorithms. A home OSA test is an acceptable alternative to polysomnography for OSA diagnosis in patients with high pretest probability without comorbidities. Such a system improves wait times by diagnosing and managing up to one-half of the referred patient population, reducing the wait for in-laboratory treatment. In-hospital sleep study is costly and can be technically challenging. High-resolution pulse oximetry tests the feasibility of screening for OSA. It is a cost-effective tool to screen and evaluate for OSA in acute stroke patients. Several OSA screening tools and questionnaires such as Berlin questionnaire, Epworth Sleepiness Scale, STOP Bang questionnaire, portable sleep monitors, etc. are more and more widely used. Current guidelines recommend repeat in-laboratory polysomnography in patients with an initial negative finding and high clinical suspicion for OSA. The OSA-5 including issues of snoring, breath holding, choking, mouth breathing and parental concern is a simple questionnaire as a triage screening tool to identify the children at risk of OSA. The Sleep Apnea Symptom Score alone has acceptable reliability and validity, but limited predictive values. For payers, a home-based diagnostic pathway for OSA in patients at high risk for moderate to severe disease with robust patient's support incurs fewer costs than a laboratory-based pathway. For providers, costs are comparable if not higher, resulting in a negative operating margin. Despite the expansion in sleep medicine services, there is a significant unmet OSA burden. This burden requires a reappraisal of service delivery, including a move toward lower-cost, simplified methods of diagnosis and treatment, an expansion of OSA workforce to include suitably trained and equipped primary care physicians, sleep medicine specialists and nurses, and the incorporation of chronic disease management principles that link patients to relevant community resources and empower them through new technologies to engage more fully in their own care.

PREVALENCE AND OUTCOMES OF OPIOID-INDUCED CENTRAL SLEEP APNEA IN A POPULATION-BASED COHORT

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Introduction: Chronic opioid use is associated with multiple breathing abnormalities during sleep including central sleep apnea (CSA). Opioid-induced CSA has been described in patients on methadone, long-acting morphine or oxycodone preparations, buprenorphine, fentanyl patches and continuous opioid infusions. Although chronic opioid use and related mortality rates have increased significantly in the U.S., there are sparse data on the prevalence of opioid-induced CSA in population-based samples and long-term outcomes are unknown.

Chronic opioid use is associated with multiple breathing abnormalities during sleep including central sleep apnea (CSA). Opioid-induced CSA has been described in patients on methadone, long-acting morphine or oxycodone preparations, buprenorphine, fentanyl patches and continuous opioid infusions. Although chronic opioid use and related mortality rates have increased significantly in the U.S., there are sparse data on the prevalence of opioid-induced CSA in population-based samples and long-term outcomes are unknown.

Materials and methods: We conducted a retrospective study to evaluate the prevalence of CSA due to opioid use and associated clinical outcomes (cardiovascular, neurocognitive, psychiatric, mortality) in patients who received a diagnosis of CSA between 2007-2015 in Olmsted County, Minnesota. Data on demographics, morphine equivalent daily dose (MEDD), polysomnographic variables, comorbidities (diabetes mellitus, hyperlipidemia, systemic hypertension, coronary artery disease, cardiac arrhythmias, mild cognitive impairment/dementia, stroke, transient ischemic attack, depression), medications, CSA treatment modalities, initial and last dates of follow-up or death were manually extracted from the electronic medical record.

Results: Of 1074 patients identified as having CSA, 7 (0.7%, 3 men, 4 women) were found to have opioid-induced CSA, classified as moderate (n=2) or severe (n=5). Opioids implicated were tramadol, buprenorphine, oxycodone and morphine. MEDD ranged between 5-225 mg. A dose-response relationship between the severity of CSA and MEDD was not observed. Median duration of follow-up was 4.4 years (range 0.2-7 years). Three patients were prescribed and 2 of 3 were adherent to adaptive servoventilation therapy. One patient was on nocturnal oxygen supplementation, another on bilevel positive airway pressure in the spontaneous-timed mode and two patients did not proceed to treatment. One patient discontinued opioids which resulted in an improvement of CSA.

Two of seven (28.6%) patients were diagnosed with depression (median time to diagnosis 1.6 years). Three (42.9%) patients died (median time to death 2.0 years, range 1-5 years); two from respiratory failure (relating to COPD and ischemic cardiomyopathy in one patient and metastatic pleural effusions in the other) and one from malignancy-related disseminated intravascular coagulation.

Conclusions: In this population-based cohort, opioid-induced CSA was rare; this may be reflective of the population studied. Opioid-induced CSA was severe in a majority of patients and a dose-response relationship was not noted. Mortality was high in this small group of patients secondary to terminal illnesses.

PEDIATRIC UPPER AIRWAY RESISTANCE SYNDROME; A USUALLY MISSED SUSPECT

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Introduction: In adults, upper airway syndrome (UARS) was first described in 1993 as a type of sleep-related breathing disorder characterized by a complaint of excessive daytime sleepiness (EDS) and frequent awakenings during sleep due to increased respiratory effort. UARS leads to interruption in sleep continuity, poor sleep quality, and significant daytime neuropsychological consequences. In addition, recent studies have shown that adult patients with UARS have worse sleep quality compared to patients with mild obstructive sleep apnea. Unlike pediatric obstructive sleep apnea (OSA) which has been thoroughly studied with regards to pathophysiology, consequences, and outcome of treatment, UARS in the pediatric population has not been studied in depth and is an under-recognized condition. The difference between OSA and UARS is based on the morphology of sleep-related breathing events recorded during a sleep study (polysomnography), a gold standard for the diagnosis of sleep-related breathing disorder. In this study, we aimed to compare the severity of symptoms for pediatric UARS and OSA patients to determine if a statistical difference exists, as if there is not, pediatric patients with UARS may be under-treated.

Materials and methods: Nearly 1,500 polysomnographic and related studies (from 2014 - 2017) were analyzed for key comparative metrics including but not limited to respiratory disturbance index (RDI), apnea-hypopnea index (AHI), and >3% oxygen desaturation index (ODI). This study's UARS cohort was determined as including patients with AHIs under 2 and having 1 or no instances of >3% ODI. A comparative cohort of OSA patients was selected based on the average ± 1 standard deviation RDI for the UARS cohort. Symptom severity for patients was determined based on a sleep questionnaire completed by patients. Parents selected weekly incidence of various issues including but not limited to sleep breathing difficulty, snoring, restless sleep, daytime sleepiness, resisting bedtime, and night waking. Total incidences were summed up per patient, and the incidences for the UARS and OSA cohorts were compared using a t-test. The null hypothesis was that there is no statistically significant difference between the UARS and OSA cohorts.

Results: Data for 42 UARS patients (25 girls and 17 boys ages 4 - 19) and 42 OSA patients (16 girls and 26 boys ages 4 - 28) with an average RDI of 8.39 ± 1.84 were utilized for the t-test. The mean disturbances for the UARS cohort and OSA cohort respectively were 34.3 and 30.9 respectively. The resulting t statistic was 1.09 which fell below the t critical one-tail value of 1.66 and the t critical two-tail value of 1.99. Additionally, the one-tail p-value was 0.14 and the two-tail p-value was 0.28, both much greater than 0.05. Based on this data, we do not reject the null hypothesis.

Conclusions: After analyzing the data, we observed that there was no statistically significant difference between the UARS cohort and the OSA cohort in terms of problem incidence as indicated on the patients' sleep questionnaires. This suggests that patients with UARS may benefit from the higher standards of treatment afforded to those with OSA.

Acknowledgements: None.

IMPROVEMENTS IN AHI FOR OSA PATIENTS AFTER WEIGHT LOSS SURGERY - WHERE TO GO FROM HERE?

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Introduction: Obesity is one of the most important factors for the development of obstructive sleep apnea (OSA). Untreated OSA is associated with an increased incidence of hypertension, heart attacks, strokes, diabetes, motor vehicle collisions and all cause mortality. Though continuous positive airway pressure (CPAP) is an effective treatment for OSA, not all patients can use CPAP. We also know that CPAP compliance is low, with less than 50% of patients using the device regularly. Bariatric surgery may be the most effective treatment for OSA in morbidly obese patients, especially for those who have such severe OSA that CPAP helps, but does not completely resolve apneas.
Reports of bariatric surgery effects on OSA have been limited by studies that were not designed to identify sleep apnea outcomes.

Materials and methods: Electronic medical records were retrieved from Cerner Powerchart for patients evaluated by the Sleep Medicine Department at Banner University Medical Center, Phoenix from 03/2018 to 03/2019 with a history of bariatric surgery including laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy. This process resulted in 81 patient encounters. Each chart was independently reviewed, and ultimately 13 patients had full sleep studies conducted before and after their surgical intervention. These charts were then evaluated in depth to produce the results summarized below. P values were obtained by chi-squared analysis.

Results: Mean age was 56.8±3.4, with pre AHI 32.1±7.7 ($p < 0.0001$) and post AHI 8.2±2.9 ($p < 0.0001$). Pre ESS 8.4±1.6 ($p < 0.0001$) with post ESS 3.1±0.7 ($p < 0.03$). Pre BMI 43.6±2.4 ($p = 0.08$) with post BMI 34.2±1.6 ($p < 0.32$). Pre HgbA1c 8.0±0.5 ($p = 0.97$) with post HgbA1c 6.9±0.4 ($p = 0.98$). Pre systolic blood pressure 131.2±3.0 ($p = 0.60$) with post systolic blood pressure 124.4±2.9 ($p = 0.62$).

Discussion: Our study reveals significant objective improvement in obstructive sleep apnea after bariatric surgery intervention. Furthermore, we found that patient's daytime sleepiness (ESS) also improved.
Though improvement was not found for other parameters of obesity including BMI, HgbA1c nor blood pressure there are likely multiple factors at play. First, the sample size was limited by the short time period assessed. Furthermore, of those patients studied throughout the year, the time when subsequent sleep studies were performed after bariatric surgery varied drastically. Lastly, multiple patients did not have follow-up sleep studies performed, likely suggesting that our evaluation is underestimating improvements.

Conclusions: OSA was present in most patients undergoing weight loss surgery. Bariatric surgery resulted in significant improvement in subjective and objective measures of OSA.

SLOW WAVES IN MIDDLE-AGED AND OLDER ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a sleep disorder characterized by cessations (apnea) or reductions (hypopnea) of airflow following upper airway obstructions. These respiratory events cause sleep fragmentation and intermittent hypoxemia. OSA in older adults is a risk factor for dementia, but the mechanisms linking OSA and dementia are not clear and need further investigation. Considering that sleep slow waves, oscillatory events in non-rapid eye movement (NREM), are important for memory consolidation and neural plasticity, the aim of the present study was to test the hypothesis that increased OSA severity is associated with lower amplitude and density slow waves.
Materials and methods: Our study included a sample of 103 middle-aged and older subjects (mean age = 64.20 years; SD = 6.63) with an OSA varying from absent to severe. They were tested with one night of in-laboratory polysomnography which allowed us to characterize their sleep. Partial correlations controlling for age and sex were performed between slow wave characteristics (i.e. amplitude, density, durations, slope and frequency) and markers of OSA severity (hypoxemia, respiratory disturbances and sleep fragmentation). We also studied the relationship between the electroencephalogram slow wave activity (0.5 to 4.5 Hz) and OSA severity.
Results: We found that higher sleep fragmentation and respiratory disturbance associated with a decreased slow wave amplitude and density (r varying from -0.260 to -0.315, p varying from 0.002 to 0.010). Moreover, increased sleep fragmentation and respiratory disturbance correlated with a lower power of slow absolute wave activity.
Conclusions: Overall, our findings suggest that OSA severity may compromise the regular generation of slow waves in middle-aged and older subjects. Further studies are required to examine whether these changes in slow wave disturb the neural plasticity and lead to cognitive dysfunctions.

WHITE MATTER LONGITUDINAL CHANGES IN MIDDLE-AGED AND OLDER ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Multiple studies have identified a potential link between obstructive sleep apnea (OSA) and dementia. Thus, evaluating the association between OSA and changes in the brain structure over time may further our understanding of how OSA could be related to neurodegeneration. Studies in dementia have identified early changes in white matter, including the corpus callosum. In parallel, a recent study from our group concluded that mild OSA was associated with widespread significant reduction in white matter diffusivity metrics compared to controls, which could be attributed to brain oedema, and this effect was prominent in the corpus callosum. However, the course of these changes remains unclear. This study aimed at exploring whether longitudinal changes in the corpus callosum are associated with OSA severity in non-treated middle-aged and older adults.

Materials and methods: Thirty-one non-treated participants (7F; 63.6 ± 5.1 years) were tested. Ten subjects had an apnea-hypopnea index (AHI) < 5, 12 had an AHI between 5 and 15, and 9 subjects had an AHI > 15. At the baseline, subjects were evaluated with overnight polysomnography and magnetic resonance imaging, including diffusion-weighted sequences. Subjects were evaluated again at 18-month follow-up with the same magnetic resonance imaging sequences. For each subject, we extracted white matter metrics (fractional anisotropy, mean, axial, and radial diffusivities) in the corpus callosum and its 7 subdivisions (rostrum, genu, rostral body, anterior midbody, posterior midbody, isthmus and splenium). The percentage of change between the two time points was then calculated for each metric. Correlations were then performed between the percentage of change in diffusion metrics and the log transformed AHI.

Results: No significant correlations were found between the log transformed AHI and the percentage of change of white matter metrics for each of the subdivisions of the corpus callosum. However, trends were found for axial diffusivity in the genu ($r = -0.321$; $p=0.078$) and for mean diffusivity in the posterior midbody ($r=-0.325$; $p=0.074$), where higher AHI were associated with decreased diffusivities over time.

Conclusions: These preliminary results suggest that middle-aged and older adults with more severe OSA do not show significant changes in the corpus callosum over an 18-month period, although subtle reductions in white matter diffusivities over time might be present with higher OSA severity. These reduced diffusivities could represent an increased intracellular water content over time in these participants. Further OSA studies should include more white matter tracts and should also focus on the evolution of these metrics over a longer time trajectory.

A SIMPLE ALGORITHM FOR ACCURATE IDENTIFICATION OF OBSTRUCTIVE SLEEP APNEA SYMPTOM SUBTYPES: VALIDATION ACROSS INTERNATIONAL SLEEP CENTERS AND A COMMUNITY-BASED COHORT

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Introduction: Obstructive sleep apnea (OSA) is a heterogeneous sleep disorder with significant public health burden. Recent efforts to characterize OSA heterogeneity using unsupervised clustering analyses resulted in the identification of reproducible symptom-based subtypes in moderate-severe OSA patients, in both clinical and population cohorts: minimally symptomatic, disturbed sleep, moderately sleepy and excessively sleepy. We have recently provided evidence that the excessively sleepy subtype has increased risk of cardiovascular outcomes compared to other subtypes. However, a major limiting factor in translating these results into clinical practice is the lack of a tool that can categorize patients into the appropriate subtype based on reported symptoms at diagnosis; prior studies have used between 14 and 23 symptom-related questions for subtype determination/validation. Here, we present the development and validation of a simple and efficient tool to predict OSA symptom subtypes, by identifying the minimum number of questions necessary for accurate classification of new patients.

Materials and Methods: Latent class analysis of symptom questionnaire data (13 questions plus the Epworth Sleepiness Scale [ESS] score) from 1,730 patients with moderate-severe OSA (apnea-hypopnea index≥15) available through the Sleep Apnea Global Interdisciplinary Consortium (SAGIC), a multi-site international cohort of patients referred to sleep centers, was used to derive symptom-based subtypes. To determine the minimum number of questions necessary to predict subtypes accurately, we then trained and evaluated a supervised machine learning method based on random forests, using 5-fold cross validation. We ranked each of the 14 symptom items according to their importance in predicting subtypes, and evaluated the predictive performance of sequential models including between 1 to 14 symptom questions, by order of importance. The optimal number of questions providing the highest acceptable accuracy was determined based on a change in average balanced accuracy < 1% after inclusion of the next question in the importance ranking. We validated the optimal model in an independent clinical cohort from Iceland (N=785) and from a community-based sample in the United States (N=1,207).

Results: The model with the highest acceptable accuracy (average balanced accuracy=87.8%, average multiclass area under the receiver operating characteristic curve [mAUC]=97.6%) in testing samples included 6 items: ESS, 'feel rested during the day', 'difficulty maintaining sleep', 'physically tired', 'sleep involuntarily' and 'sleepy during the day'. This model accurately predicted 94.3% of patients from SAGIC into the correct subtype. When this model was applied in an independent clinical cohort and a community-based sample, the predictive performance was clinically acceptable (mAUC=90.2% and 84.0%, respectively).

Conclusions: We developed and validated a clinically applicable tool for classifying patients into OSA symptom subtypes of minimally symptomatic, disturbed sleep, moderately sleepy and excessively sleepy based on only six symptom items. The derived model showed high predictive performance in three independent datasets, including clinical and community cohorts. The use of this algorithm will facilitate clinical translation by supporting the efficient identification of patients with the excessively sleepy OSA subtype who are at increased cardiovascular disease risk.

CROSS-SECTIONAL ASSOCIATION OF TRADITIONAL AND NOVEL POLYSOMNOGRAPHY METRICS WITH ATHEROSCLEROSIS IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Although obstructive sleep apnoea (OSA) is a recognised risk factor for atherosclerotic cardiovascular disease (CVD), traditional metrics of OSA severity, such as the apnoea-hypopnoea index (AHI), are inconsistent predictors for CVD. The objective of this study was to investigate traditional and novel polysomnography (PSG) metrics of OSA severity and their cross-sectional associations with self-reported CVD in a carefully phenotyped sleep clinic cohort.

Materials and methods: Data from 1102 participants (636 males, mean age: 51.5 ± 14.1 years), who attended a Western Australian tertiary hospital sleep clinic between 2005 and 2010, were analysed. All participants underwent an overnight in-laboratory diagnostic PSG and completed a clinical questionnaire. Traditional metrics of OSA severity were: AHI; arousal index (AI); time with oxygen saturation < 90% (T90, minutes); and oxygen desaturation≥4% dips (ODI4). Novel metrics were: average heart rate (HR) response to arousal (delta HR); the rate of HR changes as a function of time, which is related to non-dipping blood pressure pattern (slope HR vs. time); correlation between odds ratio product (ORP), a continuous index of sleep depth, in the right and left central electrodes (R/L ORP correlation); and inspiratory duty cycle, i.e., a measurement of inspiratory time/total respiratory cycle time (respiratory duty cycle). Multivariable models were constructed with the above PSG metrics as independent variables and composite self-reported atherosclerotic CVD (one or more manifestation of: stroke; myocardial infarction; peripheral vascular disease; or revascularisation procedures) as the dependent variable. Odds ratios (OR) and 95% confidence intervals (CI) were calculated using binary logistic regression, with adjustment for potential confounders (age, sex, BMI, smoking history, self-reported: diabetes, elevated cholesterol, and hypertension).

Results: Atherosclerotic CVD was reported in 105 participants (71 males, mean age: 63.8 ± 10.9 years). Independent predictors of CVD were higher: T90 as a continuous variable (OR: 1.004, 95% CI 1.000 to 1.007); slope HR vs. time as quartiles (OR 1.218, 95% CI 1.002 to 1.480); and respiratory duty cycle during wake as quartiles (OR 1.227, 95% CI 1.002 to 1.502). Inclusion of T90 as a covariate in the models for slope HR vs. time and respiratory duty cycle (in wake) did not attenuate their associations with CVD. AHI and other PSG metrics were not independently associated with CVD.

Conclusions: T90 was associated with the presence of atherosclerotic CVD in OSA unlike AHI and other traditional PSG metrics, suggesting that OSA-related 'hypoxaemic burden' is a significant determinant of CVD. Novel metrics, such as slope HR vs. time and respiratory duty cycle during wake, are physiological measures which may improve CVD risk stratification in OSA patients.

PREVALENCE OF SELF-REPORTED SNORING IN TEMPOROMANDIBULAR DISORDERS AND CHRONIC OROFACIAL PAIN: A WISE-BASED STUDY

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Introduction: Some patients with temporomandibular disorders (TMD) and/or orofacial pain (OFP) are at higher risk for developing sleep disordered breathing. This could be due to either pain modulating drugs or to a homeostatic and/or circadian pain related sleep disruption. This increases the likelihood of slow wave sleep and REM rebound which are known to be associated with sleep related breathing disorders.
Material and methods: Data were extracted from WISE (Web-based Interdisciplinar Symptom Evaluation) completed by 605 patients who consulted the Orofacial Pain Unit at Center of Dental Medicine, University of Zurich, Zurich, Switzerland between January 2017 and August 2018.
Results: 420 females (69.4%) and 185 males (30.6%) ranging from 10-89 years of age completed the WISE. 132 (21.8%; 13.9% f) TMD/OFP patients reported to snore. 36 snorers (6%; 4.1% f) also suffered from moderate to severe insomnia (ISI score > 15). Comorbid condition (snoring + insomnia) increased from 5.6% in the third decade of life to 30.6% in the 5th decade, showing a reverse pattern thereafter with a prevalence in the 6th and 7th decades of 19,4% and 5,6% respectively. No correlations were found between number of pain related drug consumption and comorbid severity.
Conclusions: In this WISE cohort of TMD/OFP patients, 6% reported to concomitantly snore and experience insomnia. Whereas a higher proportion of females complained of TMD/OPF symptoms, no gender preference was observed among snorers with insomnia.

PERFORMANCE OF BERLIN, STOP-BANG AND EPWORTH SCALES FOR THE DIAGNOSIS OF MODERATE-SEVERE OBSTRUCTIVE SLEEP APNEA SYNDROME IN A COHORT OF PATIENTS IN NORTHEASTERN COLOMBIA

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Introduction: Obstructive Sleep Apnea (OSA) is a frequent sleep disorder that disturbs the quality of life, representing a public health problem associated with chronic noncommunicable diseases. The diagnosis is determined by a polysomnographic Apnea-Hypopnea Index (AHI) ≥5. The severity is classified as mild (IAH ≥5), moderate (IAH ≥15) and severe (IAH ≥30). Different screening tools have been developed to determine the risk of OSA varied results. This study aims to compare the discriminative capacity of the Berlin, STOP-Bang and Epworth scales for the diagnosis of moderate-severe OSA in a cohort of patients from northeastern Colombia.

Materials and methods: Analytical cross-sectional study of patients recruited by non-probability consecutive sampling in a sleep laboratory between November 1, 2014 and January 1, 2019. Inclusion criteria: >18 y.o, daytime hypersomnia and OSA polysomnographic diagnosis. Exclusion: secondary sleep disorders, changes in the wake-sleep cycle, prior history of OSA and pregnancy. Clinical, sociodemographic and questionnaire variables were collected from Epworth, Berlin and STOP-Bang. Descriptive analysis was performed using central tendency for quantitative variables and proportions for qualitative variables; To determine the association of the clinical profile according to the different scales (EPWORTH, Berlin and STOP-Bang) with the diagnosis of moderate-severe OSA, we performed bivariate analysis using logistic regression on STATA V.14.

Results: 187 patients were included; predominantly male (53.4%), average age 56.4 ± 13.9 y.o, with a prevalence of mild OSA 36.9% (n69; AHI 10.2), moderate 28.8% (n54; AHI 21), severe 34.2% (n64; AHI 49.9). OSA severity showed significant association with apneas (OR 2.85; P 0.00), daytime fatigue (OR 2.66; P 0.00), obesity (OR 1.87; P 0.04), age ≥30 (OR 1.57; P 0.02), morning headache (OR 0.5; P 0.03), lived dreams (OR 0.43; P 0.03), oxygen saturation ≥93% (OR 0.46; P 0.00), alteration in muscle strength (OR 0.29; p = 0.00), Epworth Index ≥14 (OR 2.3; P 0.02), Berlin ≥9 (OR 1.9; P 0.05), STOP BANG ≥5 (OR 2.7; P 0.00). Predictive capacity of the scales for Moderate-Severe OSA highlighted that STOP-BANG had lower predictive sensitivity but better specificity for classifying the severity of the disease (AUC 0.6637) but showed less utility when compared to other tests for establishing the severity in OSA.

Conclusions: The diagnosis of moderate-severe OSA was presented in patients between 24 and 89 y.o with parasomnias and overweight. Due to the poor likelihood ratio of the scales as useful tools for pre-test diagnosis of OSA, the inclusion of other anthropometric measurements in a local mathematical model may improve the discriminative capacity of those questionnaires particularly STOP-Bang.

ORAL BREATHING IN CHILDREN AND ITS ASSOCIATION WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The influence of mouth breathing on development of the dentition and dento-facial deformities is a problem causes concerns among the medical specialists. Mouth breathing has a major impact on the development of the maxillo-facial region, occlusion and muscle tonus. Both - nose and mouth breathing provide lungs with oxygen but with extremely disparate effects on the body and different levels of oxygen supply.
Aim: The aim of this study is to assess the relationship between mouth breathing children and obstructive sleep apnea.
Material and methods: For this article, data is obtained from 30 medical, literary sources.
Results: Mouth breathing has been linked to oral conditions such as dental caries, secondary halitosis, craniofacial deformity and malocclusion, as well as abnormal swallowing. It is also related to medical conditions such as altered head, neck and body posture, obstructive sleep apnea and asthma.
Conclusion: The habitual mouth breathing is a great medical problem nowadays. Although the relationship between mouth breathing and oral and medical conditions seems well established, it is difficult to assess in all cases the cause-effect link. More studies are needed to explore a causal relationship.

Sleep Breathing Disorders
Board #205 : Poster session 2

DETERMINING THE DEGREE OF NASAL OBSTRUCTION IN CHILDREN WITH DIFFICULT NASAL BREATHING IN PRIMARY AND MIXED DENTITION

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Introduction: Difficult nasal breathing is the condition where there is a partial or full, temporary or permanent obstruction of the airway and the processes of inhalation and exhalation are carried out through the mouth. Where there is no morphological or anatomical reason for the occurrence of mouth breathing, it is defined as a harmful habit.

Aim: The aim of this article is to determine the degree of nasal obstruction in children diagnosed with difficult nasal breathing in primary and mixed dentition.

Material and methods: For the purposes of this article 412 children between the ages of 3 and 12 were studied. All of the studied children were examined by the same doctor of dental medicine, and were consulted and diagnosed by an ear-nose-throat specialist as well. Acoustic rhinometry and rhinomanometry were used of nasal obstruction. We used the methods of acoustic rhinometry and rhinomanometry and the nasal resistance was reported in the following obstruction classes:

- Class 1 (VR < = 0.75, Flow> 500 Pa) - very low (missing) degree of obstruction
- first degree of obstruction, Class 2 (VR = 0.75-1.00, Flow = 300-500 Pa)
- the second degree of obstruction, Class 3 (VR = 1.00-1.25, Flow = 180-300 Pa)
- third degree of obstruction, Class 4 (VR = 1.25-1.50, Flow = 60-180 Pa)
- fourth degree of obstruction, Class 5 (VR> 1.50, Flow < 60 Pa).

Results: In deciduous dentition the children with first degree of obstruction predominate (54,50%), followed by those with third degree (38,20%). In early mixed dentition the percentage distribution of second and third degree of obstruction is the same (45,70%). In late mixed dentition the greatest number is comprised of the children with first degree of obstruction (57,00%), followed by those with second degree.

Conclusion: Our results show that of all the children with difficult nasal breathing 99 (24,00%) have first degree of nasal obstruction, 162 (39,30%) have second degree, followed by 151 children (36,70%) with third degree.

Sleep Breathing Disorders
Board #293 : Poster session 3
CPAP THERAPY IS NOT NEEDED IN EVERY OBESE SLEEP APNEA PATIENT AWAITING BARIATRIC SURGERY: RESULTS OF A 1103 PATIENTS COHORT STUDY

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Introduction: Due to a higher risk of postoperative complications in obstructive sleep apnea (OSA) patients, a systematic screening of OSA is recommended for patients undergoing bariatric surgery. We developed an algorithm based on results of nocturnal oximetry and capillary gas to identify patients who should or not be treated with continuous positive airway pressure (CPAP) before surgery. According to this algorithm, no treatment is prescribed to patients whose 3 % Oxygen desaturation index (ODI) < 25 /h, recording time below 90% SaO2 < 10 % and PaCO2 < 45 mmHg at rest. The objective was to determine the safety of our algorithm by comparing peri and post-operative outcomes in patients without/mild OSA (ODI < 10 /h: controls), patients with presumed moderate OSA not receiving pre-operative treatment (ODI 10-24 /h: OSA untreated) and patients with severe OSA receiving pre-operative treatment (ODI >25/h: OSA treated) with no feature of hypoventilation in any of these patients.

Material and methods: This is a prospective cohort study conducted from 2014/01/01 to 2018/07/01. We collected data from 1103 subjects undergoing bariatric surgery (sleeve gastrectomy or bypass surgery) (448 controls; 357 OSA untreated and 298 OSA treated). For OSA treated patients, a good CPAP compliance was mandatory for surgery and CPAP was installed immediately after extubation and continued after. Peri and post-operative outcomes were compared according to apnea status with adjustment for the type of surgery.

Results: OSA treated patients were significantly older than controls and OSA untreated patients (49.7 ±10.7; 39.4 ±10.5 and 44.9 ±10.9 years respectively, mean ± SD, p< 0.0001) with a higher BMI (49.5 ±8.9; 45.7 ±6.6 and 47.6 ±7.4 Kg.m^{-2}, p< 0.001) and higher % of men (41.6%; 8.0% and 20.5%, p< 0.001). Hypertension and diabetes were significantly more prevalent in treated and untreated OSA than in controls. There was no difference in the repartition in laparoscopic sleeve gastrectomy and biliopancreatic derivation between the 3 groups.

No statistical difference was found between the 3 groups regarding occurrence of 10 days reoperation, 30 days rehospitalisation and cardiopulmonary complications except a higher occurrence of cardiac arrhythmia in the OSA treated patients than in the controls and the OSA untreated patients (2.7%; 0.4% and 0.6%, p = 0.01). OSA treated patients had a longer length of stay in the recovery room (1.7 ± 0.5; 1.5 ± 0.5 and 1.5 ± 0.5 hours p< 0.0001) and slightly longer length of hospital stay (2.8 ± 1.7; 2.6 ±2.1 and 2.6 ±1.8 days, p=0.01) than controls and OSA untreated patients.

Conclusions: Our results demonstrate that there is no increase in risk of complications following bariatric surgery not treating OSA patients with mild/moderate risk of severe sleep apnea and hypoventilation. Patients with severe OSA, even when correctly treated remain at higher risk of complications probably because of their comorbities, higher age and gender. Our algorithm safely selects patients who don't need CPAP treatment before surgery, allowing a more time and cost-effective management of patients awaiting bariatric surgery.

Sleep Breathing Disorders
Board #289 : Poster session 1
CONCOMITANT BENZODIAZEPINE USE WITH OPIOIDS DECREASES THE RISK OF SLEEP APNEA IN CHRONIC PAIN PATIENTS ON OPIOID THERAPY

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Introduction: The concomitant use of centrally acting drugs such as sedatives and hypnotics by opioid patients is contraindicated due to concerns of compromised breathing resulting in an increase in sleep apnea risk. Centrally acting drugs such as benzodiazepines, zopiclone, antidepressants, gabapentin, pregabalin, and muscle relaxants are commonly co-prescribed with opioids, and the magnitude of their effects on sleep apnea associated with opioid use has not been well characterized. This study aimed to assess the effects of concomitant centrally acting drugs + opioids on sleep apnea, versus sole opioid use in chronic pain patients. We hypothesize that the combined use of centrally acting drugs + opioids would augment sleep apnea risk in chronic pain patients.

Materials and methods: This study is a prospective cohort trial conducted at five Canadian chronic pain clinics (Op-Safe Trial). The effect of opioids on sleep apnea in chronic pain patients on opioid therapy was analyzed. Participant underwent an in-laboratory polysomnography and their daily morphine milligram equivalents (MME) were calculated. Participants were then grouped into centrally acting drug categories + opioids and compared to sole opioid users. Regression and multivariable logistic regression was used, adjusted for demographics, comorbidities and other confounding variables. The primary outcome measure was the apnea-hypopnea index (AHI ≥5 events per hr).

Results: Of the 332 consented participants, 204 underwent polysomnography and 120 (58.8%) had sleep apnea (72% obstructive, 20% central, and 8% indeterminate sleep apnea). The average age of participants was 52(SD 13.1) years with average body mass index (BMI) 28.6 kg/m^2(SD 6.4) and 41% were male. Seventy-one (35%) were taking opioids alone, and 133 (65%) were taking opioids + centrally acting drugs. The median (IQR) MME for sole opioid users versus opioids + concomitant centrally acting drugs were 72 (22,135) mg/day and 68.8 (30,180) mg/day respectively. No significant difference in demographics was found amongst the two groups. There was a 68% decrease in the odds of having sleep apnea (AHI ≥5 events/h) in participants taking concomitant opioids + benzodiazepine versus sole opioid users, after adjustment for confounding variables (OR 0.324, 95%CI: 0.12-0.87, P= 0.026). Age (OR 1.06, 95%CI: 1.0-1.1, P< 0.001), BMI (OR 1.09, 95%CI: 0.9-3.4, P=0.002) and MME (OR 2.23, 95%CI: 1.2-4.1, P=0.012) were associated with increased prevalence of sleep apnea. Additionally, concomitant opioids + benzodiazepine versus sole opioid use was associated with a decrease in the respiratory arousal index scores, after adjusting for confounding variables (P= 0.020). Concomitant use of other centrally acting drugs with opioids showed no effect on the prevalence of sleep apnea.

Conclusions: Administration of certain benzodiazepine sedatives may reduce sleep apnea risk in chronic pain patients. While the mechanisms require further investigation, improvements in breathing stability during sleep with sedative use in this population may be mediated via an increase in the respiratory arousal threshold.

Sleep Breathing Disorders
Board #294 : Poster session 3

A COMPARISON OF A WRIST WORN PORTABLE DEVICE (WATCHPAT)™ WITH IN-LAB POLYSOMNOGRAPHY FOR THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Overnight in-lab technician attended polysomnography (PSG) is the gold standard method for the diagnosis of OSA. However, long waiting period results in the delay in diagnosis and therapy leading to significant morbidity. For the diagnosis of sleep apnea, newer portable device (WatchPAT™) is available which is based upon peripheral arterial tonometry rather than conventional flow sensor-based technology. This device has not been well studied in Indian subjects.

Materials and methods: The aim of the study was to assess the correlation of apnea hypopnea index (AHI) measured using WatchPAT™ and in-lab polysomnography and to estimate the sensitivity and specificity of WatchPAT™ for the diagnosis of moderate to severe obstructive sleep apnea. We prospectively evaluated the diagnostic performance of wrist worn portable sleep study device, the WatchPAT 200™, which is a combination of oximetry, actigraphy and peripheral arterial tonometry. Patients with suspected OSA underwent simultaneous in-lab level 1 diagnostic polysomnography and WatchPAT™ testing. The results from both the modalities were compared. The PSG scorer was blinded to the result of the WatchPAT™ study.

Results: Thirty patients (23 males and 7 females) were studied and had a mean (SD) age of 49.10 (12.97) years. The mean (SD) body mass index of study subjects was 31.91 (5.8) kg/m^2. Twenty one out of 30 patients were found to have moderate to severe OSA by polysomnography (AHI $\geq$ 15). The mean WatchPAT™ sleep efficiency was 78.13% (12.32), whereas the mean PSG sleep efficiency was 78.56% (18) (r = 0.31, p=0.09). There was a strong correlation (r=0.93, p< 0.001) between the mean WatchPAT™ AHI (37.97± 27.51 events/hour) and the mean PSG AHI (29.68± 23.58 events/hr). A strong correlation (r=0.94, p< 0.001) between the mean WatchPAT™ oximetry desaturation index (ODI) (29.63± 28.60 events/hour) and the mean PSG ODI (34.37 ± 33.76 events/hr) was also found.For the diagnosis of moderate to severe OSA (AHI $\geq$ 15), the sensitivity as well as specificity of WatchPAT™ were 100%. The sensitivity and specificity of WatchPAT™ for the diagnosis of OSA (AHI $\geq$ 5) were 100% and 66.67% respectively. The sensitivity and specificity of WatchPAT™ for the diagnosis of severe OSA (AHI $\geq$ 30) were 91.6% and 72.2% respectively.

Conclusions: WatchPAT™ is a useful portable diagnostic device for the diagnosis of obstructive sleep apnea especially for moderate to severe disease.

Sleep Breathing Disorders
Board #290 : Poster session 1
INVESTIGATING THE ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNOEA AND ORGAN DAMAGE: A LITERATURE REVIEW

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Introduction: Many studies and reviews have reported links between obstructive sleep apnoea (OSA) and different medical conditions, but a comprehensive review that summarises OSA's effect on specific organs is lacking. The primary aim of this project was to review the literature examining the association between OSA and common diseases in different organ systems, and to assess whether continuous positive airway pressure (CPAP) ameliorates these effects.

Materials and methods: PubMed, Google Scholar and Scopus were searched in September 2017, and November 2018 to March 2019, using appropriate medical subject headings and text words to capture reviews, observational, randomised-control and meta-analysis studies examining the associations, clinical outcomes and effects of CPAP on OSA and conditions of the heart, lungs, eyes and kidneys. Eligibility criteria included: English, peer-review, full text.

Results: Of the 550 articles reviewed, 100 were selected for their robustness to synthesize this article. OSA is an independent risk factor for a range of diseases of the heart, lungs, kidneys and eyes. In turn, the presence of these conditions is associated with an increased risk and prevalence of OSA. Certain conditions have a strong prevalence of OSA and vice versa, including atrial fibrillation (49%), stroke (43-91%), hypertension (30-40%), resistant hypertension (82%), coronary artery disease (30-58%), idiopathic pulmonary fibrosis (85-88%), chronic kidney disease (40-60%), floppy eyelid syndrome (96%), and non-arteritic ischemic optic neuropathy (75%). Certain conditions of the eye and lung had a paucity of trials. The underlying cause of system-wide damage is thought to be nocturnal hypoxemia, duration of sleep spent under $SpO_2 < 90\%$ and the associated cardiovascular stress response. OSA was associated with more exacerbations, morbidity, poorer quality of life and increased medical costs. A number of studies reported that in the presence of OSA, CPAP significantly alleviated the severity of many of these co-morbidities, and enhanced response to treatment. In addition, the use of CPAP in early OSA reduced the incidence of subsequent comorbid conditions in all organs.

Conclusions: The review highlights the bi-directional relationship and knowledge gaps that exist between OSA and a range of conditions across organ systems. Given the far-reaching consequences of OSA, physicians should consider the possibility of comorbid OSA in these diseases, even if patients lack the typical risk profile for OSA (e.g., snoring, overweight and excessive daytime sleepiness), as CPAP treatment has the potential to benefit both OSA and the associated co-morbidities, while also preventing the incidence of excess comorbidities consequently.

EXAMINING THE PREVALENCE OF OBSTRUCTIVE SLEEP APNOEA IN A CARDIOLOGY OUTPATIENT CLINIC POPULATION AND TOWARDS A BETTER SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNOEA IN CARDIOLOGY PATIENTS

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Introduction: Obstructive Sleep Apnoea (OSA) is a common and largely underdiagnosed sleep disorder. OSA is estimated to be prevalent in over fifty percent of cardiac patients, and OSA patients also have higher rates of cardiovascular disease than the general population. For example, nearly half of patients with atrial fibrillation and systemic hypertension have OSA and vice versa. Some cardiac conditions like resistant hypertension have a very high prevalence of OSA (85-88%) while nocturnal cardiac events such as heart attacks and sudden cardiac death are more like to be comorbid in OSA patients. However, in cardiology patients it is commonly observed that screening tools such as the STOP-Bang questionnaire (SBQ) lack specificity in predicting OSA and produce many false positives including false negatives. Efficient detection of those at high risk of OSA is especially crucial in this population where the risks of morbidity, mortality and poor quality of life are high. The current study aims to examine the prevalence of risk factors for OSA in a cardiac population, and to develop a screening tool for OSA that is more specific and sensitive than the SBQ. The predictions of the tool will be compared to OSA diagnosis as confirmed with polysomnography.

Materials and methods: Sequentially recruited patients presenting to an Australian cardiology outpatient department completed the SBQ, the Epworth Sleepiness Scale (ESS), Functional Outcomes of Sleep Questionnaire 10, a newly developed cardiac-specific screening tool, Mallampati score and observational eye assessment. Prevalence of OSA based on the SBQ (answered "yes" to 4 or more items) will be estimated with the present data. Furthermore, items in each screening tool will be examined to determine whether they are correlated with the confirmed OSA diagnosis, presenting with high specificity and sensitivity.

Results: To date, 98 cardiac patients have been screened (mean age= 66.0 ± 12.2; 73 males). Of the five patients with a prior diagnosis of OSA only two were compliant with CPAP. Seventy participants (71%) had a high risk of OSA based on their SBQ results and were subsequently referred for clinical investigation. Validation of the new cardiac-specific OSA questionnaire is ongoing.

Conclusions: A large proportion of cardiology patients are at high risk for OSA. Results of this study have the potential to provide a better screening tool for cardiac patients with undiagnosed OSA - with higher sensitivity and specificity producing more true positives. Better screening for cardiology patients is critical to ensure accurate and timely diagnosis and treatment of their sleep disorder and cardiac condition, to reduce its impact on their cardiovascular symptoms. It will also raise awareness among cardiologists to reflexively consider the possibility of comorbid OSA in all presentations of cardiac diseases, especially the highly correlated cases, even when patients lack the typical risk profile for OSA (e.g. snoring, overweight and excessive daytime sleepiness).

INSOMNIA SEVERITY AND DEPRESSION AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive Sleep Apnea (OSA) and Insomnia are two common sleep disorders. More than 40% of patients with OSA reported at least one insomnia symptom. Coexistence of OSA and insomnia will result in lower sleep quality, lower quality of life and lesser compliance to continuous Positive Airway Pressure (CPAP) therapy as the first line treatment for OSA. In this study we aimed to evaluate insomnia prevalence and its severity in Iranian sleep clinic patients who were suspicious to OSA.

Materials and methods: This cross-sectional study was conducted among 1771 participants referred to sleep clinic located in Baharloo hospital, Tehran, Iran from 2012 to 2018.Insomnia Severity Index (ISI) and Beck Depression Inventory (BDI- II) questionnaires were filled out by the sleep clinic patients who were suspicious to OSA. All the participants underwent one-night Polysomnography.

Results: In current study, of 1771 subjects, 1242 (68%) were male. The mean age of patients was 47.18 ±13.65. Patients had mean RDI of 41.53 ± 31.98, mean ISI of 12.11 ± 5.99 and mean BDI score of and 12.88 ± 11.22. Moderate and severe insomnia (ISI score≥15) was reported by 639(36%) patients. Subjects with normal RDI had mean ISI score of 13.71±6.32, and patients with mild, moderate and severe OSA reported mean ISI scores of 12.76±5.96, 11.61±5.92 and 11.91±5.95, respectively (P value:0.001). The correlation between RDI and ISI score was 0.006 (P value: 0.8).

Conclusions: Evaluation of insomnia and depression in patients with OSA is recommended. There may be an association between respiratory parameters of PSG and symptoms of insomnia among patients with OSA.

Sleep Breathing Disorders
Board #295 : Poster session 3

EVALUATING PATIENT PREFERENCE FOR TREATMENT OF POSITIONAL OSA IN A CROSSOVER RANDOMIZED CONTROLLED TRIAL: CPAP VERSUS A POSITIONAL THERAPY DEVICE

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Introduction: Obstructive sleep apnea (OSA) is a common disorder associated with cardiovascular risks and daytime sleepiness that impair function and quality of life. However, the gold standard treatment with continuous positive airway pressure (CPAP) receives poor patient treatment acceptance and adherence. Up to 75% of Asian OSA patients have 'positional OSA' (POSA) where breathing abnormalities are reduced in a non-supine sleeping position. For these patients, positional therapy (PT), the avoidance of supine sleep, is an attractive strategy. Recently, convenient and more affordable PT devices have been invented and preliminary studies suggest they are efficacious with high treatment adherence. However, there is no available published data from randomized controlled trials evaluating patient treatment preference between CPAP and the new PT devices.
Methods: 41 untreated POSA patients with significant daytime sleepiness (Epworth sleepiness scale (ESS) 10 to 16) were recruited in a 17-week crossover randomized controlled trial. They were randomized into one of the intervention arms (CPAP then PT, or PT then CPAP). Each patient crossed-over to the alternative intervention after 8 weeks with a 1-week washout period. The CPAP device used was Airsense 10 (Resmed, San Diego CA, USA), in the automated mode. PT was a small device (Night Shift, Advanced Brain Monitoring, Carlbad CA, USA) worn at the back of the neck. When a supine position is detected, it vibrates with increasing intensity till the patient changes to a non-supine position. Patient treatment preference was obtained with questionnaires at the end of trial participation.
Results: 40 patients completed the trial. 72.5% were males, mean age was 44.0 ± 11.2 years, mean BMI: 26.1 ± 3.3 kg/m^2, mean ESS: 12.1 ± 2.6 and ethnicity was predominantly Chinese (72.9%). 60% of patients preferred CPAP, 20% preferred PT, while 20% preferred neither device. Of the 8 patients who preferred PT, device user friendliness and ease of operation was the top reason for preference (75%). Of the 24 patients who preferred CPAP, being able to obtain a better night's rest and feeling more energized in the day was the main reason (75%). For the 8 patients who preferred neither treatment, device discomfort was the predominant reason (75%). 45% (18/40) of patients expressed satisfaction with CPAP but not PT whereas 17.5% (7/40) of patients were satisfied with PT but not CPAP (p = 0.043). 7.5% (3/40) of them were satisfied with neither of the devices.
Conclusion: For sleepy POSA patients, CPAP was the preferred treatment due to greater improvements in subjective symptoms. However, there remained a proportion of POSA patients who preferred PT in part due to its user friendliness, which may impact long term adherence. Of note, a fifth of patients preferred neither modality, reflecting ongoing treatment challenges. Hence, more research is required to identify POSA patients who would benefit from PT as first line treatment, and to improve comfort of both devices.

RESPIRATORY-PHASE IDENTIFICATION USING RESPIRATORY TRACHEAL SOUND AND MOVEMENT DURING SLEEP

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Introduction: One of the main respiratory signals to assess sleep apnea is airflow. The airflow is commonly measured using nasal cannula connected to a pressure sensor. However, during sleep nasal cannula is inconvenient and inaccurate due to the leakage of air. The alternative way of estimating airflow is through recording the tracheal sound using a more convenient and cost-effective portable device. To estimate airflow, it is essential to localize inspirations and expirations in tracheal sound signal. In this study, we developed the first automated algorithm for analyzing overnight tracheal sound and movement during sleep to identify respiratory phases.

Materials and Methods: Adult individuals aged 18 years or above with suspected sleep apnea who were referred to the sleep laboratory of Toronto Rehabilitation Institute were recruited for this study. Simultaneously with polysomnography (PSG), an embedded microphone and accelerometer attached to the suprasternal notch was used to record tracheal sounds and movements. First, an adaptive detection algorithm was developed to assess the energy of background noise sound and detect the onsets of respiratory phases in tracheal sound. The phase detection algorithm was validated based on the gold standard thoracoabdominal movements. Then, a set of morphological features including the negative of phase skewness, the width of each phase, phase falling slope, the ratio of area under the curve (AUC) of the last and first half of a phase, and the ratio of AUC of last and first third of a phase were extracted from each phase. Finally, using the morphological features combined with falling/rising pattern of tracheal movement, the detected phases were automatically classified into inspirations or expirations. The morphological features during different respiratory phases were compared using unpaired t-test or Wilcoxon signed-rank test. The proposed algorithm for respiratory phase detection was validated against the gold standard nasal pressure during normal breathing, snoring and respiratory events.

Results: Sixty-three subjects, 31 females, age: 51 ± 15 years, BMI: 29.0 ± 5.5kg/m^2, and AHI: 12.55 (0.6 -86.1) were included. Compared to expiration, all the morphological features were significantly higher ($p < 0.01$) during inspiration. The respiratory phases were detected by average error and time delay of 7.62% and 181 ms during normal breathing, 8.95% and 194 ms during snoring and 13.19% and 220 ms during respiratory events, respectively. The classification accuracy was 83.7 ± 7.5% for inspiration and 75.0 ± 8.3% for expiration.

Conclusion: These results show that inspirations and expirations can be localized and identified using sound energy and respiratory related movements recorded over the trachea. By recording tracheal sounds and movements, a more accurate and convenient portable device can be developed to estimate respiratory airflow. The device can have extensive applications such as home-based sleep apnea monitoring, or monitoring respiratory parameters during exercise assessment.

IS CATATHRENIA SLEEP RELATED BREATHING DISORDERS? - PSG FINDINGS AND RESPIRATORY AROUSAL THRESHOLD

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Introduction: Catathrenia is characterized by episodes of expiratory monotonous vocalizationduring sleep. Although catathrenia had been classified as a parasomnia in the International Classification of Sleep Disorders (ICSD) 2nd edition, catathrenia was re-classified as one of normal variants in sleep-related breathing disorders (SRBD) in the ICSD 3rd edition. The pathophysiology remains unclear until now.Recently, SRBD is reported that caused by not only an impaired upper airway anatomy, but also by several non-anatomical factors. The aim of this study is to clarify the pathophysiology of catathrenia from the point of view of SRBD.

Methods: The subjects were consecutive 23,052 patients who presented with sleep and/or wake problems at our sleep center between April 1998 and October 2014. Diagnosis of catathrenia was made based on ICSD-2 criteria. We analyzed the video-polysomnography (PSG) characteristics of catathrenia patients with special emphasis on sleep stages that nocturnal groaning (NG) appears, temporal relationship between NG and EEG arousal, and respiratory events.

Results: A total of 47 cases (0.20%) were diagnosed as catathrenia. Thirty-three of 47 cases who presented episodes of NG on video-PSG were studied. The mean age at presentation in 33 patients (17 men and 16 women) was 40.0 ± 14.8 years. In 7 of 33 cases (21.2%), NG was exclusively or predominantly observed during REM sleep (REM sleep cluster group), but the other showed groaning regardless of sleep stage (sleep stage-independent group). Patients who were classified into REM sleep cluster group were all women and younger than subjects with sleep stage-independent group. Apnea hypopnea index (AHI) inREM sleep cluster groupwas 6.1 ± 9.3/hr (REM AHI 15.5 ± 17.4/hr , NREM AHI 4.0 ± 4.5/hr) and AHI in sleep stage-independent group was 18.9 ± 23.1/hr (REM AHI 17.5 ± 21.1, NREM AHI 18.9 ± 24.2/hr).We investigated estimated values of arousal threshold (REM sleep cluster group -12.3 ± 1.9 cmH$_2$O, sleep stage-independent group -13.0 ± 8.3 cmH$_2$O). Proportion of REM-related OSA in two groups was no significant difference. REM AHI/ NREM AHI values showed higher in REM sleep cluster group and about 60% of NG events appeared post arousal.

Conclusion: We could classify catathrenia patients into two groups based on sleep stages that NG occurred during video-PSG. Patients with REM sleep cluster group have obvious similarities with patients with REM-related OSA (female, younger, and milder OSA), and arousal threshold calculated was not different between REM sleep cluster group and sleep stage-independent group. It is necessary to consider that patients of REM sleep cluster group may shift to sleep stage-independentgroup in the future. On the other hand, most of NG events occurred post arousal in both groups. Instability of breathy may be also involved in the pathophysiology of catathrenia during the transition from awakening to sleep. More data is needed to clarify the pathophysiology of catathrenia.

COMORBIDITIES OF OBSTRUCTIVE SLEEP APNEA IN A LARGE ACADEMIC HEALTH CENTER

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Introduction: Obstructive sleep apnea (OSA) is one of the most prevalent sleep disorders. OSA is characterized by repeated breaks in breathing during sleep caused by relaxation of muscles in the throat. This blocks the airway and causes problems with continuous breathing. It is associated with significant morbidity, and early recognition and management can have a profound impact on quality of life.

Materials and methods: The Leaf research database was used to obtain retrospective data for all patients with ICD-9 or ICD-10 code diagnosis for obstructive sleep apnea (using ICD 9 - 327.23 and ICD 10 G47.33) at the University of Washington. The correlations between OSA and associated comorbidities were analyzed. Sub-analysis for pharmacotheraphy and other treatment was performed.

Results: Obstructive sleep apnea was diagnosed in n = 61814 patients. We analyzed comorbidities of OSA. These included: obesity (44.3%, n = 27406), hyperlipidemia (41.7%, n = 25803), depression (36.8%, n = 22725), respiratory abnormalities (33.2%, n = 20508), fatigue (31.3%, n = 19341), diabetes (30.0%, n = 18550), anxiety (30.0%, n = 18550), tobacco/nicotine (14.8%, n = 9147), kidney-related diseases (12.7%, n = 7844), fibromyalgia (10.6%, n = 6531), circulatory disorders (8.2%, n = 5078), episodic migraine (8.2%, n = 5059), stroke (5.5%, n = 3430), seizures (4.4%, n = 2742), alcohol disorders (4.3%, n = 2668), and cannabis disorders (3.9%, n = 2401). Significant proportion of patients had comorbid hypertension (58.6%, n = 36243). 30.5% of OSA patients had commercial insurance. 28.6% were fully employed, 27.5% were unemployed, and 23.3% were retired.

Conclusions: Patients diagnosed with OSA have a significant co-morbidity burden, having high rates of metabolic syndrome, depression and anxiety, and substance use disorders. These comorbidites are likely mutually reinforcing, and operate by a multidirectional mechanism. Causal relationships with and between these comorbidities have yet to be identified, and are likely complex. OSA patients have a lower rate of employment compared to the general population, demonstrating the functional impact of the disorder.

SLEEP AND ATTENTION IN YOUTH WITH SLEEP DISORDERED BREATHING

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Introduction: Neurobehavioral problems are some of the most frequently reported consequences of sleep disordered breathing in children. Although some deficits may be related to hypoxemia, the prevalence of similar impairments in children with primary snoring, who do not have gas exchange abnormalities, indicates that alterations in sleep also likely play a role. However, a number of studies have found only minimal differences between sleep macrostructure in children with OSA and healthy controls. Thus, while sleep disturbance is a feature of the disorder, current technologies have failed to significantly advance our understanding of how sleep quality may differ in children with OSA or to explain how changes in sleep may impact daytime neurobehavioral performance.

Methods: Overnight high-density electroencephalography (hdEEG, 256 channels) was recorded in eight children with OSA (age: M = 8.29, SD = 2.28; 10 female; AHI: M= 11.63, SD = 7.85), and 8 age and sex-matched healthy controls (age: M = 8.31, SD =2.38; AHI: M = 1.56, SD = .82). Attentional capacity was assessed using the Test of Variables of Attention (TOVA) before and after sleep. All-night spectral analysis was performed for NREM sleep and averaged across group. Topographic differences in spectral density for SWA/delta: 1-4Hz; theta: 4-8 Hz; alpha: 8-12 Hz; sigma: 12-15 Hz; beta: 15-25 Hz; and low gamma: 25-40 Hz) were assessed using statistical non-parametric mapping. Sleep macrostructure and TOVA variables were assessed using between groups ANOVA.

Results: Total sleep time (minutes), wake-after-sleep-onset (minutes), and percentage of time spent in N1, N2, and N3 did not differ between participants with OSA and controls. A significant global increase in high-frequency activity, particularly in the alpha band (8-12 Hz) was observed in children with OSA relative to control children. This relative increase in high-frequency was evident in the first hour of sleep and all night, and was present when considering only stage N3. Group comparisons of topographical alpha power also revealed a broadly distributed increase in OSA youth relative to healthy control children. Alpha topography was robustly correlated with AHI, but was not related to TOVA performance.

Conclusion: Alpha activity is the quintessential marker of the transition into sleep (stage N1), and alpha is prominent in a number of disorders involving sleep pathology, including insomnia. Although the presence of elevated alpha during NREM is thought to indicate impending arousal or transition to wakefulness, it is unclear whether the presence of alpha activity is sufficient to produce nonrestorative sleep. In this small sample of youth, increased alpha is associated with AHI, but it does not predict performance on an attentional task sensitive to the effects of impaired sleep.

SLEEP-DISORDERED BREATHING ASSESSED BY HOLTER-MONITORING IS ASSOCIATED TO WORSENED ONE-YEAR CLINICAL OUTCOMES IN ISCHEMIC STROKE PATIENTS: A CARDIOPULMONARY COUPLING ANALYSIS

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Introduction: Sleep-disorder breathing (SDB) using polysomnography is closely associated to poor functional and clinical outcomes in ischemic stroke patients. The cardiopulmonary coupling analysis using Holter-monitoring (CPC-Holter analysis) is an emerging feasible modality to investigate SDB. We investigated the association between SDB defined by CPC-Holter analysis and one-year clinical outcome in patients with acute ischemic stroke.
Materials and methods: A total 666 patients with acute ischemic stroke who underwent Holter-monitoring were enrolled. The CPC-Holter analysis was conducted and SDB was defined as the presence of narrow-band (NB) coupling during sleep time. Primary outcome was recurrent ischemic stroke, and secondary outcome was major adverse cerebrovascular event (MACE), a composite of recurrent ischemic stroke, transient ischemic attack, and all-cause mortality within one year since discharge.
Results: The NB coupling was present in 205 (30.8%) of 666 patients with mean age of 64.1 ± 12.8 years. The NB group showed significantly higher incidence of both recurrent ischemic stroke (8.3% vs. 1.4%, $p< 0.001$) and MACE (14.9% vs. 3.0%, $p< 0.001$) within one-year. In multivariate analysis, NB coupling remained as an independent predictor for both recurrent ischemic stroke and MACE (HR: 4.81; 95% CI: 1.73-13.4; $p=0.003$; and HR 4.17; 95% CI: 1.74-10.0; $p< 0.001$, respectively). The results were consistent after propensity-score matched analysis with 164 patient pairs (C-statistics=0.757).
Conclusions: The SDB assessed by CPC-Holter analysis at early phase of ischemic stroke is a powerful prognostic marker for predicting one-year adverse clinical outcomes. The CPC analysis using Holter-monitoring can be a useful and easily assessable modality for predicting clinical outcomes in acute ischemic stroke.
Acknowledgements: none

Sleep Breathing Disorders
Board #210 : Poster session 3

IMPACT OF OBSTRUCTIVE SLEEP APNEA ON CEREBROVASCULAR HEALTH AS MEASURED BY MRI IN OBESE CHILDREN

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Introduction: There is a high prevalence of OSA in youth with obesity. It is recognized that OSA is associated with neurocognitive morbidity although the mechanisms of this association are not well understood. However, it is hypothesized that intermittent hypoxia related to OSA and subsequent oxidative stress may lead to damage of endothelial cells, increase cerebral blood and disrupt the vasodilatory capacity of the cerebral circulation causing cerebrovascular dysfunction. Non-invasive MRI can measure cerebrovascular reactivity (CVR) and can serve as a tool to assess cerebrovascular health. The aim of this study was to measure CVR using MRI in these subjects with and without OSA. We hypothesized that CVR would be impaired in obese children with OSA compared to those without OSA.

Materials and methods: Obese subjects aged between 9 and 18 years of age were included. All subjects underwent a baseline polysomnography (PSG) to confirm presence of OSA. Subjects were classified as having no OSA (n=10, OAHI< 1.5), mild-OSA (n=9, 1.5≤OAHI≤5.0) or moderate-to-severe OSA (n=14, OAHI>5.0). Each patient was then imaged on a 3T MRI scanner using a 32-channel head coil. CVR data were acquired using a BOLD sequence during a computer-controlled administration of a vasoactive stimulus through a rebreathing mask. The stimulus paradigm alternated between 60 seconds of normocapnia ($PETCO_2$ = 40mmHg, $PETO_2$ = 100mmHg) and 45 seconds of hypercapnia ($PETCO_2$ = 45mmHg, $PETO_2$ = 100mmHg). Cerebral blood flow (CBF) was measured using arterial spin labelling. SPSS v23 was used to perform comparisons between OSA groups and Pearson correlation analysis on the resulting data.

Results: Patients in the moderate-to-severe OSA group had higher grey matter (GM) CBF measures compared to the no OSA and mild OSA groups (56.1, 50.4 and 50.9 mL/100g/min respectively, p< 0.05). CVR measures were similar across the no, mild and moderate-to-severe OSA groups (0.301, 0.273 and 0.285 %ΔMR/mmHg CO2, respectively). Higher CBF was inversely associated with CVR in obese patients with moderate-to-severe OSA for both GM and white matter (WM) (r=-0.331 and r=-0.590, respectively). Furthermore, in patients with moderate-to-severe OSA, a decline in CVR was observed for both GM and WM when plotted against the Obstructive Sleep Apnea Index (OAHI) (r=-0.297 and r=-0.508, respectively).

Discussion and conclusions: In this study, we have demonstrated higher CBF values in obese patients with moderate-to-severe OSA compared to those with no or mild OSA. Reduced CVR in children with obesity and moderate-to-severe OSA may lead to a higher risk of cerebrovascular damage. If left untreated, this may present behaviourally as neurocognitive deficits and serious vasculopathies such as stroke. Further studies are needed to confirm our results in a larger cohort and to assess the effectiveness of CPAP therapy to minimize cerebrovascular damage.

CONTINUOUS POSITIVE AIRWAY PRESSURE ADHERENCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Obstructive sleep apnea syndrome (OSAS) is a common sleep disorder with serious consequences. The best treatment for moderate to severe OSA is continuous positive airway pressure (CPAP), and is associated with reduced OSA-related adverse consequences. However, poor adherence to CPAP is still an important issue in these patients. This study aimed to evaluate CPAP adherence, and predisposing factors for poor adherence.
Materials and methods: In this longitudinal study, 120 patients with confirmed OSAS who underwent positive airway pressure titration study were enrolled. After at least six months of CPAP therapy, the subjects were evaluated for CPAP adherence.
Results: Of 120 participants, 40 (33.3%) used CPAP device for at least 4 hours per night in 70% of nights after at least 6 months of prescription (compliant subjects). Older age was associated with more CPAP adherence (54.3±11.3 vs. 49.3±12.0, P= 0.037). Patients with higher prescribed device pressure were less likely to use CPAP regularly (8.7±5.4 vs. 24.3±44.2, P= 0.049). Difficult breathing and discomfort with full-face mask were the most common reported problems by compliant patients.
Conclusions: Poor adherence to CPAP therapy is a serious issue in patients with OSAS. Older age and lower CPAPdevice pressure were associated with favorable adherence. More interventions should be evaluated for improving acceptance and adherence of CPAP therapy among the patients with OSAS.

OBSTRUCTIVE SLEEP APNEA AND DECREASED GLOMERULAR FILTRATION RATE AMONG COMMERCIAL DRIVERS

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Introduction: Chronic Kidney Diseases (CKDs) are remarkable due to the high cost of treatment for outcomes like Kidney transplant. However, CKD is an overlooked disorder among commercial drivers. Present study aimed to assess kidney function and sleep apnea among commercial drivers.

Materials and methods: In this cross-sectional study, a total of 903 commercial drivers referred for receiving their health licensee were recruited. After obtaining informed consent, a questionnaire consisted of demographic characteristics was completed. Blood pressure, level of lipid profile, blood sugar, blood urea nitrogen and plasma creatinine was measured for all study participants. STOP-BANG questionnaire was completed. Chi-square and independent student T test were used for data analysis.

Results: All participants were male. The mean (SD) of age and Body mass index were 42(10) years and 27(4) kg/m2, respectively. Of 903, 40(4%) had GFR< 60. Increased age and high blood pressure had significant association with reduced GFR (p-value < 0.0001). The ones with sleep apnea were more likely to have GFR< 60, however the association was not statistically significant after adjusting for related risk factors.

Conclusions: Older age and hypertension are considered the risk factors of CKD among commercial drivers. Obstructive sleep apnea also should be kept in mind as a possible risk factor that requires further investigation and management.

USING PREDICTION FORMULAS FOR CONTINUOUS POSITIVE AIRWAY PRESSURE IN OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Continuous positive airway pressure (CPAP) is a standard therapy for patients with moderate to severe obstructive sleep apnea (OSA). Increased demands for polysomnography (PSG) and CPAP titration have led to long waiting lists and high cost. CPAP prediction formulas derived from sleep and anthropometric parameters are used to set the initial CPAP level during CPAP titration. In the current study, we aimed to compare the pressure derived from prediction formulas with the pressure resulted from CPAP titration in a sample of Iranian patients.

Materials and methods: In this cross-sectional study, 90 subjects with confirmed OSA in a full PSG who underwent CPAP titration in Baharloo Sleep Clinic, Tehran, Iran, during 2017, were enrolled. All of the participants had Respiratory Disturbance Index (RDI) ≥ 15 in their PSG test. Then, the optimal pressure obtained from manual CPAP titration was compared with the one calculated by different prediction formulas for each patient.

Results: The mean CPAP pressure from manual titration was greater than the pressures calculated by four prediction formulas. The difference between mean CPAP pressure obtained by manual titration and pressures calculated by Hoffstein, Lin, and Hukins formulas was statistically significant, whereas mean CPAP pressure obtained by manual titration was not statistically different from Loredo formula (11.7 ± 2.6 vs. 11.0 ± 2.3, P = 0.110).

Conclusions: Estimation of optimal therapeutic pressure for CPAP device using several prediction formulas is very similar to pressure found during manual titration study. These formulas can be used in our setting for estimation of optimal CPAP pressure to save time and cost.

EFFECTIVENESS OF SCREENING QUESTIONNAIRES FOR OBSTRUCTIVE SLEEP APNEA IN AFRICAN AMERICANS

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Introduction: Numerous studies have evaluated the performance characteristics of the STOP-BANG, NoSAS, and Epworth Sleepiness Scale (ESS) in various populations. However, very limited data exists regarding the performance of the questionnaires as a screening too for OSA in African American patients and their reliability in this population is unclear. We evaluated the sensitivity and specificity of these tests for predicting a diagnosis of OSA in African American patients referred to a sleep medicine clinic.

Materials and methods: The study was done on African American patients who were referred to HUH sleep clinic for evaluation and treatment of suspected sleep apnea between April 2018 to June 2019. Patient medical records were reviewed for demographic information, body mass index, neck circumference, and medical history, including the presence of hypertension. presence of snoring, tiredness/sleepiness, observed apneas, and hypertension. Data were collected from 131 patients who subsequently underwent diagnostic sleep testing. Questionnaire data for each patient was converted to the STOP-Bang equivalent with an ordinal rating of 0 to 8 and NoSAS with an ordinal rating of 0 to 17. ESS answers were entered by patients. ROC curve was used to measure AUC.

Results: The mean age of the sample was 48 ± 15.4 years. In our patient population, 87.8% had snoring, 70.2% reported being tired, and the mean ESS was 9.9 ± 6.4. 66.9% had hypertension, 34.4% reported observed apnea. Sleep testing demonstrated that 80.8% had some levels of OSA with 33.1% demonstrating mild OSA, 17.7% moderate OSA, and 30% severe OSA.

In general, all questionnaires performed poorly with low sensitivity and specificity. STOP-BANG had a AUC of 0.723, NoSAS showed an AUC of 0.701, but was more predictive of OSA in male patients with any grade of OSA (AHI>5) with AUC=0.811. ESS was found to be especially poorly predictive with an AUC of 0.481.

Conclusions: In comparison with their performance in other studies, we find that these tests have lower predictive power in our African American sleep clinic population. If confirmed in a larger patient sample, these results would suggest that alternative screening methods with additional or different indicators may be needed to properly identify African Americans at risk for OSA.

ACUTE EFFECTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY ON THE ABNORMAL SYMPATHETIC NERVOUS ACTIVITIES AND HEART RATE VARIABILITY OF OSA PATIENTS ON THE CONSECUTIVE NIGHTS

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Introduction: Obstructive sleep apnea (OSA) is likely to develop lifestyle-related diseases and fatal events because OSA causes the abnormal sympathetic nervous activities, which can be improved through continuous positive airway pressure (CPAP) therapy. Long-term CPAP therapy can reduce the risks of lifestyle-related diseases in OSA patients to almost the same level as healthy people. In addition, even acute CPAP may improve the sympathetic nervous irregularity. However, only a few reports have assessed the effects of acute CPAP. The present work reports the effects of acute CPAP on the abnormal sympathetic and parasympathetic nervous activities by measuring the change of heart rate variability (HRV)features in OSA patients with CPAP, OSA patients without CPAP, and healthy people.
Materials and methods: HRV reflects the relationship between the sympathetic and the parasympathetic nervous functions, typical HRV features, SDNN, LF, and HF can be used for monitoring the cardiovascular conditions. SDNN is standard deviations of heartbeats. LF and HF are defined as the power of the low frequency band (0.04Hz - 0.15Hz) and the high frequency band (0.15Hz - 0.4Hz) in power spectrum density. OSA patients underwent polysomnography (PSG) on two consecutive nights. While the OSA patients did not use CPAP on the first night, they used CPAP on the second night. In addition, the full PSG data of healthy people were collected at the Shiga University of Medical Science hospital. To verify the effects of acute CPAP on the abnormal sympathetic and parasympathetic nervous activities, we evaluated the changes of SDNN, LF, and HF between OSA patients with CPAP, OSA patients without CPAP, and healthy people. Statistically significant differences were evaluated using non-parametric comparison methods, the Steel-dwass test, which is a multiple comparison rank sum test for the simultaneous comparison of all pairs.
Results: The results showed that SDNN, LF, and HF in the OSA patients decreased in comparison with the healthy people. In addition, SDNN, LF, and HF were significantly lower in the OSA patients with CPAP in comparison with those without CPAP. The differences in these HRV features changes were statistically significant($p < 0.05$, the Steel-dwass test).
Conclusions: The abnormal sympathetic and parasympathetic nervous activities can be improved by even acute CPAP. The significant differences in SDNN, LF, and HF in OSA patients with CPAP could be explained because pulmonary stretch receptors did not function well.

FRACTION OF APNEA IS THE ALTERNATIVE INDEX WHICH PARTIALLY REFLECT UPPER AIRWAY COLLAPSIBILITY IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a common disorder characterized by upper airway (UA) narrowing and collapse during sleep. Pharyngeal critical pressure (Pcrit) is the standard measurement to evaluate the collapsibility of UA on research base. However, because it is time-consuming and labor-demanding to measure Pcrit, the alternative way is needed clinically. Landry et al. (Sleep 2017) reported CPAP level was the predictor for Pcrit. And still, titration PSG is needed to estimate Pcrit. As apneas are assumed to be more collapsible than hypopneas, we hypothesize that the more apneas per respiratory events, the more severe collapsibility of UA. Therefore this study was done to see whether fraction of apnea (Fapnea) is the alternative index to reflect UA collapsibility.

Materials and methods: Patients with AHI > 20/h who underwent titration study were recruited retrospectively. Patients with cardiovascular, psychiatric diseases, accompanying periodic leg movement index >15/hour, and those who took medication to affect sleep also were excluded. CPAP titration was done according to clinical guideline for the manual titration from AASM in 2008. Optimal CPAP was defined as the highest pressure obtained during REM sleep of the patients in the supine position in the titration PSG. Fapnea was defined as the percent of apneas over total apneas and hypopneas during REM sleep in the supine position in the diagnostic PSG. Data were 70/30 split randomly into development and validation data sets. In development data set, multiple linear regression was used to assess the association of variables including age, sex, BMI, REM supine AHI and Fapnea with the optimal CPAP level. And the correlation between the actual and the predicted CPAP levels was evaluated in the validation data set. A $p < 0.05$ was considered significant.

Results: One hundred sixty one patients (16 women, mean age 47.8 years, BMI 28.0 kg/m^2, AHI 46.4/h) were recruited. There were no differences of independent variables between development and validation datasets. BMI and Fapnea were the only significant factors to predict the optimal CPAP level (adjusted $r^2 = 0.28$, $p < 0.001$) in the development data set. An estimated formula was obtained as follow: CPAP level = $10^{0.0130*BMI+0.00138*Fapnea+0.442}$. Validation data set showed a significant correlation between the actual and the predicted CPAP levels ($r = 0.69$, $p< 0.0001$).

Conclusions: Our data showed that approximate 10% higher CPAP level was needed if Fapnea was 30% bigger. Fapnea was the significant factor to estimate CPAP level, which is the reflection of UA collapsibility, independently of BMI.

NOCTURNAL INTERMITTENT HYPOXIA AND STRUCTURAL BRAIN CHANGES: A POPULATION-BASED STUDY

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Introduction: Intermittent hypoxia in sleep has been associated with cardiovascular disease and metabolic comorbidities, as well as neuropsychiatric disorders and stroke. In this study, we aimed to evaluate the association between nocturnal intermittent hypoxia, by comparing the oxygen desaturation index (ODI), lowest oxygen saturation (LSaO2), percent time spent with oxygen saturation below 90%, number of events with desaturation below 90%, and structural brain changes in adults.

Materials and methods: A total of 2,812 participants of the Korean Genome and Epidemiology Study (mean age: 59.25 ± 6.88 years; 49.6% men), who underwent both in-home polysomnography and magnetic resonance image scanning, were cross-sectionally analyzed. We investigated the associations of nocturnal intermittent hypoxia with whole (WV) and gray matter volumes (GMV) in multi-regions using multivariate linear regression after adjustment for intracranial volume, age, sex, smoking status, hypertension and diabetes.

Results: The lowest $LSaO_2$ tertile (severe group) was significantly more associated with reduced WV and GMV in the cerebellum region (WV: β = -0.788 mL, p-value = 0.03; GMV: β = -0.954 mL, p-value = 0.003) and brain stem (β = -0.220 mL, p-value = 0.02) than the highest $LSaO_2$ tertile (normal group) after adjustment for cardiovascular risk factors. In addition, the upper ODI tertile (severe group) had a higher negative correlation with GMV in the cerebellum and brain stem than the lower ODI tertile (normal group) (all adjusted p-values < 0.05). Furthermore, the association between lower $LSaO_2$ and structural brain changes with higher ODI was stronger than participants without intermittent hypoxia (WV in cerebellum: β = -0.996 mL, p-value = 0.03; GMV in cerebellum: β = -1.255 mL, p-value = 0.001; brain stem: β = -0.268 mL, p-value = 0.02).

Conclusions: Intermittent hypoxia was independently associated with structural brain atrophy, especially whole and gray matter volumes in the cerebellum region and brain stem.

PREDICTORS OF SUBCLINICAL CORONARY ARTERY DISEASE IN PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNOEA: A SINGAPORE SLEEP CENTRE STUDY

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Introduction: Obstructive sleep apnoea (OSA) increases the risk of coronary artery disease (CAD) and its severity is associated with the extent of CAD. However, most studies were conducted on patients with symptoms of CAD. Hence, the association of OSA and subclinical CAD is not well described. This study aims to identify predictors of subclinical CAD in patients with severe OSA to identify high-risk patients who require coronary screening.
Methodology: Of 1189 patients diagnosed with severe OSA during overnight in-laboratory polysomnogram at a single tertiary institution from January 2016 to November 2018, retrospective chart reviews were performed on 182 patients without history and symptom of CAD who were newly referred to a Cardiologist in our institution for coronary screening. Severe OSA was defined as an apnoea-hypopnoea index of >=30 events/hour. Patients were reviewed by a Cardiologist within 1 year of their polysomnogram and the presence or absence of CAD was determined by a Cardiologist after various coronary investigations. Predictors of subclinical CAD were identified with univariable logistic regression and prediction performance was analysed using receiver operating characteristic (ROC) curve.
Results: Age (OR=1.05, 95% CI 1.01-1.09, p=0.011) and hyperlipidaemia (OR=2.74, 95% CI 1.18-6.75, p=0.022) were significant predictors of subclinical CAD.
Age >=54 had 74% sensitivity and 57% specificity of predicting subclinical CAD (area under ROC curve, AUC=65.4%) in all patients. In patients with hyperlipidaemia, age >=56 had 83% sensitivity and 52% specificity of predicting subclinical CAD (AUC=64.7%). In patients without hyperlipidaemia, age >=46 had 89% sensitivity and 43% specificity of predicting subclinical CAD (AUC=62%).
Prediction performance was better when age and hyperlipidaemia were included in a multivariable model (AUC=69%).
Conclusion: Severe OSA patients with older age and known hyperlipidaemia are more likely to have subclinical CAD. The risk of subclinical CAD increases by 5% per year increment of age. Patients with hyperlipidaemia are 1.74 times more likely to have subclinical CAD than those without hyperlipidaemia. Hence, these patients should be referred to a Cardiologist for coronary screening especially those who are >=54 years old.

ESTABLISHING A PREDICTIVE EQUATION FOR AUTO-ADJUSTING TITRATION IN OSAS PATIENTS USING ANATOMICAL AND POLYSOMNOGRAPHIC PARAMETERS

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Introduction: Although several equations have been developed to predict optimal pressure of CPAP (continuous positive airway pressure) therapy, they do not take anatomical factors into consideration. The aim of this study is to identify factors contributing to APAP titrated pressure using polysomnographic (PSG) parameters, the physical examination and cephalometric variables.

Method: A total of 187 adult patients with OSA who decided to use APAP between January 2010 and December 2017 were enrolled. They underwent auto-adjusting titration to determine the optimal pressure over 1 to 3 weeks. Pearson's correlation and univariate analysis were used to identify common factors between the auto-titrated pressure and baseline data (including anthropometry, polysomnography, physical examination and cephalometric variables). Multivariate regression analysis was used to develop a predictive equation for the APAP pressure. We performed external validation of the current equation for 48 patients from another tertiary hospital, and compared the predictive rate of our equation with the previous formula.

Result: The mean AHI of the study patients was 49.5±22.0. The mean auto-titrated 95th percentile pressure by APAP titration was 10.6±2.1 cmH2O. The univariate regression analysis showed that AHI, BMI, age, soft palate length (SPL), tonsil grade, and Epworth sleepiness scale were strongly correlated with the pressure. The derived predictive equation for this study was as follows: APAP pressure (cmH2O) = (BMI x 0.164) + (ESS x 0.054) + (tonsil grade x 0.44) + (arousal index x 0.016) + (SPL x 0.084) (R²=0.345, adjusted R²= 0.314). The success prediction rate of the current study equation was 77.1%, which was higher than Lin's equation (60.4%, p=0.049) and Wu's equation (68.7%, p=0.358).

Conclusion: This is the first study to establish an equation to predict APAP titration pressure that includes various anatomical parameters. We think that the predictive equation in this study can be helpful to determine the extent of initial APAP pressure.

EVALUATION OF PSYCHOMOTOR PERFORMANCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Respiratory disorders, especially snoring, are common problems during sleep. They Snoring results in neurobehavioral impairment due to hypoxia, increased sympathetic activity, increased nocturnal perspiration, as well as reduction in working memory, vigilance, and executive function. Regarding the importance of this issue, we performed his study to assess neurobehavioral impairment among snoring subjects.

Materials and methods: In this cross-sectional study, 65 consecutive subjects attending the snoring clinic in Baharloo Hospital, Tehran, Iran, underwent polysomnography under the same conditions. On the next day, after waking up and eating breakfast in a calm room with desired ventilation, the neurobehavioral tests were performed and the association with apnea hypopnea index (AHI) was assessed.

Results: Among the 65 patients, 43 (66.2%) had AHI scores higher than 15. In univariate analysis, the Benton, aiming, and simple reaction time (SRT) scores were not related to AHI scores (P>0.05); however, Santa Ana (P=0.001), digit-span (P=0.043), and digit-symbol (P=0.001) scores were significantly higher in those with AHI scores of 15 and lower. In multivariate analysis, the Santa Ana (P=0.001), digit-span (P=0.04), digit symbol (P=0.00), aiming (P=0.01), and SRT (P=0.00) scores were significantly better in those with AHI scores of 15 and less. No significant effect was observed in case of Benton test (P=0.47).

Conclusions: According to the obtained results, it may be concluded that neurobehavioral impairment is common among snorers and mainly the auditory memory is impaired in these subjects.

SEVERITY OF DESATURATIONS REFLECTS OBSTRUCTIVE SLEEP APNEA (OSA) RELATED DAYTIME SLEEPINESS BETTER THAN APNEA HYPOPNEA INDEX (AHI)

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Introduction: Previous studies assessing the effect of sleep apnea on daytime sleepiness have mainly focused on evaluating the effect of the number of arousals, apneas, hypopneas, or desaturations on subjective or objective daytime sleepiness. No previous studies have assessed the effect of the severity of individual apneas, hypopneas and related desaturations on objectively measured daytime sleepiness. The aim of this study was to investigate how the severity of apneas, hypopneas and related desaturations events is associated to excessive daytime sleepiness in patients with obstructive sleep apnea (OSA).
Materials and Methods: Multiple Sleep Latency Tests and polysomnographic recordings of 362 OSA patients were retrospectively analyzed and novel diagnostic parameters (e.g. Obstruction Severity and Desaturation Severity), incorporating severity of apneas, hypopneas and desaturations, were computed. Conventional statistical analysis and multivariate analyses were utilized to investigate connection of apnea-hypopnea index (AHI), oxygen desaturation index (ODI), conventional hypoxemia parameters and novel diagnostic parameters with mean daytime sleep latency
Results: In whole population, 10% increase in values of Desaturation Severity (risk ratio=2.01, $p < 0.001$), Obstruction Severity (risk ratio=2.18, $p < 0.001$) and time below 90% saturation ($t_{90\%}$) (risk ratio=2.05, $p < 0.001$) induced significantly higher risk of having mean daytime sleep latency ≤5 minutes compared to 10% increase in AHI (risk ratio=1.63, $p < 0.05$). In severe OSA, Desaturation Severity had significantly ($p < 0.02$) stronger negative correlation ($\rho = -0.489$, $p < 0.001$) with mean daytime sleep latency compared to AHI ($\rho = -0.402$, $p < 0.001$) and ODI ($\rho = -0.393$, $p < 0.001$). Based on general regression model, Desaturation Severity and gender were the most significant factors predicting daytime sleep latency.
Conclusions: Severity of sleep related breathing cessations and desaturations is more strongly related to excessive daytime sleepiness than AHI or ODI. This highlights the need for characterizing the severity of individual obstructive events and related desaturations when diagnosing and assessing the severity of obstructive sleep apnea

SLEEP APNEA : CARDIOVASCULAR INVOLVEMENT AND ECHOCARDIOGRAPHIC ASSESSMENT

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Introduction: Obstructive sleep apnea(OSA) syndrom is **a highly prevalent disease**, affecting roughly **4 %** of men and **2 %** of women .It is recognized as real health problem since it has been associated with significant cardiovascular effects such as systemic hypertension ,stroke, heart failure, myocardial infarction, and arrhythmias .**transthoracic echocardiography** does play a major role in the assessement of the cardiovascular effects of OSA. However, it is not clear whether these cardiac effects are due to the condition itself or are influenced by associated factors.
Materials and methods: This review provides an overview of cardiovascular involvment in OSA syndrom such as hypertension , heart failure , coronary artery disease , arrythmias and pulmonary hypertension , with a focus on echocardiography findings.
Conclusions: OSA is **strongly** associated to cardiovascular diseases: CHF, resistant HTN, pulmonary hypertension, Atrial Fibrillation, ventricular arrhythmias And CAD. Doppler-Echocardiography is an accurate tool for assessment of alterations in cardiac structure and function and their consequence in OSA. Therefore, all cardiologists should remember to refer their patients with heart disease for sleep study, and perform echocardiography for their OSA patients .

USE OF NON-INVASIVE VENTILATION IN CHILDREN WITH CONGENITAL TRACHEAL STENOSIS: A 10-YEAR RETROSPECTIVE REVIEW

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Introduction: Congenital tracheal stenosis (CTS) is a rare airway condition characterised by complete tracheal rings. Most patients undergo a slide tracheoplasty, which greatly reduces mortality but significant morbidity remains. The assessment of sleep disordered breathing and use of non-invasive ventilation (NIV) in these children has not been described. To describe the presence of sleep disordered breathing and use of NIV in children diagnosed with CTS over a 10-year period (2005-2015).

Materials and methods: Retrospective case series at a tertiary children's hospital

Results: There were 16 patients identified with CTS with a median [range] age at diagnosis of 2.5 months (0-9 months). One child died in the immediate post-operative period following a slide tracheoplasty, leaving 15 survivors. There were no later deaths at 3 years after surgery. Most patients (12/15) underwent slide tracheoplasty surgery. 3/15 patients had a short-segment tracheal stenosis, and 12/15 had a long-segment tracheal stenosis. The use of NIV occurred in 10/15 (66.67%) patients, all of whom had long-segment CTS. The median [±SD] obstructive apnoea/hypopnoea index (OAHI) off NIV was 14.6/hr (± 6.2) which reduced to 7.2/hour (± 4.2) on NIV trial. The median oxygen desaturation index (ODI) before NIV use was 15.3 (± 19.4) which reduced to 6.3 (± 11) on NIV. The median period of NIV use was 5 [1-24 months] months.

Conclusions: Patients with CTS have obstructed sleep disordered breathing. Trials of NIV are well-tolerated and improve sleep disordered breathing

Acknowledgements: David Read sleep unit

OBSTRUCTIVE SLEEP APNEA FREQUENCY AND POLYSOMNOGRAPHIC FINDINGS IN PEDIATRIC PATIENTS WITH EARLY ONSET SCOLIOSIS

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Introduction: Early onset scoliosis (EOS), defined as curvature of the spine >10 degrees with onset before 10 years of age, places patients at an increased risk of chronic restrictive disease and, to a lesser degree, obstructive disease. EOS may also place them at greater risk of sleep disordered breathing. We aim to establish the frequency of obstructive sleep apnea (OSA) in children with EOS who underwent polysomnogram (PSG) at our institution and compare these polysomnographic findings to those of children with OSA without EOS. We postulate that, amongst those tested, children with EOS will have a higher frequency of OSA than patients without EOS and that children with EOS and OSA will have worse AHI than patients with OSA without EOS.

Materials and methods: We performed a retrospective chart review on 58 patients with EOS (ages 1-17 yr) who underwent a PSG at our institution from 2003 through 2019. A comparison group of 58 patients without scoliosis who underwent diagnostic PSG at our institution was chosen consecutively (ages 1-18 yr). Polysomnographic parameters from patients with OSA (obstructive apnea-hypopnea index (AHI) > 2 events/hr) from both groups were compared: total sleep time (TST), sleep latency, sleep efficiency, REM latency, % N1, % N2, % N3, % REM, arousal index, obstructive AHI, central AHI, mean oxygen saturation in REM, mean oxygen saturation in NREM, oxygen saturation nadir, time spent < 88% oxygen saturation (mins), desaturation index, maximum CO_2, % TST with $ETCO_2$ >50 mmHg, periodic leg movement index. For the subset of patients with full raw polysomnographic data available, further comparisons were made of average and maximum lengths of apneas and hypopneas in both REM and NREM.

Results: No statistically significant differences in age, sex, and BMI were found between groups. 84.4% of patients with EOS had OSA, compared to 65.5% without EOS. Of the PSGs in patients with EOS, 40 were diagnostic, 13 were split, and 5 were titration studies. Patients with EOS and OSA had statistically significantly higher obstructive AHI than the comparison group without EOS (7.09 ± 5.06 vs. 5.24 ± 6.17; $P = 0.048$). Amongst patients with full PSG data available, patients with EOS and OSA had significantly longer hypopneas during REM (21.86 seconds ± 4.27 vs. 13.30 vs. 4.01; $P = < 0.001$) and greater maximum length of hypopneas during REM (41.95 seconds ± 13.21 vs. 19.70 ± 9.48; $P = < 0.001$). No other parameters were statistically significantly different between the two groups.

Conclusions: Pediatric patients with EOS referred to our institution for polysomnography had a higher frequency of OSA than patients without EOS referred for routine polysomnography. Children with EOS also had more severe OSA than children without EOS. Incidentally, we found that children with EOS showed longer hypopneas during REM sleep. We advocate for routine polysomnography for children with EOS due to the high frequency of OSA amongst those tested and the increased risk for severe and long obstructive events.

NOCTURNAL ARRHYTHMIA DURING SPLIT-NIGHT POSITIVE AIRWAY PRESSURE TITRATION POLYSOMNOGRAPHY IN OBSTRUCTIVE SLEEP APNEA PATIENTS AT CENTRAL CHEST INSTITUTE OF THAILAND

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Introduction: Cardiac arrhythmias are one of cardiovascular complications from obstructive sleep apnea (OSA). Positive airway pressure (PAP) has been demonstrated as an effective treatment of cardiac arrhythmias in OSA patients.

Materials and methods: This retrospective study, interrupted time series recruited patients with OSA, based on clinical history and symptoms underwent diagnostic portion of split-night positive airway pressure titration polysomnography shown Apnea-Hypopnea Index (AHI) ≥ 5/hour with cardiac arrhythmias at Central Chest Institute of Thailand during April 2013 to January 2019. This study is conducted to compare nocturnal arrhythmias and sleep parameters in OSA patients during split-night positive airway pressure titration polysomnography and factors related to optimal or good PAP titration among these patients. Statistical methods for comparison of categorical data between groups using Fisher's exact probability test and continuous data using paired t-test. Factors related to optimal or good PAP titration using multivariate logistic regression analysis and measured by generalized linear regression with 95% confidence intervals. The probability level for statistical significance was established at $p < 0.050$.

Results: A total of 104 OSA patients with cardiac arrhythmias were enrolled and 33 patients were excluded. A total of 71 patients were analyzed. Most patients were male (57.75%). The average age of patients was 58.08 ± 11.48 years. A half of those had previous cardiac arrhythmias (57.75%). Most common cardiac arrhythmias were persistent atrial fibrillation (35.21%). The average left ventricular ejection fraction (LVEF) was 60.04 ± 13.18%. The majority of patients were severe OSA (92.96%). Sleep parameters were significantly improved in sleep efficiency (68.07 ± 16.40, 77.95 ± 15.38, $p < 0.001$), percentage of rapid eye movement (REM) sleep (6.50 ± 10.20, 19.70 ± 10.32, $p < 0.001$), AHI (68.59 ± 31.50, 23.23 ± 15.53, $p < 0.001$), REM-AHI (53.35 ± 28.90, 32.46 ± 30.91, $p = 0.004$), oxygen desaturation index (27.31 ± 25.95, 6.56 ± 9.07, $p < 0.001$), average oxygen saturation (SpO2) (88.67 ± 15.53, 94.39 ± 3.08, $p = 0.002$), REM-SpO2 (83.17 ± 10.67, 89.28 ± 8.86, $p = 0.004$), average heart rate (66.60 ± 11.07, 63.28 ± 11.84, $p < 0.001$) and arousal index (75.19 ± 30.48, 38.14 ± 16.09, $p < 0.001$) after PAP titration, respectively. There was a significant reduction of isolated premature ventricular contractions (PVCs) (252.33 ± 371.85, 141.59 ± 202.43, $p = 0.012$) after PAP titration. No significant factors related to optimal or good PAP titration among these patients.

Conclusion: Sleep parameters were significantly improved and there was a significant reduction of isolated PVCs in OSA patients with cardiac arrhythmias during split-night positive airway pressure titration polysomnography. No significant factors related to optimal or good PAP titration among these patients.

OBSTRUCTIVE SLEEP APNEA SCREENING IN HIGH RISK PATIENTS: MISSED OPPORTUNITIES FOR EARLY DIAGNOSIS IN PRIMARY CARE SETTING

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Introduction: Obstructive sleep apnea (OSA) is known to increase risk of cardiovascular and cerebrovascular morbidity, increase likelihood of motor vehicle accidents and affect quality of life. Current evidence does not support wide scale screening of general population. However selective screening of those considered to be high risk for OSA such as patients with obesity, resistant hypertension, diabetes, atrial fibrillation, previous TIA/stroke and pulmonary hypertension is supported. Little is known about rates of screening of high risk patients in Canada in primary care setting.

Objective: To look at current practices of screening and management of OSA in high risk patients at a university affiliated single large academic primary care center.

Method: A retrospective chart review was done for patients rostered to the primary care office who were over age of 50 and had history of either taking three or more medications for hypertension, obesity, history of TIA/stroke, diabetes, atrial fibrillation or pulmonary hypertension. Charts were reviewed to see if a validated screening tool for OSA was administered or if patients were ever asked about their sleep and if there was documentation of snoring and how these patients were managed.

Results: Of randomly selected 199 charts, 54.7% were female and 45.3% were male. Mean age of population was 74.9 years with standard deviation of 10.78. 45.2% of patients had two risk factors listed in their cumulative patient profile for OSA, 20.6% had 3 risk factors for OSA and 8% had four risk factors for OSA. None of the patients had a validated screening tool for OSA in their charts. 89% had discussion about sleep and majority of discussion occurred in context of routine preventative visits (64%), followed by sleep specific visits (9.5%) and mood visits (5.1%). Each one risk factor increase was associated with a 0.1062 increase in the log-odds that a patient had a sleep discussion. This effect was not significantly significant, $z = 0.40$, $p = .69$. Increasing the number of risk factors, a patient has by one, only multiplied their odds or likelihood of having a sleep discussion by 1.11. Only 11.2% of those who had discussion on sleep had documentation about snoring. 40% of those who snored were referred to a sleep lab for further testing, but for remaining nothing further was offered (35%) or had discussion on sleep hygiene (25%).

Conclusion: While discussion around sleep is occurring at a high rate during routine preventative visits in primary care office, screening rates for obstructive sleep apnea in patients considered to be high risk for obstructive sleep apnea is very low and validated screening tools are not used. Further studies looking at barriers for screening high risk patients in primary care setting is needed.

DETERMINANTS OF AGE-ADJUSTED HIGHER NT-PRO-BNP VALUES IN ADULTS WITH CORONARY ARTERY DISEASE AND OBSTRUCTIVE SLEEP APNEA IN THE RICCADSA COHORT

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Introduction: N-Terminal Pro-B-Type Natriuretic Peptide (NTproBNP) is an important prognostic biomarker in cardiac patients. Though there is an accepted consensus by the European Cardiology Society to suggest an age-independent rule-out cut-off value of NTproBNP < 300 pg/ml to exclude heart failure, different rule-in cut-off values with a wide range of "gray zones" have been proposed in literature. A recent work has shown reliable age-dependent cut-points of >450, >900, and >1,800 pg/ml for patients younger than 50 years of age, between 50 och 75 years of age, and older than 75 years of age, respectively. Utility of these values in a coronary artery disease (CAD) cohort with concomitant obstructive sleep apnea (OSA) is unknown.

Materials and methods: In this secondary analysis of the RICCADSA trial, conducted in Sweden, 511 revascularized CAD patients (median age 64.0 years; inter-quartile range [IQR] 58.9-70.0) with OSA (Apnea-Hypopnea-Index [AHI]≥15 events/hr; n=399) or no-OSA (AHI< 5 events/hr; n=112) were included. The sleepy phenotype was defined as the OSA patients with an Epworth Sleepiness Scale (ESS) score ≥10, and the nonsleepy phenotype as the ones with an ESS score < 10. Determinants of the higher NTproBNP concentrations based on the age-adjusted cut-off values as defined above were analyzed in a multivariate logistic regression model.

Results: The median NTproBNP values were 212 (IQR 104-519) pg/ml in patients with OSA, and 195 (IQR 83-409) pg/ml in patients with no-OSA (*p=0.112*) while the corresponding values were 259 (IQR 125-643) pg/ml in nonsleepy OSA, and 172 (IQR 96-391) pg/ml in sleepy OSA (*p=0.002*). In the entire cohort, 57 (11.2%) CAD patients had higher NTproBNP values (12.8% of OSA *vs* 5.4% of no-OSA; *p=0.027*), with a higher percentage among the nonsleepy OSA phenotype (16.8% *vs* 6.5%; *p=0.003*). In a multivariate analysis, the higher NTproBNP category was predicted by OSA (odds ratio [OR] 3.5; 95% confidence interval [CI] 1.4-8.7), and history of atrial fibrillation (OR 2.5; 95% CI 1.3-4.8) while ESS ≥10 and obesity (body-mass-index ≥30 kg/m^2) were inversely correlated (ORs 0.37 *vs* 0.48, and 95% CIs 0.18-0.77 *vs* 0.23-0.99, respectively).

Conclusions: We conclude that nonsleepy OSA phenotype was associated with higher NTproBNP values at baseline in this CAD cohort following revascularization. The clinical significance of the association between NTproBNP values and OSA phenotypes with regard to cardiovascular outcomes, and response to treatment with continuous positive airway pressure needs to be further evaluated.

Sleep Breathing Disorders
Board #311 : Poster session 2

INTERACTIONS BETWEEN OBSTRUCTIVE SLEEP APNEA AND SLEEP DURATION WITH SUBCLINICAL ATHEROSCLEROSIS EVALUATED BY CORONARY CALCIUM SCORE: CROSS-SECTIONAL DATA FROM ELSA-BRASIL STUDY

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Introduction: Recent data suggest that the sleep disorders can contribute to the progression of the coronary artery disease. However, the interaction of Obstructive Sleep Apnea (OSA) and the Sleep Duration (SD) with subclinical markers of the coronary atherosclerosis remains to be determined.

Materials and methods: We consecutively evaluated participants from ELSA-Brasil, a cohort study of adult civil servants. All participants were submitted to a single night portable sleep monitoring (Embletta Gold™) to determine OSA status and wrist actigraphy during one week (Actiwatch 2™) for the objective ascertainment of the SD. An apnea-hypopnea index (AHI) < 5 events per hour was considered normal; AHI 5-14.9 and IAH ≥15 events per hour were classified as mild OSA and moderate-severe OSA, respectively. Computed tomography using a Philips Brilliance 64-detectot scanner (Philips Heathcare, Andover, MA) was performed to assess the calcium score by a standard protocol adjusted for each participant's biotype. Subclinical atherosclerosis was defined as a CAC >100 score. Analysis of adjustment for potential confounding factors was performed, including age, sex, and cardiovascular risk factors and drug use.

Results: We studied 2.169 participants (age: 49±8 years; 56.6% female). The frequency for OSA was 32%. We observed a progressive increase in the frequency of CAC >100 in parallel to the severity of OSA: No OSA: 4%, mild OSA: 8% and moderate-severe OSA: 12% (p trend: < 0.001). Interestingly, participants with long SD (>8 hours) presented higher frequency of CAC >100 (15%) as compared to subject with SD 6-8 hours (7%) and SD < 6 hours (9%; p trend: 0.01). In the logistic regression, moderate-severe OSA (OR 1.18; IC 95% 0,85 1,64) or SD >8 hours (OR 1.39; IC 95% 0,88 2,21) were not associated with CAC >100. However, the interaction of OSA with SD >8 hours was independently associated with CAC >100 (OR 2.78, p=0.01) when compared to the reference group (no OSA, SD < 8 hours).

Conclusions: The interaction of OSA with long SD (>8 hours) is associated with almost three-fold chance to present a CAC >100.

Acknowledgements: ELSA SLEEP TEAM

Sleep Breathing Disorders
Board #300 : Poster session 1

OBSTRUCTIVE SLEEP APNEA (OSA) AS A PREDICTOR OF OXIDATIVE STRESS

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Introduction: Obstructive sleep apnea (OSA) is an independent risk factor for cardiovascular disease. In cardiovascular disease, oxidative stress is well-established to play a pivotal role in the initiation (endothelial dysfunction) and progression of atherosclerosis. Animal models when exposed to intermittent hypoxia consistently exhibit a significant increase in measures of oxidative stress. However, in human studies, there's still need to investigate the role of OSA and its association with oxidative stress.

Materials and methods: Patients referred to the UBC Sleep Laboratory for a polysomnogram (PSG) for suspected OSA were recruited and provided a morning blood sample after PSG. Plasma levels of 8-isoprostane, 8-ohdg and Superoxide Dismutase were measured.

Results: 490 patients participated; mean age was 51.15 years old, mean AHI was 21.58/hr and mean BMI was 31.83. 77% were male. In unadjusted analyses (Pearson's coefficient), body mass index (BMI) was significantly associated with serum levels of the three oxidative stress molecules investigated. AHI was significantly associated with 8-isoprostane ($p < .01$) but not 8-ohdg ($p = 0.917$) or SOD ($p = .0687$).

The relationships between all markers and BMI/AHI were further explored using multiple linear regression. Models were adjusted for presence of previous heart disease, diabetes, smoking status, sex, age, ethnicity, and lipid lowering medication usage. For SOD activity, sex ($p < .0001$) and previous heart disease ($p=0.0018$) were significant predictors. Sex ($p=0.0006$) and body mass index ($p=0.0036$) predicted plasma levels of DNA oxidation (8-ohdg). Finally, levels of 8-isoprostane were significantly predicted by age ($p=0.0045$), BMI ($p=0.0458$) and severity of obstructive sleep apnea ($p=0.0076$). Exploratory analysis showed that the proportion of females is higher (55%) in the 4th quartile of SOD activity.

Conclusions: AHI is significant predictor of 8-isoprostane levels after adjusting for well-known clinical confounders. A higher proportion of women were present in the 4th quartile of superoxide dismutase levels, indicating a higher antioxidant capacity. 8-isoprostane could be a potential marker for risk stratification in OSA patients. Further research is required to determine the clinical consequences of elevated levels of 8-isoprostane associated with OSA and obesity.

OBSTRUCTIVE SLEEP APNEA PREVALENCE IN SUBJECTS WITH SKELETAL CLASS II OR CLASS III WITH MAXILLARY HYPOPLASIA DEFORMITIES WAITING FOR ORTHOGNATHIC SURGERY

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Introduction: Orthognatic surgery (OS) could be an alternative treatment to continuous positive airway pressure (CPAP) therapy in patients with skeletal class II or class III with maxillary hypoplasia deformities (SCII-III+MhD) suffering also from obstructive sleep apnea (OSA) with potential satisfactory and permanent results for both disorders. The aim of the present study was to determine OSA prevalence in subjects suffering from SCII-III+MhD waiting for OS regardless of OSA symptoms.

Materials and methods: All subjects with SCII-III+MhD waiting for OS were studied regardless of OSA symptoms. Sleep study (respiratory polygraphy and polysomnography [PSG]), anthropometrical, OSA symptoms, sleep quality and Epworth Sleepiness Scale [ESS] data were collected. OSA was defined by an apnea-hypoapnea index (AHI) above 5 events/hour and severe OSA by an AHI above 30 events/hour.

Results: From 34 subjects included in the waiting list, 22 patients (65%) were evaluated. From the remaining 12 patients (35%), 3 refused and 9 could not be evaluated. Regarding age, sex and skeletal deformity, there were no differences between studied subjects (n = 22) versus non- studied subjects (n = 12). 59% of the evaluated patients were women, median age was 28y (23-26), BMI 24Kg/m^2 (22-26), ESS 8 (6-11) and AHI 2 (0.7-3.5). The overall OSA prevalence was 13.6%. Only one subject had severe OSA and received CPAP therapy (female, 44 years, BMI 29 Kg/m^2, ESS 24, AHI 59/hour, supine AHI 75/hour, non-supine AHI 57/hour, 64% obstructive apneas).

Conclusions: OSA prevalence and CPAP indication in subjects waiting for OSA due to SCII-III+MhD are low, thus systematic screening does not seem to be justified. Further studies with larger sample sizes are needed to confirm these results.

Acknowledgements: The authors would like to thank all the staff of the Sleep Unit and Oral Maxillofacial Surgery Department at Bellvitge University Hospital for their inestimable collaboration.

Sleep Breathing Disorders
Board #301 : O05: SBD Epidemiology
SARCOPENIC OBESITY IS ASSOCIATED WITH OBSTRUCTIVE SLEEP APNEA: A POPULATION-BASED STUDY

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Introduction: Evidence suggests increased body weight is associated with changes in sleep quality and quantity, as well as a higher risk of obstructive sleep apnea (OSA). However, investigations including objective evaluations of sleep and body composition states are scarce. We aimed to evaluate the associations of poor sleep indicators and OSA with body composition states in a sample from the general population.

Methods: Data from the cohort EPISONO, in a representative sample from the city of São Paulo, Brazil. Questionnaires, actigraphy, and full polysomnography assessed sleep, and bioelectrical impedance analysis evaluated body composition. Appendicular skeletal muscle mass adjusted for body mass index defined sarcopenia (men< 0.789; women< 0.512); total body fat defined obesity (men>30%, women>40%); and the overlap between both conditions defined sarcopenic obesity (SO). Final results were obtained by multiple multinomial logistic regression analysis.

Results: 359 adults (median [range] age, 59 [50-88] years; 212 [59.1] female) were enrolled in the study. Obesity was detected in 22.6% of the sample, sarcopenia in 5.6%, and SO in 16.2%. After controlling for covariates, no poor sleep indicator or sleep disorder was associated with obesity or sarcopenia. However, OSA was independently associated with SO (OR=3.14, 95%CI=1.49-6.61). Additionally, nocturnal hypoxemia was associated with both obesity (aOR=2.59, 95% CI=1.49-4.49), and SO (OR=2.92, 95% CI=1.39-6.13).

Conclusion: Participants with OSA were more likely to have SO, and those with nocturnal hypoxemia were more likely to have both obesity and SO. The findings indicate both fat deposition and muscle mass decline may play a synergistic role in the development of OSA and suggest a more complex pathophysiologic relationship between adverse body composition and OSA, which may go beyond obesity and include lower lean mass. Future research appraising prospective evaluations and therapeutic strategies to reduce clinical consequences of OSA should simultaneously target adipose and muscle tissues.

SLEEP QUALITY AND SLEEP DISORDERS IN PATIENTS DIAGNOSED WITH PRIMARY CILIARY DYSKINESIA

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Introduction: Primary ciliary dyskinesia (PCD) is a heterogeneous autosomic recessive genetic disease, characterized by disfunction of ciliary motility. It is not well known and therefore underdiagnosed. The gold standard for its diagnosis is by identification of the alteration of the ciliary axoneme in electronic microcopy. The treatment is oriented to avoid infections and chronic lung damage. Sleep in all children is a vital process for growth and development, and in this population, it has been observed altered, with diminished quality, presence of obstructive sleep apnea and alterations in gas exchange, mainly hypoxemia. Nevertheless, the data presented in several studies is divergent, with reports of prevalence of obstructive sleep apnea in this population of 80 to 18 to 50 percent. Therefore, we aim to describe sleep characteristics in children with this diagnosis from 3 to 18 years old, including prevalence of obstructive sleep apnea.

Materials and methods: All parents of children in our center with diagnosis of PCD confirmed with electronic microscopy have been invited to participate. Those who agree are receive an appointment to the Sleep Medicine Unit, were they are asked to fill out questionnaires about sleep symptoms (one developed in our center and the Pediatric Sleep Questionnaire) and are assigned a date for polysomnography. Polysomnography is performed by qualified technicians in our sleep laboratory and scored according to the AAMS manual version 2.5. All polysomnographies are to include transcutaneous carbon dioxide measurement. Afterwards, the subject meets with the researchers for a third time to inform the results from their studies and receive subsequent medical management if necessary.

Results: Out of 32 patients with diagnosis of PCD in our center 23 have been successfully contacted and 16 have so far filled out the questionnaires mentioned above. These children have a mean age of 1.24 years, with 62.5% male, and reside in the metropolitan area of Mexico City. They go to bed around 10 pm and wake up around 7 during the week and 9 am on weekends and are exposed 2 to 3 hours per day to screens. Half still take naps (longer than one hour) even though all are older than five years old. 25% refer initial and maintenance insomnia, 37.5% refer fear of the dark and 25% present resistance to go to bed. 68% refer snoring, 50% observed apneas and 50% diaphoresis. In the PSQ 62.5% present risk for obstructive sleep apnea. 93.75% refer movements while sleeping, 68.75% somniloquies and 37.5% bruxism, 37.55 refer symptoms of Willis-Ekbom disease. We are currently performing the polysomnographies of these 23 patients and expect to finish them by October 2019.

Conclusions: Children in our center with diagnosis of PCD present a relatively high prevalence of reported sleep disorders such as insomnia and no-REM parasomnias and have a high prevalence of risk for obstructive sleep apnea and related symptoms. These symptoms will be correlated with their objective evaluation in the PSG, and will allow us a better evaluation and education for these patients.

THE DIAGNOSTIC ACCURACY OF TYPE IV PORTABLE SLEEP MONITORS VERSUS POLYSOMNOGRAPHY FOR OBSTRUCTIVE SLEEP APNEA IN CHILDREN: A SYSTEMATIC REVIEW

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Introduction: Obstructive sleep apnea syndrome (OSAS) is a disease with high prevalence in children, and severe complications when not treated. The gold standard for diagnosis is polysomnography, but this study is not available for all patients. Therefore, other diagnosis options have been explored as type 4 monitors. These consist of the register of one to three channels, and are more comfortable and disseminated. While there are systematic reviews about both type 3 (4 to 7 channels) and 4 monitors for the diagnosis of OSAS in children, there isn´t one explicitly evaluating type 4 monitors as diagnostic tests against polysomnography for OSAS in children.

Materials and methods: Searches were performed in MEDLINE, EMBASE, PsycINFO, CINAHL, LILACS, African Index Medicus, Web of Science, Scopus, KoreaMed, China Knowledge Resource Integrated Database and the Cochrane Central Register of Controlled Trials (CENTRAL). The results were purged of duplicates using Mendeley Desktop and JavRef. After removing duplicates, the results were screened for pertinence to the protocol, being the inclusion criteria that the studies evaluated a monitor with one to three channels to diagnose obstructive sleep apnea in children, and that the monitor was compared to polysomngraphy. There were not restriction of language. The evaluation was performed first in the titles, then in the abstracts and finally reviewing the full text of the article. All was performed by two researchers individually, with disagreements being resolved via discussion. In case of having more than three articles that evaluated the same montior, meta analysis would be considered. The statistical analysis will be done with STATA 14.1, with the bivariated random effects model.

Results: The initial search yielded 1701 results (PubMed 492, CINAHL 72, Cochrane 60, AIM 75, LILACS 168, PsycInfo 8, Scopus 562, Web of Science 264). From this 750 were removed because of duplication, being 951 evaluated in title and abstract. From this 872 were excluded and 79 were evaluated in full text. From this 79, 31 were excluded in the full text review, mostly because the research compared PSG with type 3 monitor (9 studies) and because the population evaluated were adults (8 studies). 47 studies were included in the qualitative review, and are currently being evaluated in order to extract the pertinent data. 27 studies report an independent monitor and 20 a polysomnography sub analysis. Most a type 4 monitors reported are based on or consisting of oximetry, although 3 studies evaluate bed senros, 2 audio signals, 1 video recordings and 1 ECG variability. Those that report oximetry only evaluate a wide array of algorithms.

Conclusions: Even though the need for new evaluation modes for the diagnosis of OSAS is urgent, the data so far in this review indicates that an important number of reports are from PSG sub analysis, wich dismisses their validity, and the diverse algorithms used for oximetry analysis make their comparison dificult.

WORKPLACE AND DRIVING CONSEQUENCES OF SLEEPINESS IN CANADIANS WITH OBSTRUCTIVE SLEEP APNEA: RESULTS OF A MARKET RESEARCH SURVEY

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Introduction: A 2009 report by the Public Health Agency of Canada reported that 26% of Canadian adults are at high risk for OSA; however, only 3% report having received a diagnosis, prompting calls for improved recognition of at-risk individuals and better access to diagnosis and treatment of OSA. Untreated OSA has been associated with an increased risk of daytime sleepiness, leading to motor vehicle crashes, absenteeism and workplace accidents. The frequency of these consequences among Canadians with OSA is unknown.
Materials and methods: We conducted an anonymous internet survey of Canadians reporting a physician diagnosis of OSA. The survey asked about Canadian's experiences with OSA, including their course of diagnosis and treatment and the impact of OSA on their function while at work and driving. The survey was distributed to Canadians using a market research company, social media, and through patient-facing medical associations between March 1 - April 30, 2019.
Results: Six hundred Canadians with self-reported OSA responded to the survey. Sixty seven percent of respondents were English speaking while 28% were French speaking, and 60% were married or living common-law. Seventy-two percent of respondents were between 40 and 69 years old. Moderate or severe sleep apnea was reported by 76% and 18% reported mild OSA. Ninety percent of respondents drove regularly with 72% driving between 1-20 hours a week. Eighty-four percent worked at least part-time, 8% reported some form of shift work, and 9% had an irregular schedule. Twenty eight percent of respondents reported having fallen asleep while driving and 5% had experienced a sleepiness related crash or near miss within the previous five years. Absenteeism was reported by all respondents with 13% reporting missing at least one week of work per month. Following treatment for OSA, only 7% of respondents reported missing at least one week of work per month. Four percent of individuals reported having suffered a workplace injury due to sleepiness.
Conclusions: Canadians with OSA experience important health and safety consequences of daytime sleepiness while at work and while driving. The reported rates of motor vehicle crashes were comparable to a previously published meta-analysis; however the high frequency of self-reported sleepiness at the wheel suggests more substantial risks to driver safety. Absenteeism was high but mitigated by CPAP therapy. These findings highlight the importance of timely identification and treatment of OSA.
Acknowledgements: This project was supported by the Canadian Sleep and Circadian Network

MORE THAN A NUMBER: THE IMPACT OF AHI STATISTICAL UNCERTAINTY ON CLINICAL DIAGNOSIS AND ELIGIBILITY

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Introduction: The apnea-hypopnea index (AHI) (or one of its derivatives) is the primary clinical metric for characterizing sleep disordered breathing—the value of which with respect to a threshold determines severity of diagnosis and eligibility for treatment reimbursement. The index value, however, is taken as a perfect point estimate, with no measure of statistical uncertainty. Thus, current practice does not robustly account for variability in diagnosis/eligibility due to chance. In this paper, we quantify the statistical uncertainty associated with respiratory event indices for sleep disordered breathing and the effect of uncertainty on treatment eligibility.

Materials and methods: We develop an empirical estimate of uncertainty using a non-parametric bootstrap on the inter-event times, as well as a theoretical Poisson estimate reflecting the current formulation of the AHI. We then apply these methods to estimate AHI uncertainty for 2,049 subjects (954/1095 M/F, age: mean 69 ± 9.1) from the Multi-Ethnic Study of Atherosclerosis (MESA).

Results: The mean 95% empirical confidence interval width was 11.500 ± 6.208 events per hour and the mean 95% theoretical Poisson confidence interval width was 5.998 ± 2.897 events per hour, suggesting that uncertainty is likely a major confounding factor within the current diagnostic framework. Of the 278 subjects in the symptomatic population (ESS>10), 27% (76/278) had uncertain diagnoses given the 95% empirical confidence interval. Of the 2049 subjects in the full population, 43% (880/2049) had uncertain diagnoses given the 95% empirical confidence interval. The inclusion of subjects with uncertain diagnoses increases the number of eligible patients by 21.3% for the symptomatic population and by 84.8% for the full population. The exclusion of subjects with uncertain diagnoses given the 95% empirical confidence interval decreases the number of eligible patients by 12.4% for the symptomatic population and by 34.8% for full population. Further analyses suggest that it is practically infeasible to gain diagnostic statistical significance through additional testing for a broad range of borderline cases.

Conclusions: These results suggest that AHI alone may be insufficient to determine eligibility in many patients and that information from other co-variates is necessary for diagnosis. Thus, statistical uncertainty is a vital additional piece of information that would greatly benefit clinical practice, as well as benefit studies linking event rate to clinical outcome.

Sleep Breathing Disorders
Board #188 : Poster session 1

LONG-TERM ADHERENCE TO POSITIVE AIRWAY PRESSURE THERAPY IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Positive airway pressure (PAP) therapy is the second most common treatment of childhood obstructive sleep apnea (OSA) next to adenotonsillectomy. Despite its effectiveness, poor adherence is the major barrier to its long-term utility especially in younger population. We aimed to determine the incidence of long-term adherence to PAP and identify contributing factors associated with non-adherence in childhood OSA.

Materials and methods: A retrospective chart review was conducted to recruit consecutive OSA children, aged 2-18 years, who underwent PAP titration under polysomnography at Ramathibodi Hospital Sleep Disorder Center between January 2010 and December 2018. Those with neuromuscular disorders, craniofacial abnormalities and those who could not afford PAP device were excluded. Objective adherence data were obtained by downloading data from PAP machine's memory SD cards. We defined adherence as $\geq$ 4 hours of nightly use for $\geq$ 70% of the days monitored for $\geq$ 3 successive months. Variables between the two groups (adherence vs. nonadherence) were compared statistically by using Student's t-test or $\chi 2$ test. Logistic regression analysis was used to determine the important contributing factors affecting PAP adherence.

Results: 98 children were recruited. 7 with neuromuscular disorders and 1 with craniofacial abnormalities were excluded. 39 (40%) could not afford PAP device. Of 46 children (aged 2-18 years) whose adherence data could be obtained, 18 (39%) were adherent. Children with history of adenotonsillectomy, functional class 2-4 and mask fitting by themselves were more likely to be adherent (p=0.029, 0.022, 0.025 respectively). Fitting the masks by parents was found to be the most important factor affecting PAP adherence (OR 4.73, 95% CI 1.21-18.47, p=0.026). Adherence was not associated with age, obesity status, OSA severity, pressure levels, developmental disabilities, familial socioeconomic and educational background.

Conclusions: Long-term PAP adherence in our children is only 39%. Fitting the masks by parents, not by the children themselves, is an important factor related to nonadherence. Training children to fit masks may improve adherent rate.

THE EFFECT OF ACETAZOLAMIDE ON THE IMPROVEMENT OF CENTRAL APNEA CAUSED BY ABUSING OPIOID DRUGS IN THE CLINICAL TRIAL

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Introduction: Abusing raw opium or Taryak as it is called in Persian is quite prevalent addiction across Iran which is mainly used either orally or by smoking**.** Regarding the treatment of probable complications caused by Taryak, there are yet no special and well-known treatment methods reported, in general, and regarding treatment methods of CSA caused by these types of drugs, in particular. Acetazolamide is utilized as a mild diuretic which falls effective in treating central sleep apnea (CSA) caused by Congestive Heart Failure. Hence, it might be effective as far as opium addicts who suffer from CSA Index more than 5/h or periodic breathing regarding normal $PaCO_2$ are concerned.

Materials and methods: The current study was a double-blind, placebo-controlled, cross-over study (clinicalTrials.gov ID: NCT02371473). The whole procedures were identical for both placebo and acetazolamide phases of clinical research. A group of addicts including 250 patients who had polysomnography file in sleep laboratory of Masih Daneshvari Hospital were surveyed. Among this group, there were 14 CSA more than 5/h and more than 50% of apnea-hypopnea Index (AHI). Out of these 14 patients, 10 volunteered to participate in the study. Heart rate variability time-domain indices quantify the amount of HRV observed during recording periods. From among all the time domain variables, mean, SDNN, NN50, PNN50 and RMSSD were used.

Fast Fourier Transformation was used to separate HRV into its component VLF (very low frequency band), LF (low frequency band), and HF (high frequency band) rhythms that operate within different frequency ranges**.**

Results: There are significant results in terms of decreased mix apnea and central apnea together due to acetazolamide compared with placebo (P< 0.023). Time of Sat < 90% is decreased as well (P< 0.1). There is also decrease of SDNN and NN50 after treatment with acetazolamide respectively (p< 0.001). Regarding Fast Fourier Transformation, there is increase of pHF and decrease of pLF after acetazolamide treatment (p< 0.001).

Conclusions: Acetazolamide seems to be effective in improving oxygenation and a decrease of mixed and central apnea events together. But the question of how far it can be effective during clinical treatment needs to be studied and explored in terms of longer periods of treatment and prescribing various dosages. In HRV analysis section, VLF and LF power have decreased significantly as a result of treatment using acetazolamide, which shows enhanced prognosis of the patients.

Acknowledgements: Acetazolamide can improve partially mixed, central apnea events,desaturation in abusing opioid drugs.

EFFECTS OF CHRONIC INTERMITTENT HYPOXIA, ANGPTL4 AND ANGPTL8 ON DYSLIPIDEMIA IN OBSTRUCTIVE SLEEP APNEA: EVIDENCE FROM TWO MATCHED CLINICAL STUDIES

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Introduction: Both angiopoietin-like protein 4 (ANGPTL4) and ANGPTL8 are known as important regulators in lipid metabolism. However, the roles of ANGPTL4 and ANGPTL8 in dyslipidemia under chronic intermittent hypoxia (CIH) conditions, a prominent hallmark of obstructive sleep apnea (OSA), remain unclear.

Materials and methods: A total of 125 male OSA subjects from the Shanghai Sleep Health Study (SSHS) who were matched for age, body mass index (BMI) and lipid profile were included. Then, serum ANGPTL4 and ANGPTL8 levels were detected using an ELISA method. The association of the ANGPTL4 T266M and ANGPTL8 R59W variants with dyslipidemia was investigated in 913 severe OSA subjects (matched for CIH) from the SSHS. Those relationships were quantified via ordinal logistic regression and multivariate linear regression models.

Results: Serum ANGPTL4 and ANGPTL8 levels were significantly lower in patients with severe OSA than in non-OSA patients after matching for age, BMI, and lipid profile ($P=8.34\times10^{-17}$, $P=0.032$, respectively). Both ANGPTL4 T266M and ANGPTL8 R59W variants had positive correlations with different abnormal lipid accumulation ($OR=3.373$, $P=0.014$ and $OR=1.771$, $P=0.011$, respectively) in severe OSA patients when adjusted for age, BMI, glucose, and homeostasis model assessment-insulin resistance (HOMA-IR). Furthermore, OSA patients carrying the T allele of R59W had lower levels of HDL-C and apolipoprotein A-I (APOA-I) after adjusting for age and BMI ($\beta=-0.079$, $P=0.024$; $\beta=-0.1$, $P=0.004$, respectively).

Conclusion: Our study revealed that serum levels of both ANGPTL4 and ANGPTL8 were affected by CIH, while both the ANGPTL4 T266M and ANGPTL8 R59W variants were associated with dyslipidemia accumulation. Both CIH and ANGPTL4 and ANGPTL8 variants were involved in dyslipidemia of OSA and might have important roles in lipid regulation.

THE COMPARATIVE EFFECTIVENESS OF A SIMPLE ALARM-BASED SUPINE-AVOIDANCE DEVICE VERSUS USUAL CARE WITH CONTINUOUS POSITIVE AIRWAY PRESSURE FOR TREATING PATIENTS WITH SUPINE PREDOMINANT OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is the most common pathological problem of breathing in sleep, and affects around 25% of males and 10% of females. Around 30% of OSA patients show positional OSA (POSA) where abnormally frequent airway obstruction occurs only in supine sleep. Thus, simply avoiding supine sleep could be an effective therapy in this group. Traditional methods of supine avoidance (e.g. strapping a tennis ball to the back) are inherently uncomfortable and most patients self-report abandoning discomfort-based supine avoidance treatment within one month. Non-discomfort supine-alarm devices are now widely available, but there is a lack of data on comparative effectiveness to reduce daytime sleepiness, the primary complaint in OSA, and treatment compliance compared to standard treatment with constant positive airway pressure (CPAP). This study aimed to test the hypothesis that alarm-based supine-avoidance is non-inferior to CPAP at reducing sleepiness, and achieves superior treatment adherence at 2 months in patients with POSA.
Method: 66 patients with POSA and Epworth sleepiness scale (ESS)≥8 completed baseline measurements including questionnaires, inactive supine-avoidance for 1 week for supine-time measurements, and in-home full sleep study, before randomisation to active supine-avoidance or CPAP treatment, followed by cross-over to the remaining treatment after 2 months. Repeat questionnaires, sleep studies and treatment compliance measurements were collected after 2 months on each treatment. Non-inferiority was assessed from the change in ESS with supine-avoidance compared to CPAP using a pre-specified non-inferiority margin of 1.5. Average nightly use over 2 months was also compared between treatments.
Results: Patients were predominantly males (62%) aged (mean±SD) 52.8±11.9 years, body mass index 31.9±7.8 kg/m², with POSA (total, supine and non-supine AHI 18.0±8.9, 40.2±38.8, 5.0±3.2 /hr respectively), 47.6±20.4% supine sleep and ESS 10.3±3.9. At 2 months the reduction from baseline in ESS with supine-avoidance (mean [95%CI] -1.9 [-2.9 to -0.9]) was no worse than CPAP (-2.3 [-3.3 to -1.3], difference -0.2 [-1.3 to 0.9]). Average treatment usage was substantially higher with supine-avoidance compared to CPAP (5.6 [5.0 to 6.3] versus 3.9 [95%CI 3.2 to 4.6] h/night, p< 0.001).
Conclusion: This study supports that alarm-based supine-avoidance is non-inferior to CPAP at reducing sleepiness and achieves superior 2 month treatment adherence in patients with POSA.

OBSTRUCTIVE SLEEP APNEA (OSA) AND FLOPPY EYELID SYNDROME- AN EYE OPENER

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Introduction: Obstructive sleep apnea (OSA) is a common yet under diagnosed sleep disorder associated with partial or complete obstruction of upper airway during sleep. Floppy eyelid syndrome (FES) is another frequently overlooked diagnosis associated with lax upper eyelids, a soft and foldable tarsus, and a chronic papillary conjunctivitis of the upper palpebral conjunctiva. There has been growing literature to support the association between the two and this study is an attempt to explore the same and also the clinical implications in an Indian scenario.

Materials and methods: Retrospective study from 2015 to 2018 at Nithra Institute of Sleep Sciences, India. Fifty-one consecutive patients diagnosed with FES at an ophthalmic care hospital, and referred for evaluation of suspected OSA based on symptoms of snoring and daytime hypersomnolence, during 2015 to 2018. Subjects underwent clinical evaluation and sleep study.

Results: All the referrals were males and the mean age was 49.8 ± 13.4. Of 51 patients, 13 (25.4%) were not willing to undergo sleep study as they were unwilling to accept the possible association of OSA and FES and/or could not afford additional testing. Thirty-six of the 38 patients with FES were diagnosed of OSA (94.8%) and 20/38 had severe OSA (55.5%). Some of them had additional concerns such as weight gain (15.7%) or comorbidities like Hypertension (13.7%) or diabetes mellitus (11.8%). Of the 38 patients diagnosed with OSA only one patient accepted Continuous Positive Airway Pressure (CPAP) therapy.

Conclusions: Previous studies have observed a male predominance with regards to presence of both FES and OSA, which has been reestablished in our study although a selection bias cannot be excluded. Significant proportion of the patients were not ready to undergo the study or commence treatment despite being diagnosed and explained the consequences of untreated severe OSA.

Ophthalmologists were able to effectively screen patients for OSA with simple screening questions about snoring and daytime hypersomnolence. Knowledge about OSA and its association with disorders specific to their domain would help them treat patients more holistically and thus improve the prognosis.

BEYOND THE AHI - USING BREATH-BY-BREATH FLOW AMPLITUDE TO QUANTITATE SEVERITY OF OSA

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Introduction: To date no optimal physiological metric has been proposed capturing severity of obstructive sleep apnea (OSA), which is desirable for diagnosis, for "phenotyping" patients and potentially for predicting response to therapy. The Apnea Hypopnea Index (AHI) is widely used but captures only the occurrence rate of sleep respiratory events. It has been repeatedly observed that the AHI has many conceptual and demonstrable limitations, including mediocre correlations with most physiologic, epidemiologic and prognostic outcomes. Attempts to improve the utility of AHI have included changing the definition of "hypopnea," attempts to integrate event duration, event severity or hypoxemia. However, few of the metrics proposed show substantially increased correlations to sleepiness, cardiovascular outcomes or separating "normal" from disease in epidemiological studies. Recent work suggests the nature of the "obstruction," ie aspects of the typical reduction of flow during obstructive events, may hold information beyond the number of such events (ie the AHI). However, no examination of the distribution of the severity of obstruction of individual breaths has been proposed. The present abstract describes a new approach to visualizing this distribution of breath size solely obtained from airflow collected during a whole night of sleep in the lab or at home.

Method: From standard NPSGs containing a nasal cannula/pressure transducer signal, individual breaths were identified using custom software (Minerva). The amplitude of each breath was expressed as a % of the moving average of the prior breaths, excluding from the average all flow-limited (flat) breaths and all hyperventilatory breaths (>1.5 times the current average). For each apnea n "zero flow breaths" are imputed where n=apnea duration/current respiratory frequency. Plots display cumulative frequency of breaths (y axis) as a function of %amplitude (x axis) and histograms display % breaths in each size bin. From data in normals, breath size 80-120% is taken as "normal".

Results: Plots of 16 Normal Subjects without sleep complaints defined a normal range. 26 Patients with AHI4%>5/hr show a spectrum of leftward shift with mild (5-15) and moderate(15-30) AHI overlapping.

Conclusions: These plots of normal/sleep apnea patients show proof of principle that breath size distribution quantitates severity of OSA.In normal subjects without significant obstructive sleep apnea most breath amplitudes are ~80-120% and very few small breaths occur. Patients with sleep apnea show small breaths, a left shift of the cumulative distribution and an increased number of "overshoot" breaths. The median position of the cumulative curve is loosely related to the AHI and may relate to Pcrit. The "overshoot" breaths may capture loop gain and arousal threshold responses. In histogram plots, % breaths in 0-20% size and 20-40% size bins capture "severe events" while bins 60-80% capture "mild" obstructive events. The latter may indicate how easily a patient can be treated by non-CPAP therapies. The % of "severe" events and the amount of "overshoot" may suggest poor responses to certain treatments. These parameters may capture total "obstructive burden" better than the AHI, absent desaturation. Application of the approach in large datasets with established outcomes remains to be tested .

LATE CHRONOTYPES REPRESENT AN INCREASED CARDIOVASCULAR RISK FOR OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS - A PILOT STUDY

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Introduction: Arterial blood pressure (ABP) follows a circadian rhythm that is mainly related to the wake/sleep periods. Obstructive sleep apnea (OSA) reduces or abolishes the physiological reduction of ABP during the night period. It is not known, if the combination of circadian rhythm disorders furthermore interferes with the hemodynamic pattern in OSA patients.

Materials and Methods: In this pilot study we included 16 OSA patients from the Portuguese Sleep Medicine Center (CENC). Participants were divided in normal types and late types according to the value of their Mid-sleep-Time (MSF) analyzed by Munich Chronotype questionnaire (MCTQ) (MSFsc³3 - < 5 vs. MSFsc³5). The social jetlag (SJL) was also calculated for each participant. All patients underwent complete polysomnographic (PSG) recording with a Somnocreen device (Somnomedics, Germany). Beside the routine parameters we analyzed the ABP by pulse transit time (PTT) via the Domino software. During the first two sleep cycles periods of 10 minutes sleep were compared by dividing the sleep in: light sleep (N1/2); slow wave sleep (N3) and REM sleep. The student-t test for independent samples (SPSS vs. 25) was applied to compare results with a significance level of $p < 0.05$.

Results: Mean age: 52.2±8.1, mean BMI 27.8±3.5. A total of 9 OSA patients demonstrated a regular chronotype (OSA-RT) and in 7 we found a late chronotype (OSA-LT).
Within the two groups we detected no significant difference for any of the PSG values (total sleep time, sleep latency, efficiency, micro arousal index, N1, N2, N3 and REM percentages, apnea/hypopnea index and oxygen desaturation index) SJL was significantly higher for the OSA-LT: 1.7±0.7, OSA-RT :1.0±0.6 ($p < 0.05$). The PSG morning wake-up time was later in OSA-LT ($p < 0.05$). The sleep stage analysis of the cardiovascular parameters showed that the mean heart rate was always higher in the OSA-LT group and the mean systolic BP was higher in wake and REM. We detected no o differences for the diastolic ABP

Conclusion: This pilot study demonstrates, that a late chronotype was associated with possibly negative ABP pattern in OSA patients. To our knowledge the influence of the chronotype has not been yet investigated in sleep related breathing disorders. The assessment of a larger cohort is warranted to confirm our preliminary results.

CORRELATION ANALYSIS OF VASCULAR ENDOTHELIAL FUNCTION IN PATIENTS WITH OSA COMBINED WITH HYPERTENSION

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Introduction: Obstructive sleep apnea (OSA) can induce vascular endothelial dysfunction through intermittent hypoxia-induced inflammation, which can lead to hypertension and multi-system damage of heart and cerebrovascular. Reactive hyperemia index (RHI) can reflect vascular endothelial function, with a critical value of 1.67. When RHI is less than 1.67, vascular endothelial function is significantly impaired. Through clinical examples, this study observed and explored the related factors affecting endothelial function in patients with OSA and hypertension.

Materials and methods: This study included 37 patients with OSA combined with hypertension were included in this study. The apnea hypoventilation index（AHI）, the lowest oxygen saturation（SaO_2）, the mean systolic pressure（MSBP）at 24 hours, the mean diastolic pressure（MDBP）at 24 hours, the MSBP at night and the MDBP at night were recorded. The changes of vascular tension mediated by endothelial cells were detected by fingertip biosensor, and the RHI was calculated and recorded，and using bivariate correlation analysis to explore the correlation between them.

Results: There is no correlation between RHI and AHI, lowest SaO_2, MSBP at 24 hours，MSBP at night in patients with OSA and hypertension. But when RHI is less than 1.67 and the lowest SaO_2 is less than 80%, there is a significant positive correlation between them (R=0.477, P=0.007). RHI is positively correlated with night MDBP (R=0.368, P=0.025) and 24-hour MDBP (R=0.383, P=0.019).

Conclusions: The study suggests that the damage of endothelial function caused by OSA—induced intermittent hypoxia is not obvious in patients with mild or moderate hypoxemia，but severe hypoxemia can significantly impair vascular endothelial function. At the same time, intermittent hypoxia can lead to sympathetic nerve excitation and increase oxidative stress, especially when patients are accompanied by severe hypoxemia, it can lead to the aggravation of systemic inflammatory response, and further，it can cause vascular endothelial dysfunction and metabolic disorder，and then，it can result in decreased vascular compliance and increased MDBP throughout the day and at night. The number of cases is relatively small, which can not be further grouped, compared and explored, and needs to be collected for multi-case analysis and summary.

Sleep Breathing Disorders
Board #307 : Poster session 1

APNEA-HYPOPNEA EVENTS DURING REM/NON-REM SLEEP AND HYPERTENSION AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) has been associated with hypertension. It is possible that the association between OSA and hypertension is distinct for non-REM versus REM sleep because of differences in sleep-state-dependent sympathetic activation and/or degree of hypoxemia. We intended to examine the association between REM-related/non-REM-related OSA and hypertension, and whether the severity of OSA modifies such association.

Materials and methods: A total of 10,102 patients with apnea-hypopnea index (AHI) ≥ 5/h were recruited into this study (83.8% males, mean age = 44.92 ± 11.86 years). Hypertension was defined based either on direct blood pressure measures or on physician diagnosis. OSA severity during REM and non-REM sleep was quantified using the apnea-hypopnea index in REM (AHI_{REM}) and non-REM sleep (AHI_{NREM}), respectively. Linear regression was used to assess the associations of AHI_{REM} and AHI_{NREM} with hypertension and blood pressure.

Results: A 53.4% was found to have hypertension in total observed OSA patients. After adjusting for age, gender, body mass index (BMI), Epworth sleepiness scale, tobacco use, alcohol use, nocturnal oxygen desaturation, sleep duration and efficiency, AHI_{REM} was only associated with diastolic blood pressure (DBP), while AHI_{NREM} was associated with percentage of hypertension, systolic blood pressure (SBP) and DBP. Among mild-moderate OSA patients, AHI_{REM} was associated with DBP (B = 0.87; 95% CI, 0.05-1.58; P = 0.037) while AHI_{NREM} was not; among severe OSA patients, AHI_{NREM} was associated with percentage of hypertension
(B = 0.28; 95% CI, 0.18-0.37; P < 0.001), SBP (B = 7.49; 95% CI, 4.53-10.44; P < 0.001) and DBP
(B = 7.23; 95% CI, 5.07-9.38; P < 0.001) , whereas AHI_{REM} was not.

Conclusions: The association between AHI_{REM}/AHI_{NREM} and hypertension varies across the severity of OSA. Significant association to AHI_{REM} was found in mild-moderate patients, whereas association to AHI_{NREM} was only shown in severe patients.

SLEEP OBSTRUCTIVE APNEA AND SLEEP ARCHITECTURE IN PATIENTS WITH DOWN SYNDROME: A POLYSOMNOGRAPHIC STUDY

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Introduction: Down Syndrome (DS) is the most common genetic disorder with an estimated prevalence of 3.05 to 14 per 10.000. The prevalence of obstructive sleep apnea (OSA) is about 50% to 100% in patients with DS compared to 1% to 5% in the general pediatric population. Early diagnosis and treatment of OSA are important, since it has been implicated as a contributing factor in a population susceptible to pulmonary hypertension, cardiovascular complications, failure to thrive, impaired cognition, and behavioral problems. The American Academy of Pediatrics (AAP) recommends a polysomnography (PSG) for four year olds regardless of symptoms. Some authors have described that sleep architecture is altered in children with DS independently of OSA severity with increased slow-wave sleep and reduced REM sleep. The aim of the present study was to describe the sleep architecture and OSA in children and adolescents with DS.

Materials and methods: A retrospective review of PSG was conducted between August 2017 and April 2019. The PSG was scored based on the American Academy of Sleep Medicine guideline. This included the monitoring of six electroencephalograms, electro-oculogram, submental and tibial electromyogram, chest and abdominal wall inductance plethysmography, airflow measurements (nasal pressure and thermistor), oxygen saturation and video recordings. Apnea events were classified as obstructive, central or mixed. The severity of OSA was categorized using an Obstructive Apnea-Hypopnea Index (OAHI). An OAHI between one and five events/hour was considered mild, between five and ten was moderate and greater than ten was categorized as severe. Associations between sleep architecture characteristics and OSA severity were examined using Fisher's exact test. Spearman´s correlation coefficient was used to assess correlations between OAHI and the lowest saturation (%SpO2 Nadir).

Results: A total of 77 children and adolescents with DS who underwent PSG were included. Their age ranged from 1-18 years (median 6), and 51.04% (47) were males. All subjects were found to have OSA, 22,07% (17/77) were mild, 35,06% (27/77) moderate and 42.87% (33/77) severe. The meant OAHI was 10.48 events/hour (1.30 to 72), and the median was 6.15 events/hour. In addition, 31.16% (24/77) presented poor sleep efficiency (less than 85%), reduction in REM sleep (59.74% of DS children spent ≤ 25% of total sleep time in REM). There was not a significant correlation between OAHI severity and the sleep efficiency (p=0.6644) or a diminished REM sleep (p=0.6904). OAHI severity was correlated with %SpO2Nadir (Spearman'´ r = -0.4616; p = 0.00002) and arousal index (p=0.0342).

Conclusions: Our data confirmed the high prevalence and the severity of OSA in children and adolescents with DS. Sleep architecture is altered and a reduced REM sleep was not correlated to OSA severity. Moreover, the AAP recommendation must be followed in order to get an early diagnosis and treatment and to prevent the consequences of OSA.

Sleep Breathing Disorders
Board #315 : Poster session 2

PARENTAL PERCEPTION OF OBSTRUCTIVE SLEEP APNEA IN DOWN SYNDROME CHILDREN AND ADOLESCENTS AND ITS CORRELATION WITH POLYSOMNOGRAPHIC DATA

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Introduction: Obstructive Sleep Apnea (OSA) is highly prevalent, more complex and severe in Down Syndrome (DS), which is the most common chromosomal disorder. This increased prevalence is likely related to a combination of anatomic abnormalities that are predisposing risk factors to develop airway obstruction (midfacial and mandibular hypoplasia, a narrow nasopharynx, relative macroglossia, adenotonsillar hypertrophy, generalized hypotonia) and a greater risk of additional comorbidities (respiratory infections, thyroid dysfunction, obesity, gastroesophageal reflux, laryngomalacia). Some studies have showed a poor correlation between parental perception of sleep respiratory symptoms and OSA.The aim of the present study is to evaluate the prevalence of OSA in DS children and adolescentes and to investigate if parental perception, age, gender or Body Mass Index (BMI) correlates with OSA severity.

Materials and methods: A cross-sectional study was performed in 74 DS children aged 1-18 years old referred for full overnight PSG at Sleep Lab from August 2017 to April 2019. Sleep intake forms assessing sleep parent-observed apnea, snoring and daytime sleepiness were completed by parents before the beginning of PSG. OSA severity was categorized in accordance with an obstructive apnea/hypopnea index (oAHI) as follows: mild oAHI between one and five events/hour, moderate oAHI between five and ten and severe oAHI greater than ten. Fisher´s exact test and Kruskall-Wallis test were used to assess the relationship between symptoms referred by parents, age, gender or Body Mass Index and OSA severity.

Results: PSG data and sleep intake forms were performed in 74 DS children (44 boys), median age 6 years old (1-18), and body mass index (BMI) median 17.31 (9.07 - 50.5). The overall prevalence of OSA was 100%, 16 (21,63%)26 (35,13%) presented mild OSA, 26 (35,13%) moderate and 32 (43,24%) severe OSA. OSA severity was not associated with parental reports of apnea (p=0.4987), daytime sleepiness (p=0.7499) and snoring (p=0.514). Sex (p=0.0957), BMI (p=0.2482) and age (p=0.9154) were not correlated with OSA severity.

Conclusions: prevalence of OSA was 100% in our sample of DS children and did not correlate with parental perception, age, gender or BMI. This indicates the importance of establishing protocols for early diagnoses of OSA regardless of the symptoms,

RECRUITMENT OF PATIENTS WITH CHRONIC KIDNEY DISEASE AND OBSTRUCTIVE SLEEP APNEA FOR A CLINICAL TRIAL

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Introduction: Obstructive sleep apnea (OSA) is common in patients with chronic kidney disease (CKD) and may accelerate the decline in kidney function. Although observational studies suggest that treatment of OSA with continuous positive airway pressure (CPAP) may slow the decline in kidney function in patients with CKD, there have been no well-designed trials to assess this. However, recruitment for such a trial may be challenging since OSA may be asymptomatic in patients with CKD and does not have proven benefit for kidney function. The objective of this study was to identify the challenges associated with recruitment of CKD patients for a trial in which they are screened for OSA and randomized to receive CPAP therapy for 12 months.

Materials and methods: Patients attending outpatient nephrology clinics who were 18-76 yrs old and had CKD stage 3 or 4 (estimated glomerular filtration rate (eGFR) 15-59 ml/min/1.73m^2) were asked to perform a home sleep apnea test (HSAT), regardless of sleep symptoms. Those with OSA who had an oxygen desaturation index (ODI, 4% desaturation) > 5 and oxygen saturation < 90% for more than 12% of the recording time were invited to participate in the study. Exclusion criteria included severe daytime sleepiness (Epworth Sleepiness Scale > 15), commercial driver who reported a recent road traffic accident, mean oxygen saturation (SaO_2) < 80% on the HSAT, awake hypoxemia (PaO_2 < 60mmHg), and/or hypercapnia ($PaCO_2$ > 45mmHg). All patients who met these inclusion and exclusion criteria and who consented to participate in the study were scheduled to receive a standardized education session about OSA and CPAP and subsequently randomized to receive CPAP or not.

Results: Between June 2015 and June 2018, 1,501 patients who were scheduled to attend the nephrology clinic met the age and eGFR inclusion criteria. However, only 54 of these patients were ultimately randomized. The sequential reasons (and number of patients) for recruitment failure were as follows: no show at clinic appointment (123), insufficient recruiters to approach every eligible patient (404), OSA currently treated with CPAP (110), unable to provide informed consent (62), refused consent (589), HSAT not completed (47), HSAT inclusion criteria not met (104), declined education session (8). All patients who attended the education session agreed to randomization.

Conclusions: The commonest recruitment challenges we encountered were inability to meet with every patient who attended clinic and failure to obtain patient consent. These preliminary data can be used to improve recruitment strategies and the design of future studies.

DANGEROUS DRIVING RISK IN DRIVERS WITH OBSTRUCTIVE SLEEP APNEA WHO EXPERIENCE FATIGUE

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Introduction: Most of the studies that evaluate risk of dangerous driving in individuals with obstructive sleep apnea (OSA) examine the role of sleepiness. It is known that fatigue is also a very common complaint among drivers with OSA, however, fatigue and sleepiness are rarely examined separately when assessing risk for dangerous driving in this population. The present investigation examines the role of daytime sleepiness and fatigue and how these relate to driving simulator performance in a newly diagnosed, untreated sample of individuals with OSA.

Materials and Methods: Participants with OSA (N=13; age: M=48.72, SD=10.02) were recruited from sleep clinics shortly after being diagnosed with OSA. Age- and gender-matched Control participants (N=5, age: M=43.77, SD=17.69) were recruited from the community through media advertisements. All participants completed a questionnaire on fatigue and sleepiness (*Empirical Sleepiness and Fatigue Scale, ESFS*). They also performed a 1.3 hour driving simulation task at the Université de Montréal driving simulator laboratory. Participants were categorized into high/low fatigue and high/low sleepiness groups based on median splits on ESFS scores. Driving performance tests were scheduled at either 2 PM or 3:30 PM, a time period associated with a peak for daytime sleep-related accidents. All participants completed a 20-minute warm-up at the beginning of the driving simulation task. The simulation task was designed to be monotonous, to facilitate sleepiness at the wheel. Location of the pedals as well as location and speed of the vehicle were recorded throughout the task. A potentiometer attached to the steering column allowed detailed recording of steering wheel movements. Data were then analyzed in 3 time periods: after 20 minutes, 40 minutes and 60 minutes. Three measures were obtained for each of the three time periods: standard deviation of lateral position, standard deviation of speed, and standard deviation of orientation of steering wheel (lower scores indicate better performance).

Results: Throughout the trajectory, the standard deviation of the lateral position on the road deteriorated for most participants with high scores on the fatigue scale (Manova; F = 5.452, p < 0.05). After 40 minutes, only the performance of participants with sleep apnea and high scores on the fatigue scale deteriorated significantly (Manova; F = 3.733, p < 0.05): participants with OSA who report more fatigue had significantly more difficulty maintaining the lateral position on the road. No significant differences were found for sleepiness in either group.

Conclusions: Participants reporting less fatigue appeared to have reached a plateau after 40 minutes of driving, whereas the performance of participants complaining more of fatigue continued to deteriorate. High levels of fatigue in individuals (as distinct from sleepiness) with OSA could be a risk factor for experiencing greater variations of lateral position (i.e. "weaving") on the road - a known risk for dangerous driving.

Sleep Breathing Disorders
Board #311 : Poster session 3

SLEEP-DISORDERED BREATHING IN ADOLESCENTS WITH OBESITY: WHEN DOES IT START TO AFFECT CARDIOMETABOLIC HEALTH?

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Introduction: Pediatric obesity and sleep-disordered breathing (SDB) are closely and independently associated with cardiometabolic risk (CMR), but the degree of severity at which SDB affects cardiometabolic health is unknown. In this context, we assessed the relationship between the CMR and the apnea-hypopnea index (AHI), tending to identify a threshold of AHI from which an increase in the CMR is observed, in adolescents with obesity. We also compared the clinical, cardiometabolic and sleep characteristics between adolescents presenting a high (CMR+) and low CRM (CMR-), according to the threshold of AHI.

Materials and methods: 114 adolescents with obesity were recruited from three institutions specialized in obesity management. Sleep and SDB as assessed by polysomnography, anthropometric parameters, fat mass (FM), glucose and lipid profiles, and blood pressure (BP) were measured at admission. Continuous (MetScore$_{FM}$) and dichotomous CMR (MetS) were determined. A sensitivity analysis was conducted to determine the best threshold of AHI from which CMR was increased using effect-size for univariate analyses and regression coefficients (β) for multivariable analyses.

Results: Data of 82 adolescents were analyzed. Multivariable analyses enabled us to identify a threshold of AHI$\geq$2 above which we observed a strong and significant association between CMR and AHI (Cohen's d effect-size=0.57 [0.11;1.02] p=0.02). Adolescents with CMR+ exhibited higher waist circumference (p< 0.05), insulin resistance (p< 0.05), systolic BP (p< 0.001), sleep fragmentation (p< 0.01) and intermittent hypoxia than CMR- group (p< 0.0001). MetS was found in 90.9% of adolescents with CMR+, *versus* 69.4% in the CMR- group (p< 0.05).

Conclusions: In the current context of the continued increase in pediatric obesity worldwide, the identification of a threshold of AHI $\geq$2 corresponding to the cardiometabolic alterations in adolescents with obesity seems of major importance since it highlights the need for the early diagnosis and management of SDB, even when considered as mild, and of obesity in adolescents, in order to prevent cardiometabolic diseases.

EFFECTIVENESS OF AN INTENSIVE WEIGHT-LOSS PROGRAM FOR SEVERE OBSTRUCTIVE SLEEP APNEA SYNDROME (OSA) IN PATIENTS UNDERGOING CPAP TREATMENT: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Obstructive sleep apnea syndrome (OSA) is a common disorder affecting 14% of men and 5% of women when defined by an apnea-hypopnea index (AHI) of 5 or more plus symptoms of daytime sleepiness. Obesity, particularly central adiposity, is one of the main risk factors for sleep apnea. Weight loss is considered to be an adjuvant treatment for OSA. We hypothesized that patients with obesity and OSA who are already undergoing CPAP treatment are able to achieve weight loss and subsequently a general improvement in OSA, as well as obtaining beneficial effects on metabolic syndrome and subclinical cardiovascular disease. This study therefore aimed to determine whether an intensive weight-loss program is effective for reducing weight, the severity of sleep apnea syndrome and metabolic variables in patients with obesity and severe OSA undergoing continuous positive airway pressure treatment.

Materials and Methods: 42 patients were randomized to the control (CG,n=20) or the intervention group (IG,n=22), who followed a 12-month intensive weight-loss program. The primary outcome was a reduction in the apnea-hypopnea index as measured at 3 and 12 months by full polysomnography. Metabolic variables, blood pressure, body fat composition by bioimpedance, carotid intima media thickness and visceral fat by computed tomography scan were also assessed.

Results: Mean age was 49(6.7) years, body mass index 35(2.7) kg/m^2 and AHI 69(20) events/h. Weight reduction was higher for the IG than the CG at 3 and 12 months, -10.5 vs -2.3 kg (p< 0.001), and -8.2 vs -0.1 kg (p< 0.001), respectively, as was loss of visceral fat at 12 months. AHI decreased more in the IG at 3 months (-23.72 events/h vs -9 events/h) but the difference was not significant at 12 months, though 28% of patients from the IG had an AHI < 30 events/h compared to none in the CG (p=0.046). At 12 months, the IG showed a reduction in C-reactive protein, -1 vs 0 mg/L (p=0.013), glycated hemoglobin, -0.2 vs -0.1 % (p=0.031) and an increase in high density lipoprotein cholesterol, 0.2 vs -0.02 mmol/L (p=0.027).

Conclusions: An intensive weight-loss program in patients with obesity and severe OSA is effective for reducing weight and OSA severity. It also results in an improvement in lipid profiles, glycemic control and inflammatory markers.

INCIDENCE AND DURATION OF COMMON ADVERSE EVENTS IN 2 SOLRIAMFETOL PHASE 3 STUDIES FOR TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN OBSTRUCTIVE SLEEP APNOEA AND NARCOLEPSY

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Introduction: Excessive daytime sleepiness (EDS) is common among individuals with obstructive sleep apnoea (OSA) or narcolepsy. Solriamfetol (formerly JZP-110), a dopamine and norepinephrine reuptake inhibitor, has been approved in the United States to improve wakefulness in adult patients with EDS associated with OSA or narcolepsy. A Marketing Authorisation Application for these indications is under review with the European Medicines Agency. The approved dose range of solriamfetol in the United States is 37.5 to 150 mg/day in OSA and 75 to 150 mg/day in narcolepsy. This post-hoc analysis evaluated the weekly incidence and overall duration of common early-onset treatment-emergent adverse events (TEAEs) during solriamfetol treatment in the two 12-week pivotal trials.

Materials and methods: Participants (OSA, N=474; narcolepsy, N=236) were randomised to 12 weeks of placebo or solriamfetol 37.5 (OSA only), 75, 150, or 300 mg. For any common, early-onset TEAEs (defined as those occurring in ≥5% of participants in any solriamfetol dose group and >placebo during week 1), the incidence of any new occurrence or worsening in severity over time was calculated for each subsequent study week. Data were analysed separately for each study. Analyses were summarized by placebo (OSA, n=119; narcolepsy, n=59) and combined solriamfetol (doses ≤150 mg: OSA, n=237; narcolepsy, n=118; all doses: OSA, n=355; narcolepsy, n=177).

Results: In the OSA study, common early-onset TEAEs during week 1 (doses ≤150 mg/all doses) were headache (5.1%/5.1%), decreased appetite (4.2%/5.6%), feeling jittery (3.0%/3.7%), nausea (2.5%/3.7%), anxiety (2.1%/3.9%), and insomnia (1.3%/3.1%). Incidence was highest at week 1 and decreased over time. Eleven of 25 TEAE-related discontinuations on solriamfetol were due to common early-onset TEAEs (all between weeks 3-9). Median durations of common early-onset TEAEs (doses ≤150 mg/all doses) were 8/5.5 days for headache; 18/57 days for decreased appetite; 4/4 days for feeling jittery; 8/10 days for nausea; 36/26 days for anxiety; and 21/8.5 days for insomnia.
In the narcolepsy study, common early-onset TEAEs during week 1 (doses ≤150 mg/all doses) were headache (8.5%/11.9%), decreased appetite (5.9%/7.9%), nausea (4.2%/5.7%), and dry mouth (4.2%/5.1%). Incidence was highest at week 1 and decreased over time. Of 9 TEAE-related discontinuations on solriamfetol, 1 was due to common early-onset TEAEs (at week 8). Median durations of common early-onset TEAEs (doses ≤150 mg/all doses) were 2/2 days for headache; 80/79 days for decreased appetite; 5/5 days for nausea; and 82/80 days for dry mouth.

Conclusions: In participants with OSA or narcolepsy, common early-onset TEAEs during solriamfetol treatment included decreased appetite, headache, and nausea, as well as anxiety, feeling jittery, and insomnia in participants with OSA, and dry mouth in participants with narcolepsy. At doses ≤150 mg, headache, nausea, and feeling jittery had median durations ≤10 days; decreased appetite, anxiety, insomnia, and dry mouth had longer median durations. Common early-onset TEAEs accounted for 44% of TEAE-related

discontinuations in OSA and 11% in narcolepsy. This analysis may inform clinician and patient expectations regarding the type and duration of common early-onset TEAEs associated with solriamfetol.

Sleep Breathing Disorders
Board #310 : Poster session 1

SLEEP APNEA DIAGNOSIS USING TRACHEAL RESPIRATORY SOUNDS AND MOVEMENT

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Introduction: Sleep apnea is a chronic respiratory disorder due to intermittent partial (hypopnea) or complete (apnea) collapse of the pharyngeal airway during sleep. Approximately, 26% of the Canadian adults are at high risk of sleep apnea, and it is becoming more prevalent as the population ages and becomes more obese and sedentary. However, due to the complexity and limited access to polysomnography (PSG), 84% of Canadians who are at high risk of sleep apnea are not diagnosed. To address this problem, a robust and cost-effective home based technology to assess sleep apnea severity is required. Thus, we aimed to develop a new algorithm for sleep apnea diagnosis using respiratory sounds and respiratory related movement recorded over trachea.

Materials and methods: Adults referred to the sleep laboratory of Toronto Rehabilitations Institute for suspected sleep apnea were recruited for this study. Simultaneously with PSG, respiratory sounds and respiratory movement were recorded over the suprasternal notch using The Patch. The Patch is a wearable device developed by our group, which includes a microphone to record respiratory sounds and an accelerometer to record respiratory movement in 3 dimensions.

We developed an automatic algorithm to differentiate quiet breathing and snoring segments from the respiratory sounds. The accelerometer signal was low-pass filtered to extract respiratory related movements. Energy and duration of breathing and snoring segments as well as the magnitude of respiratory related movements were extracted. Extracted features were normalized between 0 and 1 and the weighted average of the features were estimated and compared with an adaptive threshold to detect apneas and hypopneas. The threshold was variable to compensate for the effects of wakefulness and body position. We increased the threshold in the breathing segments around the time that subject was upright which shows high probability of wakefulness, and lowered the threshold for the supine position.

The number of apneas and hypopneas per hour of recording time (apnea-hypopnea index, AHI) was estimated. Estimated AHI was compared to the AHI obtained from PSG (PSG-AHI) scored by technicians according to standard criteria.

Results: Data from 59 subjects (35 had AHI≤15, 10 had 15< AHI< 30, 14 had AHI≥30), age: 50.2 ± 16.2 years, BMI: 29.6 ± 5.4 kg/m^2 were investigated. A high correlation was found between the estimated AHI and PSG-AHI ($r = 0.84$, $p < 0.01$). Considering AHI cut-off of 15, sensitivity and specificity of diagnosing sleep apnea were 84.0% and 85.3%, respectively.

Conclusion: Utilizing a microphone and an accelerometer embedded in a small wearable device, we could achieve very high accuracies in diagnosing sleep apnea. Our proposed system is easy to attach and comfortable for the participants. Introduction of small, cost-effective and easily accessible wearable devices for monitoring of sleep apnea will significantly increase the diagnostic rate of sleep apnea.

INVESTIGATION OF THE RELATIONSHIP BETWEEN SNORING SOUNDS FEATURES AND RESPONSE TO THE MANDIBULAR ADVANCEMENT DEVICES

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Background: Mandibular advancement devices have been increasingly used to treat obstructive sleep apnea (OSA). One of the main challenges with mandibular advancement devices is to predict responders. Consequently, efficacy of mandibular advancement devices is 40 to 60%. Snoring sounds analysis is a promising signal to assess the anatomy of upper airway and potentially predict the responders to mandibular advancement devices. Previous studies have shown that the 1st formant (F1) frequency of snoring sounds is positively associated with the degree of narrowing in the upper airway. Since mandibular advancement devices enlarge the upper airway area, their application is expected to decrease the F1. Therefore, we hypothesized that larger response to the mandibular advancement devices will be associated with more decreases in F1 of the snoring sounds.

Materials and Methods: OSA patients who accepted the mandibular advancement treatment were recruited from the dental clinic located at Toronto Rehabilitation Institute. During the treatment, the mandibular advancement devices were adjusted gradually in 4 to 5 sessions. Before and after the treatment, apnea-hypopnea index (AHI) was assessed using the polysomnography (PSG). The percentage reduction of AHI from the baseline was calculated from before to after treatment. Also, the subjects received a wearable device developed in our laboratory, The Patch, which includes a microphone to record breathing sounds and an accelerometer to record the body and neck movement. Before and after last treatment, the breathing sounds were recorded at participants' home by The Patch, which was placed over the suprasternal notch. From the recorded breathing sounds, snoring segments were automatically extracted (snoring detection accuracy: 96.3%). From the snoring sounds, the F1 of the snoring sounds was extracted using linear predictive coding method. For every night, the average F1 of all snores was calculated. The reduction in F1 from before to after treatment was estimated for every subject.

Results: Data from 4 subjects (3 females), age: 57.8±4.9 years, BMI: 29.5±8.2 kg/m^2 were investigated. From before the after treatment, AHI reduced by 67.6±3.4% (before: 26.8±11.0, after: 8.7±3.9 events/hr) and F1 reduced by 16.9±18.5 Hz (before: 424.1±46.0 Hz, after: 407.2±58.2 Hz). There was a trend of an association with the reduction in AHI and decreases in F1. Moreover, subjects with lower baseline F1 had a trend for a larger reduction in AHI after treatment. This may indicate that those with wider upper airway at baseline may have a larger positive response to the mandibular advancement devices.

Conclusion: Our preliminary study shows the proof of concept that enlargement of the upper airway with mandibular advancement could be monitored by the resonance frequency of snoring sounds. Furthermore, the association between baseline resonance frequency and reduction in AHI may demonstrate the predictive capability of snoring sounds features to assess mandibular advancement efficacy. Once validated in larger population, snoring sounds features could be used as a convenient tool to monitor the mandibular advancement treatment.

A FOLLOW-UP STUDY ON THE RELATIONSHIP BETWEEN AGING AND WEIGHT CHANGE ON MITIGATING SLEEP DISORDERED BREATHING IN JAPANESE COMMUNITY MEMBERS: THE TOON HEALTH STUDY

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Introduction: Weight gain and aging are major factors that worsen sleep disordered breathing (SDB). However, there are few studies that look at the difference on the effects of aging and weight changes on worsening SDB.

Materials and methods: There were 793 Japanese females aged 30-79 years who participated in the Toon Health Study, a prospective cohort study evaluating risk factors for cardiovascular disease prevention in a community setting, at baseline survey from 2009 to 2012. Respiratory disturbance index (RDI) was assessed by a single-channel airflow monitor. The difference in body weight and RDI were measured approximately five years after during the follow-up. The indicated age was taken at baseline. Those treated for SDB and those who did not have tracking data were excluded from this analysis. Female weight change (kg) was stratified into three parts: more than 75% (A-high), 75-25% (A-middle), and less than 25% (A-low). Smoking (B) and drinking (C) status were stratified into three parts, each with 75% or more (B/C-high), 75-25% (B/C-middle), less than 25% (B/C-low). The Wilcoxon signed rank sum test was used to test changes in SDB severity (median RDI) after stratification by gender, age and weight at a 5% level of significance.

Results: 1) The number of subjects by group was 193 in A-high, 393 in A-middle, and 207 in A-low. The drinking rates at baseline were 39%, 42%, and 44%. The smoking rates at baseline were 4.1%, 2.0%, and 4.8%. The average age by group was 58.5, 59.2, and 53.5. The change in RDI values after 5 years was A-high 9.5-11.7 (p< 0.0001), A-middle 8.5-11.4 (p< 0.0001), A-low 8.8-10.2 (p= 0.0015). In addition, changes in RDI values under the age of 61 (105 people) were 7.6-11.1 (p= 0.0002), 7.8-9.5 (p < 0.0001), 7.9-8.8 (p= 0.0245) respectively. The change in RDI values for those aged 61 and over (88 people) were 11.8 to 12.2 (p = 0.0072), 9.6 to 13.4 (p< 0.0001), 12.1 to 14.2 (p= 0.0249) respectively.
2) Among subjects in the non-smoking group, there were 185 in B-high, 385 in B-middle, and 197 in B-low. The change of the RDI value after 5 years were 9.5 to 11.8 (p< 0.0001), 8.5 to 11.4 (p< 0.0001), 9.1 to 10.3 (p= 0.0024) respectively.
3) Among subjects in the non-drinking group, there were 117 in C-high, 228 in C-middle, and 115 in C-low. The change in RDI value after 5 years was calculated as 9.3 to 11.3, (p= 0.0028), 9.1 to 12.6 (p < 0.0001), 9.8 to 11.0 (p= 0.0024) respectively.

Conclusion: We found that women in the community, after 5 years to follow-up, had SDB worsened regardless of weight change. In addition, the increase in RDI values after 5 years was not significant even when women were divided by non-smoking and non-drinking status. In the male population, in the group with less (low) weight change, SDB was significantly worsened. For male subjects, we plan to analyze the results of the ongoing 10 and 15-year follow-up.

EVALUATING SLEEP APNEA PATIENTS USING A MOBILE APPLICATION DESIGNED TO IMPROVE ADHERENCE TO TREATMENT - THE ESAMOBAPP STUDY

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Introduction: Obstructive sleep apnea (OSA) is associated with several serious health complications. Continuous positive airway pressure (CPAP) is an effective therapy for OSA, but adherence is a challenge. In the current technological era, strategies to improve adherence are necessary. We tested a mobile App designed to improve adherence to CPAP therapy.

Purpose: The aim of this study was to evaluate CPAP adherence in individuals who could access the mobile App.

Materials and methods: Individuals were prospectively recruited by two national sleep centers within a 4-month period (September to December of 2018). Inclusion criteria were: adults with newly diagnosed OSA and Apnea-hypopnea-index (AHI) ≥ 15/h (moderate/severe OSA). Fifty patients (n=50) were included in the study. They were split into two groups based on a cut-off value of 50% mobile App usage (> or < 15 days of usage/month): The High App Use (HAU) and Low App Use (LAU) groups, respectively. After one month of treatment, adherence data was retrieved, and a satisfaction survey was applied.

Results: 26 patients (52%) were included in HAU group and 24 patients (48%) in LAU group. Both were homogeneous relative to age, Body Mass Index (BMI), Epworth Sleepiness Scale (ESS) and AHI. Women showed a higher App usage (p=0,02; Wilcoxon). There was a significantly higher CPAP adherence in the HAU compared to the LAU group (73% vs 25%; p=0,001; Fisher's exact). Comparing HAU and LAU groups, there was a lower percentage of patients with residual AHI > 5 (19% vs 29%) despite no significant difference. Adaptation to CPAP treatment was superior in the HAU group (85% vs 50%; p=0,01; Fisher's exact). 96% of patients in the HAU group considered the mobile App helpful and only 25% of patients in the LAU group considered it unnecessary (p=0,04; Fisher's exact). 73% of the patients considered that the mobile App increased self-confidence while using CPAP (p=0,001; Fisher's exact). Air leaks were lower with App use, without statistical significance. In the HAU group, 73% of patients learned about OSA through the App usage.

Conclusions: Mobile App usage significantly increased CPAP adherence. The App was considered to be helpful, increased self-confidence and knowledge about the disease and respective treatment. It also significantly increased CPAP adaptation and seemed to help to control air leaks, contributing to a lower residual apnea-hypopnea-index.

PREVALENCE AND RELATED RISK FACTORS OF OBSTRUCTIVE SLEEP APNEA IN POSTMENOPAUSAL WOMEN

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Introduction: : Obstructive sleep apnea (OSA) is a common sleep disorder characterized by repeated episodes of complete or partial airflow cessation in the upper airway. Untreated OSA is associated with several consequences such as cardiovascular morbidity and mortality. It is known that male gender is a risk factor for OSA but post-menopausal women have an increased in incidence of OSA. This study aimed to investigate prevalence of OSA and related risk factors among post-menopausal women.
Materials and methods: Study participants in our epidemiological survey was randomly selected from population of Ardebil province, in north-western Iran. Study data were collected by phone interview and Berlin Questionnaire (BQ). We considered women older than 50 years old as post-menopausal women.
Results: In our study, 8.79% (9.26% in men and 8.43% in women) of study population (n=1569) were at risk of OSA. In post-menopausal women (>50 years old), frequency of OSA symptoms were significantly higher than non-menopausal women (p< 0.005) and although this frequency was higher than men of the same age but it was not statistically significant (p=0.16). Body mass index (BMI) in post-menopausal women was significantly higher than either men and non- menopausal women (p< 0.005)
Conclusions: According to higher prevalence of OSA among post-menopausal women, we need to design comprehensive preventive program for OSA in post-menopausal women and diet and weight management are very important factors

VALIDATION OF AN ELECTRONIC INSTRUMENT FOR THE TIMELY DETECTION OF OBSTRUCTIVE SLEEP APNEA SYNDROME IN THE MEXICAN POPULATION. PRELIMINARY RESULTS

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Introduction: Obstructive Sleep Apnea Syndrome is a serious and under-diagnosed sleep disorder that causes great occupational, economic and social losses for the patient and the state. The polysomnographic study is the gold standard for the definitive diagnosis of this condition, however, it is an expensive study and is not available for all patients. Instruments (questionnaire type) have been designed for the detection of these patients in other countries. Sptop Bang Questionnaire is an reliable, concise, and easy-to-use screening tool by Canadian researcher and has been validated in other Spanish-speaking countries showing adequate sensitivity to detect these patients. However, this has not been validated in the Mexican population. Our objective is to adapt and validate an electronic instrument of self-application in the Mexican population to improve coverage in the detection of these patients.
Material and methods: The Spanish translation of the STOP-BANG scale was carried out and the electronic version was designed on Google´s forms platform; The socio-demographic data and risk factors associated with Obstructive Sleep Apnea Syndrome not included in the original version were included in the electronic questionnaire. The pilot test was conducted electronically where 10 experts in sleep medicine and 26 people from the general population participated; the relevant adjustments were made until reaching 95% concordance of both groups and intergroup. A hyperlink was shared with our questionnaire to patients already diagnosed with OSA by PSG to the email of 85 patients and 212 people from the general population through social networks. The electronic questionnaire was applied to a total of 297.
Results: To obtain the validity and reliability of the electronic instrument, a factor analysis was carried out using the principal component method with varimax rotation, obtaining 2 factors that explain 50% the variance. Obtaining a Cronbach´s alpha 0.67 for the factors "risk factors" 0.67 and "apnea data" 0.67 the total questionnaire obtained Cronbach's alpha 0.75; a specificity of 61.3% and sensitivity 90.3%, with a PPV of 48.4 and NPV 94.2. The analysis was performed in the IBM SPSS version 25 program
Conclusions: Electronic instrument proved to be a valid and reliable with adequate sensitivity and specificity, so it can be used for a timely diagnosis of Obstructive Sleep Apnea.

WHAT ARE THE APPROPRIATE DIAGNOSTIC CRITERIA FOR OBESITY HYPOVENTILATION SYNDROME IN ASIAN POPULATIONS?

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Introduction: Obesity hypoventilation syndrome (OHS) is a condition with high morbidity and mortality. The diagnostic criteria for OHS include body mass index (BMI) over 30 kg/m^2 and daytime pCO_2 over 45 mmHg. However, these criteria may not be applicable in Thai or other Asian populations, as the criterion for obesity used in Asian populations is BMI over 25 kg/m^2. This study aimed to find diagnostic criteria for OHS that are appropriate for Thai patients.

Materials and methods: This study was a retrospective study conducted at Khon Kaen University´s Srinagarind Hospital. The inclusion criteria were adult patients diagnosed with OHS. Patients diagnosed with obstructive sleep apnea (OSA) were randomly selected as a control. The ratio of OHS:OSA was 1:4. Clinical factors associated with OHS were examined using multivariate logistic regression analysis.

Results: During the study period, there were 25 OHS and 108 OSA patients. The OHS group had a significantly higher average BMI (48.9 vs 29.2 kg/m^2) than the OSA group. The OHS group also had higher proportions of patients with pulmonary hypertension (50% vs 2%) and heart failure (76% vs 6.5%). There were two independent predictors for OHS including BMI and serum bicarbonate levels. The adjusted odds ratio (95% CI) for each of these factors were 1.08 (1.01, 1.17) and 1.96 (1.15, 3.34), respectively. Body mass index greater than 25 kg/m^2 and serum bicarbonate over 25 mEq/L yielded 100% sensitivity for OHS.

Conclusions: The appropriate diagnostic criteria for OHS for Asian populations may be different from those for populations in Western countries.

Sleep Breathing Disorders
Board #316 : Poster session 3

WHO WILL BUY A CONTINUOUS POSITIVE AIRWAY PRESSURE MACHINE IF DIAGNOSED AS OBSTRUCTIVE SLEEP APNEA? DO THE PATIENTS FOLLOW PHYSICIAN'S ADVICE?

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Introduction: Obstructive sleep apnea (OSA) is a common disease and related to major cardiovascular diseases such as hypertension or sudden death. The first line treatment for OSA is a continuous positive airway pressure (CPAP) machine. There are several factors associated with CPAP purchasing including insurance or educational level. This study aimed to add knowledge on predictors of CPAP purchasing in OSA patients.

Materials and methods: This study was a cross-sectional study and conducted at Sleep clinic, Khon Kaen University, Thailand. The study period was between July and December 2018. The inclusion criteria were adult patients diagnosed as OSA by polysomnography with an apnea-hypopnea index (AHI) of $\geq$ five events/hour and had experience with CPAP. A self-report questionnaire was used and comprised of baseline characteristics, OSA symptoms, effects of CPAP, side effects of CPAP, and persons who influenced patients' decision such as physicians or family members. Predictors of CPAP purchasing were analyzed by multivariate logistic regression analysis.

Results: During the study period, there were 95 OSA patients met the study. Of those, 76 patients (80.00%) purchased CPAP. There were no significant different of age or body mass index between those who purchased or did not purchase CPAP (age 55 vs 56 years; body mass index 47 vs 49 kg/m^2; p value 0.692 and 0.942, respectively). There were three independent factors associated with CPAP purchase including male sex, occupation of government officer, and CPAP discomfort. The adjusted odds ratio (95% confidence interval) of these factors were 6.036 (1.446, 25.181), 6.900 (1.377, 34.562), and 0.333 (0.169, 0.653), respectively. The Hosmer-Lemeshow chi square of the predictive model was 6.06 (p 0.641). The physician advice had no significant effect of CPAP purchase with adjusted odds ratio of 0.531 (0.189, 1.492).

Conclusions: OSA patients with male sex or work as government officer tend to purchase CPAP, while CPAP discomfort make OSA patients to deny CPAP purchase. Physician advice may not affect a decision of CPAP purchase.

Acknowledgements: none.

Sleep Breathing Disorders
Board #312 : Poster session 1
EFFECTS OF SHORT- AND LONG-TERM SOLRIAMFETOL TREATMENT ON ADHERENCE TO PRIMARY OBSTRUCTIVE SLEEP APNOEA THERAPY

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Introduction: Excessive daytime sleepiness (EDS) is common among individuals with obstructive sleep apnoea (OSA) and can persist despite primary OSA therapy use. Solriamfetol (formerly JZP-110), a dopamine and norepinephrine reuptake inhibitor, has been approved in the United States to improve wakefulness in adults with EDS associated with OSA or narcolepsy.

One concern is that medication to treat EDS associated with OSA might reduce adherence to primary OSA therapy. This analysis evaluated whether treatment with solriamfetol affected primary therapy device use.

Materials and methods: Data from a 12-week, randomised, double-blind, placebo-controlled phase 3 trial and an open-label extension (OLE) trial ≤52 weeks were analysed. Adult participants received solriamfetol 37.5 (12-week study only), 75, 150, or 300 mg/d or placebo (12-week study only). Study inclusion required current/prior primary OSA therapy use, including positive airway pressure (PAP) therapy, oral appliance, or surgical intervention. Participants who had not attempted to use a primary therapy were excluded. Primary OSA therapy use was recorded throughout the study as electronically downloadable data (when available) or via diary, and is summarised as percentage of nights/week that primary OSA therapy was used and number of hours/night (downloadable data) or percentage of nights/week with use ≥50% of the night (diary data). Participants were instructed to maintain the same level of primary OSA therapy use throughout the study. Baseline and end-of-study data are summarised for the safety population in each study; in the OLE, data are reported for the subgroup of participants with OSA directly enrolled from a previous study, and *baseline* refers to baseline in the parent study.

Results: Primary OSA therapy device use was reported for 344/474 participants in the 12-week study (solriamfetol, n=261; placebo, n=83) and 235/333 participants from the OLE. Of these primary OSA therapy device users, the majority were utilizing PAP (12-week study, 318 [92%]; OLE, 222 [94%]). In the 12-week study, baseline mean therapy use across treatment groups was similar, with use on 89%-90% nights/week, 6.6-6.7 hours/night, and use ≥50%/night on 91%-93% of nights. OLE baseline values were 90% nights/week, 6.6 hours/night, and use ≥50%/night on 90% of nights.

In the 12-week study, there was no meaningful change in primary therapy use for participants on solriamfetol or placebo, respectively: mean (SD) change from baseline to endpoint in percentage of nights/week (1.1% [12.0%]; 0.8% [12.1%]), hours/night (−0.3 [1.2]; −0.3 [0.9]), and percentage of nights with use ≥50% (2.2% [13.7%]; 2.7% [19.4%]). In the OLE, changes from baseline in percentage of nights/week (0.9% [12.4%]), hours/night (−0.8 [1.7]), and percentage of nights with use ≥50% (6.5% [20.5%]) were minimal.

Common adverse events (≥5%) with solriamfetol in the 12-week study were headache, nausea, decreased appetite, anxiety, nasopharyngitis, diarrhoea, and dry mouth, and in the OLE were headache, nasopharyngitis, insomnia, dry mouth, nausea, anxiety, and upper respiratory infection.

Conclusions: Treatment of EDS with solriamfetol did not affect primary OSA therapy device

use throughout the 12-week study or the OLE study. Safety was similar in both studies.

Sleep Breathing Disorders
Board #191 : Poster session 1

CHOLINERGIC ACTIVITY IN CHILDREN AND ADOLESCENTS WITH AND WITHOUT TYPE 2 DIABETES MELLITUS AND THEIR ASSOCIATION WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obesity, type 2 diabetes mellitus (T2DM) and obstructive sleep apnea (OSA) are associated with chronic inflammation, oxidative stress and sympathetic activation, that play a role in mediating the long-term complications of the three conditions. Impaired sympathetic/parasympathetic response has been shown to be linked to obesity, metabolic alterations and inflammation. We aimed to investigate the effect of OSA and T2DM on the cholinergic activity in obese children and adolescents.

Materials and methods: Obese children and adolescents with T2DM (study group) and obese otherwise healthy children (control group) were recruited from the National Center for Childhood Diabetes. Patients were excluded if they had any other significant chronic disease or a psychiatric disorder that was likely to affect their compliance. All participants underwent a physical examination including measurements of weight and height, waist/hip ratio, body fat percent, blood pressure measurements and assessment of pubertal stage. All participants underwent an overnight polysomnograpy (PSG).

Fasting blood samples were obtained from each participant in the morning following the PSG. Serum samples were frozen in -80° C until analysis. Acetylcholinesterase (AchE) and total cholinesterase activity levels were assayed in triplicates in microtiter plate using an adaptation of the Ellman assay. Comparisons of variables were performed between the study groups. In order to further investigate the contribution of both the glucose state and OSA to cholinergic activity, the cohort was divided into four groups: patients with T2DM and OSA, patients with OSA and no T2DM, patients with T2DM and no OSA, and patients with no OSA and no T2DM.

Results: Thirty eight subjects (65% males) were recruited. The mean age was 14.0±3.2 (range: 7-21y). The mean BMI z-score 2.4±0.39. Ten children (26%) had T2DM. Nine (24%) had OSA. No differences were found in total cholinergic activity and AchE activity between subjects with T2DM and controls nor between subjects with OSA compared to non-OSA patients. No correlations were found between cholinergic activity/AchE activity and any of the PSG parameters or HOMA. Significant correlations were found between cholinergic activity and plasma cholesterol and triglycerides levels (r=0.43, p=0.01 and r=0.39, p=0.026; respectively). No correlations were found between cholinergic activity and BP measurements or CRP concentrations. Subdividing the cohort into 4 groups based on their glucose homeostasis state and OSA revealed no differences in cholinergic activity between the 4 groups.

Conclusions: Our preliminary findings indicate that there are no differences in cholinergic activity in obese children and adolescents with T2DM compared to those without or in those with OSA compared to those without. Cholinergic activity was found to correlate with serum lipid concentrations. Further larger scale studies are warranted to better understand the precise contribution of impaired glucose homeostasis and OSA on cholinergic status in obese patients.

ESTIMATION OF COSTS AND COST-EFFECTIVENESS OF DETECTING UNDIAGNOSED SLEEP DISORDERS AMONG CHRONIC DISEASE PATIENTS : A TYPICAL GP SETTING IN TORONTO

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Introduction: Sleep apnea is a global phenomenon which is associated with significant morbidity and the consequences of undiagnosed and untreated Obstructive Sleep Apnea Syndrome are medically serious and economically costly. The risk factors for sleep apnea includes various chronic disease conditions cardiovascular risk factors, Obesity, Hypertension, Diabetes, Chronic Pulmonary Disease and Depression.The economic burden of undiagnosed sleep apnea is in the United States is approximately $150 billion annually[1]. The main objective of this theoretical study is to estimate the burden of the undiagnosed and untreated sleep disorders among patients suffering from various chronic conditions in a typical General Practice (GP) setting in Toronto
Materials and methods: The study involved extensive literature search to collect the prevalence of undiagnosed sleep disorders that are commonly associated with cardiovascular diseases (CVDs), Diabetes Mellitus (DM), Depression and Chronic Pulmonary Diseases from various countries.Data triangulation was done to get a mean estimate of prevalence of OSA/ sleep disorders among the chronic conditions. In addition, to obtain a precise estimate, information from two GPs was collected on the annual patient load and the proportion of major chronic diseases namely CVDs, DM, Obesity and Depression.
Results: The average clinic attendance rate(> 18 yrs) per GP annually was of 3000 patients. Around 20-30% of patients are diagnosed with Diabetes Mellitus, 20-30% are diagnosed with CVDs, 30% were Obese, 20-30% are diagnosed with Depression and around 10% diagnosed with Asthma/ COPD. Many patients had combinations of these conditions. Several studies have reported a prevalence of OSA in patients with T2DM, ranging from 54% to 86% [2,3]. Several studies have reported a prevalence of OSA in patients with T2DM, ranging from 54% to 86% [2,3]. Similarly 55% of patients with documented coronary artery disease have moderate to severe OSAs; the prevalence of sleep disordered breathing in patients with Atrial Fibrillation is 40% to 50% [4]. OSA with central sleep apnea are often found with heart failure patients up to 50% to 70% [5].
These undiagnosed patients are silent and untreated among the patients which would otherwise cost a substantial amount to the health care systems as well as increasing the morbidity and mortality of the population. (Refer Table 1 below)
Table 1. Estimations of undiagnosed sleep disorders the costs for home sleep testing
Diagnosis
Prevalence rate of OSA/ SDB
Estimated numbers of undiagnosed
Costs incurred for home sleep testing (@ $400 per test)
Diabetes Mellitus
37- 86% (Mean 50%)
300-450
$120,000-180,000
Cardiovascular
40-55%
(Mean 50%)

300-450
$120,000-180,000
Obesity
70%
(Mean 50%)
450
$180,000
Depression
50-60%
(Mean 50%)
300-450
$120,000-180,000

Conclusions: Primary care providers will be central to clinical approaches for addressing the burden by case-finding and providing referral for OSA. There is a strong need and potential advantage for opportunistic screening for OSA among patients with T2DM or other chronic diseases on treatment.

Home sleep testing becomes a main stay for a cost-effective strategy to address the silently rising undiagnosed and untreated burden of sleep disorders in the community.

THE SLEEP QUALITY IN ISCHEMIC STROKE PATIENTS: A CROSS-SECTIONAL STUDY

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Introduction: Sleep-disordered breathing (SDB) is a well-known disorder characterized by recurrent episodes of nocturnal hypoxemia and resultant sympathetic activation and cardiovascular distress. However, the very high prevalence of SDB suggests that stroke also aggravates SDB.
Materials and methods: This study was a restrospective analysis of 61 patients admitted to the Department of Neurology, Chang Bing Show Chwan Hospital for acute cerebral infarction who had study of polysomnography. . One-way ANOVA inference for difference test was done.
Results: In this study, the known risk factors including age, gender, body mass index, drinking, and smoking behavior between the 2 groups were of no significant difference. Different stroke subtypes seemed to be assoicated with gender and male predominance was noted in cardioembolism. Body weight index was also noted to be higher in the cardioembolism group.
Conclusions: The study showed no difference risk factor profile in patients with or without SDB.

SALIVA PHOOA-PC INCREASED IN OSA PATIENTS NEGATIVELY CORRELATES WITH THE SURFACE TENSION OF SALIVA

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Introduction: The OSA is characterized by closure and re-opening of the upper airway during sleep. Re-opening of UA is influenced by intraluminal air pressure, dilator muscle activity, and surface tension (g) of saliva, which is major component of UAL considered as important factor for maintaining upper airway patency. Lowering g of saliva reduces upper airway opening and closing pressure. Consequently, enhances upper airway stability and decreases the severity of sleep-disordered breathing. However, the factor that is responsible for surface tension in saliva is still unknown. Thus, we aimed to 1) investigate novel biomarker of OSA patients in saliva, and 2) evaluate the association between identified metabolites and g of saliva.

Materials and methods: We studied 69 male subjects who had been diagnosed with OSA by PGS. Samples were collected before (A1) and after (A2) sleep. The centrifuged saliva samples were diluted (1:3) with methanol to precipitate protein, and sample analysis was performed by liquid chromatography with high-resolution mass spectrometry (UHPLC-MS/MS). Differentially expressed metabolites from saliva samples compared to healthy control, identified by open source software XCMS and Compound discoverer 2.0 from Thermo scientific. g of saliva samples determined by the pendent drop method.

Results: We identified 4 human-derived metabolites overlapped from XCMS and Compound discoverer 2.0. Phooa-PC, Kpoo-PC, 9-nitrooreate, and cholic acid glucuronide are remarkably increased in A2 samples of OSA patients (apnea-hypopnea index (AHI) ≥10) compared to normal. Among the metabolites, only Phooa-PC was correlated with AHI ($p = 0.045$). However, in Patients samples, the mean of saliva g was decreased after sleep (A1 samples, Control = 46.4 mN/m ± 7.3, Patients = 45.5 mN/m ± 7.9; A2 samples, Control =45.21 ± 7.8, Patients = 42.7 mN/m ± 8.1). The g in A2 samples of patients was negatively correlated with Phooa-PC ($r = -0.8227$, $p < 0.0001$).

Conclusions: MS-based untargeted metabolomics identified lipid species of salivary metabolites that were upregulated in OSA patients. Among the metabolites, Phooa-PC was increased in the patients after sleep, also positively correlated with AHI. However, the mean of g in saliva samples was decreased in patients after sleep, and negatively correlated with the Phooa-PC.

GENDER DIFFERENCES IN OUTCOME, USE AND ADAPTION TO NON-INVASIVE NOCTURNAL VENTILATION (NINV) IN OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS

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Introduction: The incidence, manifestation and comorbidity of OSAS, and the benefits from NINV differ between genders. MRI studies comparing cortical sickness in OSA patients according to gender found more thinning in women in areas contributing to mood disorders and executive functions (i.e. L and R superior frontal lobes, R rostral middle-frontal and paracentral lobe; Macey et al., 2018). Jennum et al. (2015) found that CPAP use improved survival only in women after the age of 60. On the other hand, female gender and coexisting hypertension are risk factors for the discontinuation of PAP treatment (Palm et al., 2018). The aim of this study was to assess adaptation and use parameters of NINV and their correlation with anthropometric measures, comorbidity, sleep quality and mood in a cohort of consecutive OSA patients monitored at our sleep center, according to possible gender-related differences within the sample.

Materials and methods: Patients treated with NINV, reporting for their annual checkup, were included in an 18-month observational study (November 2017- March 2019). Patients completed the following scales: Beck Depression Scale (BDI), Hamilton Anxiety Rating Scale (HAM-A), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and Cues to CPAP Use Questionnaire (CCUQ).
Data were collected on weight, height, BMI, Mallampati index, smoking, chronic/ongoing pathologies and use of the NINV device [type and setting, residual index of apneas (AHI), average daily and annual use, % of use > 4h].
ESS and AHI data from patients' initial diagnoses were included. Statistical analyses were performed to assess gender differences.

Results: We examined 263 patients (194 M), with an average age of 63.51 years (SD ± 9.95) and a mean BMI of 32.92 (SD ± 6.17). With respect to quantitative variables, BMI, ESS and CCUQ scores, annual % NINV use, > 4h/day % use, average daily use (h/d), and AHI did not differ between genders.
Post-initiation of NINV treatment (T1), AHI and ESS equally improved in males and females. Delta BMI was significantly different between genders (p< 0.05), indicating weight loss in the women (-0.67 ± 3.99) vs. weight increase in the men (0.15 ± 2.37).
Among patients reporting disturbed sleep (PSQI>7), again no significant comprehensive differences were found between males and females. However, a moderate correlation between sleepiness and anxiety (r=0.408) and a strong correlation between sleepiness and depression (r=0.595) was only found in the women's subgroup. Gender sub-analysis of patients with disturbed sleep also revealed strong positive correlations between anxiety and depression in both men (r=0.670) and women (r=0.661).
Only within the female cohort, PSQI scores negatively correlated with percentage use > 4h/day (r= -0.43) and with low adaptation to NINV (CCUQ scores; r=0.38).

Conclusions: Despite the lack of significant gender differences in the overall use and adaptation to NINV, women with OSA show discriminating comorbidities, including anxiety and depression, that appear to selectively influence sleep quality (PSQI scores) and excessive daytime sleepiness (ESS scores) and impinge on the % of use and adaptation to NINV within the female cohort.

Sleep Breathing Disorders
Board #318 : Poster session 3
DISTINCTIVE FEATURES PREDICT WORSE NON-INVASIVE NOCTURNAL VENTILATION (NINV) ADAPTATION

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Introduction: NINV adherence plays an essential role for the efficacy of OSA therapy, to counter act daytime sleepiness, neurocognitive impairment, depression and cardiovascular risk factors. Adherence is influenced by many intrinsic ad extrinsic factors including adaptation. The latter depends on several biomedical and psychological indices as well as social and environmental factors. The Cues to CPAP Use Questionnaire (CCUQ) is a validated useful tool to measure NINV adaptation. The aim of this study was to determine whether mood, anthropometric and clinical characteristics discriminate patients prone to difficult NINV adaptation. A retrospective, registry based, mono-centric study was conducted to determine on follow-up visits if there were distinctive features predicting best vs. worse NINV adaptation.

Materials and methods: 94 OSA patient previously assigned to NINV therapy had yearly follow-up visit at our sleep center. On each visit, participants completed self-report questionnaires to assess anxiety (HAM-A), depression (BDI), sleep quality (PSQI) and daytime sleepiness (ESS). We also obtained: BMI, NINV utilization (total %; = > 4 h %median use time; residual AHI); patients' adaptation to NINV (CCUQ). We divided the sample into three groups: 1) patients with improved (Δ score $\geq$ -2 points), 2) with stable (Δ score $\pm$ 1 point), and 3) with worsening (Δ score $\geq$ +2 points) CCUQ scores. Descriptive analysis and ANOVA were performed to assess differences between group 1 and 3 over one year.

Results: 94 OSA patients completed a one-year follow-up: 26 (28%) women, and 68 (72%) men, mean age (65.6, SD 9.85). At the one-year follow-up 43 (46%) improved their CCUQ score (group 1), 39 (41%) were stable (group 2), 12 (13%) got worse (group 3). Between groups 1 and 3, significant differences included: mean BMI 32,43 (SD 6.5) vs 34,74 (SD 5.22) (p=0.046); median BDI score: 10.5 (mode 5), vs 16 (mode 16; p=0.016); median HAM score: 12 (mode 3), vs 15 (mode 27; p=0.027); median ESS score: 10.5 (mode 7), vs 12 (mode 12; p=0.034); mean AHI: 44,6 (SD 14) vs 48,7 (SD 23,9; p=0.046). No differences in median PSQI: 6 (mode 5) vs 5 (mode 4); p>0.05.

Conclusions: Adaptation to NINV is essential to foster adherence to therapy. Patients with second grade obesity, worse mood and daytime sleepiness are less prone to adapt to NINV therapy. Knowing the features that predict poor adaptation may be useful to make a support strategy to ameliorate patients' negative factors.

ONE-YEAR OUTCOME DIFFERENCE BETWEEN GOOD AND POOR NON-INVASIVE NOCTURNAL VENTILATION (NINV) ADAPTERS IN SLEEP APNEA

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Introduction: NINV use with good adaptation is essential to achieve cardio and cerebrovascular prevention,as well as improve sleepiness and life quality in OSA. A retrospective, registry-based, mono-centric study was conducted to determine if NINV adaptation modifies outcome in OSA patients at one-year follow-up.

Materials and methods: 94 OSA patients' initial visits in our sleep center were compared with their yearly subsequent visit. All participants completed self-report questionnaires to assess anxiety (HAM-A), depression (BDI), sleep quality (PSQI) and daytime sleepiness (ESS). We also measured: BMI, NINV utilization (total %; = > 4 h %median use time; residual AHI); patients' adaptation to NINV (CCUQ). We divided the sample into three groups: 1) patients with improved (Δ score $\geq$ -2 points), 2) with stable (Δ score $\pm$ 1 point), and 3) with worsening (Δ score $\geq$ +2 points) CCUQ scores. Descriptive analysis and ANOVA were performed to assess differences between groups 1 and 3 over a one year period.

Results: 94 OSA patients completed a one-year follow-up: 26 (28%) women, and 68 (72%) men, mean age (65.6, SD 9.85). At the 1-year follow-up 43 (46%) improved their CCUQ score (group 1), 39 (41%) were stable (group 2), 12 (13%) worsened (group 3). Within group 1, differences at the follow-up included: BMI score: 32.43 (SD 6.5) vs 31.64 (SD 4.7; P=0.000); mean one-year % of use 80.29 (SD 24.93) vs 89.65 (SD 27.18, p=0.000); mean time/day use 5.18 (SD 2.07) vs 5.5 (SD 0.7;p=0.038); >4h/day % of use 66.49 (SD 33.67) vs 76.43 (SD 27.18; p=0.002); mean AHI 44.46 (SD 14) vs 7.54 (SD 8.93; p=0.000). No significant differences in HAM-A, BDI, ESS and PSQI scores were found.

Group 3 at the one year follow-up showed differences in: mean BMI score: 34.74 (SD 5.22) vs 35.06 (SD 5.77; P=0.039); mean one-year % of use 86.78 (SD 24.30) vs 80.86 (SD 7.6; p=0.000); mean time/day use 5.92 (SD 1.58) vs 3.5 (SD 1.7; p=0.012); mean >4h/day % of use 76.6 (SD 28.06) vs 73.3 (SD 23.82; p=0.000); mean AHI 44.71 (SD vs 11.93 (SD 12.98; p=0.023); median ESS score 12 (mode 12) vs 4 (mode 3). No differences in HAM-A, BDI, ESS and PSQI scores were observed.

Conclusions: Patients with improved NINV adaptation showed increased NINV use and decreased BMI, whereas patients with worse adaptation presented decreased NINV utilization and increased BMI, despite improved ESS in both groups.

CHANGES IS SLEEP PARAMETERS FOLLOWING SHORT-TERM BIOMIMETIC ORAL APPLIANCE THERAPY FOR OBSTRUCTIVE SLEEP APNEA IN ADULTS

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Introduction: There is a plethora of oral appliances that are currently used for the management of mild to moderate obstructive sleep apnea in adults. Virtually all of these oral appliances are mandibular advancement devices (MADs) that have the sole purpose of holding the mandible forwards during sleep. Numerous, minor side effects have been reported with MADs, but the major issues are that these devices represent a lifetime of wear and the underlying condition can worsen with long-term use. In addition, patients with a short cranial base/prognathic mandibular phenotype are at risk of developing an unfavorable facial profile and worsening malocclusion. In view of these deficiencies, biomimetic oral appliance therapy (BOAT) was investigated in this study. BOAT differs from other oral devices as it aims to mimic natural craniofacial growth and development, and targets the site and severity of the upper airway obstruction.

Materials and methods: After obtaining informed consent, 18 consecutive adults participated in this study. Inclusion criteria were: age >18yrs with a diagnosis of OSA by a sleep physician; good compliance; no history of craniofacial trauma or surgery; no congenital craniofacial anomalies, and fully-dentate upper and lower arches. Exclusion criteria included: age < 18yrs; lack of compliance; active periodontal disease; poor oral hygiene, and systemic bisphosphonate therapy. The mandibular physiologic position was determined, and a neuromuscular bite registration was obtained, as well as upper and lower polyvinylsiloxane impressions. A customized, FDA-registered, biomimetic upper oral appliance (DNA appliance®, Vivos Therapeutics, Inc., USA) was constructed for each individual. All subjects were instructed to wear the device 12-16hrs/day, starting in the late afternoon and throughout the night. At each monthly follow-up, examination for the progress of midfacial development was recorded. Adjustments to the devices were performed to optimize their efficacy. Development of the lower arch was implemented using a lower device between 3-6 months, depending on the patient's progress. At the 12-month review, follow-up sleep studies were undertaken. Data measurements were repeated and compared statistically, using t-tests.

Results: The mean age of the sample was 47yrs (12 females; 6 males). The mean, pre-treatment: AHI was 40/hr; the RDI was 27.3/hr; the ODI was 55.9; the SpO_2 nadir was 78.5%, and the overall SpO_2 was 93.8%. The average treatment time was 14.2 months. Post-treatment, the sleep study was performed with no device in the patient's mouth. It was found that mean: AHI decreased by 69.6% to 12.1/hr (p = 0.02); the RDI decreased by 66.5% to 9.1/hr (p = 0.04); the ODI decreased by 59% to 22.9 (p = 0.03); the SpO2 nadir remained unchanged at 78.7%, while the overall SpO2 remained unchanged at 92.3%.

Conclusions: Biomimetic oral appliance therapy may be able to address adult patients diagnosed with OSA, and might represent a viable alternative to MAD, CPAP and surgical options currently available. Further, long-term randomized clinical trials are warranted.

UPPER OROPHARYNGEAL AIRWAY CHANGES IN KOREAN ADULTS FOLLOWING BIOMIMETIC ORAL APPLIANCE THERAPY

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Introduction: The vast majority of oral appliances that are used for the management of mild to moderate obstructive sleep apnea (OSA) in adults are mandibular advancement devices (MADs), since midfacial development in adults was not thought to be possible. In contrast, evidence suggests that maxillary expansion appears to be beneficial in pediatric OSA. Thus, BOAT differs from MADs as it aims to mimic natural growth and development of the midfacial complex in adults, at least in part. Since Asian adults with a short cranial base/prognathic mandibular phenotype are at risk of developing an unfavorable facial profile and worsening malocclusion with MAD use, biomimetic oral appliance therapy (BOAT) was investigated in Korean adults in this study.

Materials and methods: After obtaining informed consent, 13 consecutive Korean adults participated in this study. Inclusion criteria were: age > 18yrs with a diagnosis of midfacial hypoplasia; good compliance; no history of craniofacial trauma or surgery; no congenital craniofacial anomalies, and fully-dentate upper and lower arches. Exclusion criteria included: age < 18yrs; lack of compliance; active periodontal disease; poor oral hygiene, and systemic bisphosphonate therapy. A 3D cone-beam CT scan (HDXwill, Dentri-s, Seoul, South Korea) was taken for each participant. The mandibular physiologic position was determined, and a neuromuscular bite registration was obtained, as well as upper and lower polyvinylsiloxane impressions. A customized, FDA-registered, biomimetic upper oral appliance (DNA appliance®, Vivos Therapeutics, Inc., USA) was constructed for each individual. All subjects were instructed to wear the device 12-16hrs/day, starting in the late afternoon and throughout the night. At each monthly follow-up, examination for the progress of midfacial development was recorded. Adjustments to the devices were performed to optimize their efficacy. After the 12-month review, a follow-up 3D cone-beam CT scan was undertaken with no device in the patient´s mouth. Pre- and post-treatment data measurements were obtained using appropriate software, and compared statistically using t-tests.

Results: The mean age of the sample was 29.6yrs (7 females; 6 males). The mean treatment time was 16.3 months. Post-treatment: the minimum transpalatal bone width at the cervical margin of the mesio-palatal cusps of the first molars increased from 35.3mm ± 3.0 to 38.5mm ± 2.1 ($p < 0.001$); the minimum sagittal retropalatal distance increased from 9.8mm ± 2.7 to 12.4mm ± 2.2 ($p < 0.01$); the soft palate length decreased from 34.8mm ± 4.0 to 32.7mm ± 2.8 ($p = 0.05$); the minimum medio-lateral retropalatal width remained unchanged (26.8mm ± 5.0 to 27.7mm ± 6.8; $p > 0.05$), while the minimum retropalatal area in the axial plane increased from 258.1mm^2 ± 95.6 to 317.7mm^2 ± 115.0 ($p < 0.01$) with no device in the patient´s mouth.

Conclusions: Biomimetic oral appliance therapy may be able to improve upper oropharyngeal airway parameters in Korean adults, and might represent a viable alternative option to MADs. However, additional studies of the effect on sleep parameters are now needed.

SLOW FREQUENCY EEG ACTIVITY IN OBESITY HYPOVENTILATION SYNDROME

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Introduction: There are limited studies evaluating the effects of obesity hypoventilation syndrome (OHS) on neurophysiological activity and neurocognitive function. This study compared OHS with equally obese obstructive sleep apnea (OSA) patients, with similar apnea hypopnea indices.

Materials and methods: Resting wake and overnight sleep electroencephalography (EEG) recordings, neurocognitive tests, and sleepiness, depression and anxiety scores were assessed before and after 3 months of positive airway pressure (PAP) therapy in patients with OHS and OSA.

Results: Fifteen OHS and thirty-six OSA patients were enrolled in the study. Pre-treatment, increased slow frequency EEG activity during wake and sleep states (increased delta alpha ratio during sleep, and theta power during awake) was observed in the OHS group compared to the OSA group. EEG slowing correlated with poorer performance on the psychomotor vigilance task (slowest 10% of reciprocal reaction times, PVT SRRT, primary outcome), and worse sleep-related hypoxemia measures in OHS. There was no between-group significant difference in PVT performance at pre or post-treatment. Similarly, despite both groups demonstrating improved sleepiness, anxiety and depression scores with PAP therapy, there were no differences in treatment response between the OSA and OHS groups.

Conclusions: Patients with OHS have greater slow frequency EEG activity during sleep and wake than equally obese patients with OSA. Greater EEG slowing was associated with worse vigilance and lower oxygenation during sleep.

ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNEA AND SENSORINEURAL HEARING LOSS: AN AUDIOMETRY-BASED COMPARATIVE STUDY

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Introduction: Ischemic changes of the inner ear are a known cause of sensorineural hearing loss. To obtain and compare the main findings of tonal audiometry (TA) in patients diagnosed with OSAHS and primary snoring.
Material and methods: Thirty-five patients diagnosed with OSAS and primary snoring confirmed by type I sleep study (in lab polysomnography) were selected. All other etiological factors related to dysacusis were excluded. The patients were then submitted to a TA test and the data were compared in 4 groups according to severity criteria: mild OSAHS (n = 10), moderate OSAHS (n = 8), severe OSAHS (n = 9) and primary snoring (n = 8). Data were analyzed by Chi-square test of independent proportions and Fisher´s exact test.
Results: Among OSAS population, 22 patients were shown to have sensorineural lowering in the tonal auditory responses in contrast to only 1 case of the primary snoring group. In the mild OSAS group (n = 10), there were alterations in the responses of 9 patients, whereas in the moderate (n = 8) and severe (n = 9) OSAHS groups, 4 and 9 examinations were identified.
Discussion: Neurosensorial lowering demonstrated in patients with OSAHS suggests that the hearing aid may be influenced by this pathophysiology. Observed changes in TA were more significant in cases of severe OSAHS where AHI and oxyhemoglobin desaturation levels were greater.
Conclusion: In OSAHS patients, a significant sensorineural lowering was observed in tonal auditory responses when compared to those with primary snoring. These differences were particularly pronounced in those cases of severe OSAHS.

Sleep Breathing Disorders
Board #317 : Poster session 1
HEART RATE VARIABILITY AND COGNITIVE DECLINE IN OLDER ADULTS WITH SLEEP APNEA

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Introduction: Sleep apnea is common in older adults and is associated with a number of physiological consequences including hypoxemia, sleep fragmentation, and autonomic nervous system (ANS) abnormalities. Studies have shown impaired cognitive function in subjects with sleep apnea. Meanwhile, differences in heart rate variability (HRV), a measure of autonomic dysfunction, have been shown to correlate with cognitive function in cross-sectional studies. In this study, we tested the hypothesis that in older patients with untreated sleep apnea, HRV is associated with longitudinal decline in global cognitive function.

Methods and Materials: We studied 165 older adults (mean [SD] age 81.9 [7.3]; 75% female) with untreated sleep apnea (mean [SD] apnea hypopnea index [AHI] 16.0 [23.1]) participating in the Rush Memory and Aging Project, a community-based cohort study of older adults. We quantified sleep apnea physiology, using an ambulatory level III device (WatchPAT Unified, Itamar Medical). Measures of heart rate variability (HRV) were calculated from the peripheral arterial tone (PAT) signal. We quantified cognitive function annually for up to 15 years (mean 4.5 years) prior to sleep apnea assessment using a battery of 19 cognitive tests, from which a composite measure of global cognition was derived, and we related this to heart rate variability and other measures of sleep apnea physiology derived from the WatchPAT using linear mixed models.

Results: A greater percentage of total energy in the low frequency (LF; 0.04-0.15Hz) band during sleep was associated with higher level of composite global cognition at the time of sleep assessment [estimate = +1.16852, p = 0.0079] but not the rate of cognitive decline [estimate = +0.005, p=0.9]. This association remained significant in models controlling for AHI and known vascular risk factors. A greater percentage of total energy in the high frequency (HF; 0.15-0.40Hz) band during sleep was associated with more rapid cognitive decline [estimate = -0.058, p=0.045] but differences in the level of cognition were not significant [estimate=-0.36, p=0.23] and the association between high frequency percentage and cognitive decline was attenuated when controlling for AHI.

Conclusions: In older community-dwelling adults with untreated sleep apnea, measures of heart rate variability are associated with cognitive function. These findings support the hypothesis that sleep apnea associated disturbances of autonomic nervous system function may be a marker of, or contribute to, pathophysiological processes related to cognitive impairment in this population.

HYPOXEMIA AND BRAIN ATROPHY IN OLDER ADULTS WITH SLEEP APNEA

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Introduction: Sleep apnea is common in older adults and is associated with a number of physiological consequences including hypoxemia, sleep fragmentation, and autonomic nervous system abnormalities. Studies differ on whether sleep apnea is associated with gray matter hypertrophy or atrophy, and which physiological consequences of sleep apnea are the most consequential for gray matter structure. Hypoxemia is an important predictor of cognitive and other outcomes in sleep apnea. We tested the hypothesis that in older patients with untreated sleep apnea, the degree of hypoxemia is associated with differences in gray matter structure.

Materials and Methods: We studied 123 older adults (mean [SD] age 83.3 [6.2]; 74% female) with untreated sleep apnea (mean [SD] AHI = 24.0 [17.0]) participating in the Rush Memory and Aging Project, a community-based cohort study of older adults. We quantified sleep apnea severity, including hypoxemia, using an ambulatory level III device (WatchPAT Unified, Itamar Medical). We quantified total gray matter (GM) and cerebrospinal fluid (CSF) volumes from magnetic resonance images of the brain obtained within a mean of 1.1 years of sleep apnea quantification. Linear regression models were used to relate brain volumes to the severity of hypoxemia.

Results: More severe nocturnal hypoxemia, quantified as the time with an oxygen saturation under 90%, was associated with greater CSF volume [estimate = +0.0025, p=0.035] and lower GM volume [estimate = -0.022, p = 0.028]. These remained significant in models controlling for AHI, sleep efficiency, and known vascular risk factors.

Conclusions: In older community-dwelling adults with sleep apnea, greater hypoxemia is associated with lower gray matter volumes and higher CSF volumes. These findings support the hypothesis that nocturnal hypoxemia may contribute to brain atrophy in this population.

NOISE POLLUTION IN THE BEDROOM

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Introduction: Snoring is a highly prevalent condition associated with obstructive sleep apnea (OSA) and sleep disturbance in bed partners. Objective measurements of snoring in the community, however, are limited. The current study was designed to measure sound levels produced by self-reported habitual snorers in a single night. We hypothesized that snoring exceeds standards associated with noise pollution and predicts concomitant OSA.

Materials and methods: Healthy habitual snorers were excluded if they reported nocturnal gasping or choking episodes or had severe obesity (BMI>35kg/m2). Snoring was assessed during an overnight sleep study, and was defined as an inspiratory sound level ≥ 40 dB(A) measured by a sound monitor (A-weighted scale) mounted 65 cm over the head of the bed. The apnea hypopnea index (AHI) and breath-by-breath peak decibel levels were measured over the entire night. All breaths during sleep with inspiratory sound ≥ 40 dB(A) were tallied to determine the frequency and intensity (L_{Aeq_snore}) of snoring. Regression models were used to determine the relationship between objective measures of snoring and OSA (AHI≥5 events/hr). The area under the curve (AUC) for the receiver operating characteristic (ROC) was used to predict OSA.

Results: Snoring intensity (L_{Aeq_snore}) exceeded 45 dB(A) in 66% of the 162 participants studied, with 14% surpassing the 53 dB(A) threshold for noise pollution. L_{Aeq_snore} correlated with snoring frequency (r^2=0.50, p< 0.0001) and both intensity and frequency were independent predictors of OSA. AUCs for snoring intensity and frequency were 77% and 81%, respectively, and increased substantially to 87% and 89%, respectively, with the addition of age and sex as predictors.

Conclusions: Habitual snoring represents a significant source of noise pollution in the bedroom and constitutes an important target for mitigating sound and its adverse health effects on bed partners. Snoring measurements also offer a simple way to risk stratify otherwise healthy snorers for OSA.

THE ASSOCIATION OF CPAP COMPLIANCE AND NOCTURNAL HYPOXEMIA IN THE PERIOPERATIVE PERIOD

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Introduction: Obstructive sleep apnea (OSA) is highly prevalent in the surgical patient population. Continuous positive airway pressure (CPAP) is the first line treatment for OSA patients. However, evidence supporting the efficacy of CPAP and compliance rates in the perioperative period is largely lacking.

Materials and methods: This prospective cohort study included adult surgical patients with a diagnosis of OSA with or without a CPAP prescription undergoing non-cardiac surgery. Preoperative CPAP compliance was defined as average use ≥ 4 h/night for > 70% of nights based on self-reporting. Postoperative CPAP compliance was determined each night and defined as use ≥ 4 h/night. Overnight oximetry was performed preoperatively and on postoperative night 1, 2 and 3 using a wristwatch oximeter. The primary outcomes were rate of CPAP compliance and nocturnal oxygen saturation. The parameters included were mean SpO2, lowest SpO2, oxygen desaturation index (ODI) and cumulative time percentage with SpO2 < 90% (CT90).

Results: We enrolled 129 patients with OSA with a preexisting CPAP prescription in the preoperative clinic. 84 were compliant with CPAP, and 55 were non-compliant. Preoperative compliance was 60.5%; whereas compliance on postoperative night 1 was 57.8%; night 2: 66.2%, and night 3: 38.5%. One hundred twenty four patients completed preoperative overnight oximetry (75 compliant, 49 non-compliant). The non-compliant group had significantly lower preoperative lowest SpO2 (79 vs 83%) and higher ODI (10.8 vs 4.3 events/h) and CT90 (3.4 vs 0.5) compared to the compliant group. On postoperative night 1, lowest SpO2 (79 vs 83%) was significantly decreased in the CPAP non-compliant vs compliant groups. No significant differences were observed in other parameters such as ODI, CT90 or for any oximetry parameter on postoperative night 2. Supplemental oxygen use was slightly higher in the non-compliant group on postoperative night 1 (55 vs 44%) and night 2 (12 vs 5%), although these differences were not statistically significant.

Conclusions: Among patients with a preoperative CPAP prescription, compliance was 60.5% preoperatively, and on postoperative night 1: 57.8%; night 2: 66.2%, decreasing on night 3 to 38.5%. CPAP non-compliance was associated with a greater degree of oxygen desaturation (lowest SpO2, ODI, CT90) during the preoperative period, while only modest differences were detected on postoperative night 1. However, the higher rate of supplemental oxygen use in the non-compliant group may mask potential differences in oxygen saturation.

Acknowledgements: n/a

INTERPRETATION OF POLYSOMNOGRAPHY IN MYOTONIC MUSCULAR DYSTROPHY TYPE 1

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Introduction: Sleep disorders are commonly reported in patients with neuromuscular diseases. Obstructive sleep apnea associated with sleep hypoxia and hypercapnia, rapid eye movement sleep dysregulation, and diurnal somnolence are commonly reported in patients with myotonic muscular dystrophy, a rare genetic autosomal dominant myopathic disorder. Patients with other myopathies also reported similar sleep-related symptoms. We aimed to analyze polysomnography data and ventilation monitor of myotonic muscular dystrophy type 1(DM1), and compared them with that of Duchenne muscular dystrophy (DMD) to compare the different characteristics of apnea patterns.

Materials and methods: We retrospectively collected and analyzed polysomnographic data and overnight ventilation monitoring parameters among the patients with DM1 and DMD, who were admitted for evaluation of respiratory failure from January, 2012 until August, 2017 and underwent ventilation monitoring and polysomnography at the same time. Ventilation parameters such as overnight partial pressure of transcutaneous carbon dioxide ($tcpCO_2$) and oxygen saturation (SaO_2), and polysomnographic parameters such as total apnea-hypopnea index (A-HI), apnea index, hypopnea index, obstructive apnea index, central apnea index, and mixed apnea index were collected. Mean values of each parameter were compared using independent t-test and spearman correlation test was performed to find the relationship between the different parameters.

Results: Twenty-five patients with DM1 and 41 patients with DMD were included in the study. All of the patients with DM1 were with sleep apnea, where nearly half of them (12/25, 48.0%) were with severe sleep apnea. On the other hand although 34 patients with DMD (34/41, 82.9%) were with sleep apnea, only 1 was with severe sleep apnea. Also, all the polysomnographic parameters showed significant difference between the 2 groups. The average SaO_2 (p=0.011) and the lowest SaO_2 (p=0.001) during the night were significantly lower in DM1, while mean $tcpCO_2$ and maximal $tcpCO_2$ during the night were not different among the two groups. In patients with DMD, A-HI showed negative correlation with average SaO_2 (r=-0.450, p=0.001) and the lowest SaO_2 (r=-0.405, p=0.004), while it showed negative correlation with average SaO_2 (r=-0.453, p=0.012) and positive correlation with mean $tcpCO_2$ (r=0.386, p=0.035) in patients with DM1. In patients with DM1, A-HI also showed strong positive correlation with obstructive apnea index (r=0.704, p=0.002) and central apnea index (r=0.526, p< 0.001) while it only showed weak positive correlation with obstructive apnea index (r=0.457, p=0.002).

Conclusion: When comparing the polysomnographic parameters in patients with DM1 and DMD at similar $tcpCO_2$ level, severity of apnea is much more severe in patients with DM1 and proportion of central apnea is higher.

COMPARISON BETWEEN NASAL AND ORAL BREATHING IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: COMPUTATIONAL FLUID DYNAMICS

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Introduction: Mouth opening and oral breathing are thought to be associated with narrowing of the pharyngeal lumen and decreases in the retroglossal diameter, as a result, increases upper airway collapsibility during sleep, leading to airway obstruction. However, the aerodynamics of pharyngeal collapse induced by mouth breathing are still uncertain. The purpose of this study is to investigate the effect of the breathing route on collapse of the pharyngeal airway using computational fluid dynamics (CFD) technology.

Materials and methods: Japanese males with obstructive sleep apnea (OSA) were examined in this study. CT scans of the nose and pharynx were taken at 0.5-mm intervals, then, 3D reconstructed STL models and digital unstructured grid models were created. Airflow simulations were conducted using CFD software; FINE™/Open, according to our previous study (PLOS ONE 2016). Velocity, wall share stress, and wall static pressure in the nasal cavities and pharynx were analyzed during nasal breathing with closed mouth, nasal breathing with open mouth, and oral breathing with open mouth.

Results: The airflow during oral breathing with open mouth became the highest rapid stream, compared to nasal breathing with open or closed mouth.
Maximum velocity during nasal breathing with closed mouth, and nasal breathing with open mouth showed similar results, however, the airflow in the nasal cavity and pharynx during nasal breathing with closed mouth were smooth on the whole breathing rout without spreading, or disturbance, and gradually becoming fast at the oropharyngeal level. On the other hand, the airflow during nasal breathing with open mouth was relatively slow and rapidly became fast at the lower level of the velopharynx, the junction of the nasal and oral breathing routs, then, becoming spreading and disturbed unsteady stream.
The negative static pressure during oral breathing with open mouth decreased the most. on the contrary, there were no differences between nasal breathings with closed and open mouth in static pressure.

Conclusions: CFD results during nasal and oral breathing revealed that oral breathing with open mouth is the primary condition leading to pharyngeal collapse. The airflow during nasal breathing with closed mouth were smoother than those during nasal breathing with open mouth.

Acknowledgements: The authors have no conflict of interest to declare.

ASSOCIATION BETWEEN INFANT SLEEP DISORDERED BREATHING AND EXTERNALIZING BEHAVIORAL TRAJECTORIES IN EARLY CHILDHOOD

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Introduction: Childhood sleep disordered breathing (SDB) is associated with increased behavior problems such as ADHD. SDB in infancy may be associated with persistent behavior problems throughout childhood. The primary objective of this study is to determine the association between SDB symptoms at age two years and externalizing behavioral trajectories in early childhood.
Materials and methods: Data from 679 infants participating in the Edmonton sub-cohort of the CHILD birth cohort study were used to examine association between infant SDB symptoms and longitudinal behavior trajectories. SDB was determined using the Pediatric Sleep Questionnaire (PSQ; a positive PSQ score >0.33) administered at two years of age. Behavior was assessed using the parent-reported Child Behavior Checklist (CBCL; Mean T-score of 50, SD=10) annually between age 2 and 5 years. Higher scores on the CBCL indicate increased behavior problems.
The STATA Proc Traj group-based trajectory analysis was used to identify CBCL externalizing behavioral trajectories between two and five years of age. Participants had to have at least one time-point assessed in order to be included in the analysis. Trajectory analyses identified three independent externalizing behavior groups: children with high-persistent externalizing behavior problems (18.1%; mean T-score = 57, SD=4.2), children with low-risk externalizing behavior symptoms (52.3%; mean T-score = 45, SD=4.0) and children with no significant externalizing behavior symptoms (29.6%; mean T-score = 34, SD=3.0). The trajectory analysis provides the probability of each individual being included in the highest behavioral trajectory group. Multiple regression was used to examine the absolute risk of being assigned to the high-persistent externalizing behavior problem trajectory group.
Results: In adjusted analysis, SDB symptoms at two years of age were associated with a 28% absolute increased risk of being assigned to the high-persistent externalizing behavior problem group. In the same analysis, children whose mothers had SDB had a 5% absolute increased risk of developing persistent externalizing behavior problems. Similarly, children whose mothers had a history of asthma had a 6% absolute increased risk of developing persistent externalizing behavior problems. Household smoke exposure was associated with a 12% increased absolute risk of developing persistent externalizing behavior problems. Finally, quality of parent-child relationship (2% absolute risk) and infant language problems (1% absolute risk) were significantly associated with developing persistent externalizing behavior problems. There was no significant association between sleep duration and developing persistent externalizing behavior problems.
Conclusions: This analysis of data identified three externalizing behavioral trajectory groups using data from a population-based cohort. We identified that infants with SDB symptoms are at increased risk for persistently high externalizing behavior problems. These

results suggest that SDB symptoms during infancy may have adverse consequences for significant behavior problems. These findings highlight the need to screen and refer young children with SDB and behavioral difficulties to reduce risk for later mental health problems.

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EFFECT OF NOCTURNAL OXYGEN TREATMENT ON OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME IN HIGHLANDERS: RANDOMIZED, PLACEBO-CONTROLLED, DOUBLE-BLINDED TRIAL

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Introduction: Obstructive sleep apnea syndrome (OSAS) is a highly prevalent disease characterized by intermittent hypoxia and sleep disruption. High altitude, characterized by hypobaric hypoxia, may cause respiratory instability which is a determinant of OSAS. Nocturnal oxygen supplement may be an alternative method for OSAS patients when continuous positive airway pressure (CPAP) was not tolerable or available. The current study evaluates whether nocturnal oxygen treatment improves sleep, breathing disturbances and physiological index in highlanders with OSAS.

Materials and methods: 34 OSAS patients with mean age of 46.6 years and body mass index of 26.8 kg/m^2 were randomly assigned to receive nocturnal oxygen or sham oxygen treatment in a crossover design, separated by a washout period of two weeks in Shangri-La (altitude of 3200 m). Nocturnal oxygen (2 L/min) was administered by nasal cannula tubing and sham oxygen was produced at the identical flow rate as oxygen by CPAP device connected to the nasal cannula. Questionnaire evaluations and overnight polysomography were performed during nights with oxygen and sham oxygen. The primary outcome was the difference in apnea-hypopnea index (AHI) between oxygen and sham oxygen treatment.

Results: Compared to sham oxygen, mean difference (95% confidence intervals) induced by nocturnal oxygen treatment were AHI -18.8 /h (-23.3; -14.4), hypopnea index -15.3 /h (-17.6; -13.1), mean oxygen saturation (SpO$_2$) 7.2 % (6.2; 8.1) and nadir SpO$_2$ 10.5 % (6.9; 14.1). Nocturnal oxygen treatment prolonged the mean and longest obstructive apnea duration by 5.1 sec (3.7; 6.5) and 18.5 sec (12.2; 24.8), respectively, but did not increase transcutaneous carbon dioxide pressure during sleep. However, there was no change in total sleep time, sleep efficiency and percentage of rapid eye movement (REM) sleep and non-REM sleep with nocturnal oxygen treatment. Oxygen treatment also reduced systolic blood pressure and pulse by 3.8 mmHg
(0.1; 7.4) and 4.3 beats/min (1.4; 7.1) while had no effect on subjective sleep quality and cognitive performance the day after.

Conclusions: Nocturnal oxygen treatment significantly reduced AHI, mainly due to the reduction in hypopnea events, but not in obstructive apnea events, and elevated oxygen saturation during sleep in highland OSAS patients. It also reduced systolic blood pressure and pulse the day after. Since nocturnal oxygen treatment did not cause any adverse events, it may be a useful alternative treatment for highland OSAS patients.

Trial registration: ChiCTR1800017715

EVALUATING NIGHT TO NIGHT VARIABILITY OF OSA USING SMARTPHONE-BASED PORTABLE DEVICES: A PRELIMINARY STUDY

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Introduction: Although untreated obstructive sleep apnea (OSA) has serious consequences, the majority of people affected remain undiagnosed. One reason for the low rate of OSA identification is the limited availability of the gold standard for OSA diagnosis: polysomnography (PSG). The complexity and cost of PSG confine it to specialist facilities. As a result, there are long waitlists and delays in testing and diagnosis for people in need. Additionally, relationship between night-to-night variability of the severity of OSA and daytime activity is unclear. Pulse oximeter is a simple and non-invasive device to measure blood oxygen saturation (SpO_2), that has been successfully applied as a single source to identify subjects with OSA, and can be hosted on a smartphone. This device would help to monitor OSA for multiple nights and help to better understanding to daily activities that may increase severity of OSA. The aim of this study was to evaluate night to night variability of OSA by using smartphone-based portable devices including phone oximeter.

Materials and methods: 19 adults with mean age of 46.3±9.3 years (10 males) referred to the Vancouver Acute Sleep Disorders Program at UBC hospital for PSG were participated in this study. Inclusion criteria were: 1) informed consent, 2) ≥19 years old, and 3) referred for a formal overnight PSG study. Exclusion criteria were: 1) previously documented arrhythmia, 2) previously documented hemoglobinopathy, and 3) known pulse oximeter adhesive sensitivity. This study consisted of 1-night in-hospital assessment and following 7-day at-home assessment. In-hospital assessment, a smartphone-based Phone Oximeter (MLNCS YI, Masimo) and a snoring and body-positon tracker (SnoreCoach, Huneo) connected to smartphone were attached to participants during PSG testing. Participants were asked to answer the questionnaire by operating custom designed software application on smartphone before and after sleep. At-home assessment, participants used these devices as same as in-hospital assessment, in addition to wearing fitness tracker (Fitbit Flex2, Fitbit Inc.) all day. Oxygen desaturation index (ODI) drop in oxygen saturation ≥3% was calculated from phone oximeter records of both in-hospital assessment and at-home assessment.

Results: All participants completed in-hospital assessment. 12 out of 19 participants completed 3 or more nights of at-home assessment. According to PSG, 7 (36.8%) participants were AHI< 5, 6 (31.6%) were 5≤AHI< 15, 4 (21.1%) were 15≤AHI< 30, and 2 (10.5%) were 30≤AHI. ODI obtained from Phone Oximeter showed significant correlation with both AHI (Pearson correlation coefficient; r=0.88, p< 0.0001) and ODI (r=0.92, p< 0.0001) obtained from PSG. In-hospital ODI of 7 in 12 participants were within inter-quartile range, however, those of 4 participants were larger than 75 percentile and 1 participant was smaller than 25 percentile. Intra-individual correlation analysis showed no significant correlation between daytime activity and ODI, snoring minutes, or the number of body position change.

Conclusions: Although any correlations between daytime activity and sleep parameters were not observed in this small number of participants, considerable intra-individual variability of obtained data suggests the possible presence of night-to-night variability of sleep condition and the need for sleep studies across multiple days.

CHOLINERGIC ACTIVITY IN PREGNANT WOMEN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) during pregnancy has been associated with hypertensive disorders of pregnancy and gestational diabetes. In the general population, OSA is associated sympathetic activation. Impaired sympathetic/parasympatheticresponse has been shown to be linked to cardiovascular and metabolic consequences. We aimed to evaluate sympathetic/parasympathetic function by measuring the total serum cholinesterase and Acetylcholinesterase (AChE) activities of pregnant women with OSA.

Methods: Women in the third trimester of a singleton, uncomplicated pregnancy were recruited. All participants underwent an ambulatory overnight sleep study between 33 to 36 weeks of gestation in which the watch-PAT 200 device (Itamar Medical; Israel) was used. Fasting blood samples were drawn on the morning following the sleep study. Serum samples were frozen in -80° C until analysis. AChE and total cholinesterase activity levels were assayed in triplicates using the Ellman assay. Serum CRP, glucose, insulin, HbA1C and lipids were measured. Women with an apnea hypopnea index (AHI) >5 per hour of sleep were considered to have OSA.

Results: Seventy two women were recruited. The mean age was 33.4±4.2 (range: 25-46y). The mean BMI before pregnancy was 23.3±3.8 kg/m^2(6% obese before pregnancy) and the BMI at the time of sleep study was 27.9±3.7. Of the 72 women, 12 had OSA (17%). Total Cholinergic activity was significantly increased in women with OSA compared to controls (1168.7±384.4 vs. 938.5±354.4 nmol/minute×mL, p=0.047). AChE activity was significantly higher among women with OSA compred to controls (386.4±122.2 vs. 300.0±111.4, nmol/minute×mL, p=0.018). No differences were found between obese and non-obese women. No differences were found in CRP, Glucose, insulin and HbA1C levels between women with OSA compared to controls. Serum HDL levevs were significnatly lower in women with OSA compared to controls (66.6±11.4 vs. 79.5±18.2 mg/dl, p=0.02). No differences were found in cholesterol, LDL and triglycerides leves.

Conclusion: Our preliminary findings indicate that pregnant women with OSA have impaired cholinergic regulation and decreased serum HDL levels. These findings may underlie/mediate the adverse maternal and fetal outcomes associated with OSA during pregnancy.

Sleep Breathing Disorders
Board #328 : Poster session 2
SLEEP POSITION AND BREATHING IN PREGNANCY

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Introduction: Sleep position has been linked to breathing in adults with obstructive sleep apnea (OSA). In particular, supine sleep position has been shown to increase the number of apneas relative to the lateral position, as supine position compromises airway stability. Sleep disordered-breathing is common in pregnancy and has been shown to be associated with adverse maternal and fetal outcomes. ADDIN EN.CITE ADDIN EN.CITE.DATA However, the frequency of supine sleep position in pregnancy and its association with breathing have been rarely examined. We aimed to investigate the relationship between maternal sleep position, maternal breathing and fetal outcomes.

Methods: Women in the third trimester of a singleton, uncomplicated pregnancy were recruited. All participants underwent an ambulatory overnight sleep study between 33 to 36 weeks of gestation in which the watch-PAT 200 device (Itamar Medical; Israel) was used. Women with an apnea hypopnea index (AHI) >5 per hour of sleep were considered to have OSA. A medical records review was conducted. Pertinent demographic (gender, gestational age, birthweight), and clinical information (mode of delivery, Apgar scores at 1 and 5 minutes, and any perinatal complications) was collected.

Results: A total of 148 pregnant women participated in this study. The mean age was 33±4.3 (range: 23-46 years) and the mean BMI at enrollment was 27.6±4.0 (range: 19-41). The mean time spent by the entire cohort in the supine position was 47±26% of TST, and the mean time spent in the lateral position (left or right) was 34±19% of TST. Mean apnea hypopnea index (AHI) was 3.6 in the supine position, 2.9 in the prone position, 2.6 and and 2.1 for the right and left positions, respectively. Among women with OSA, mean AHI was 10.8, 9.2, 7.4 and 5.2 in the supine, prone, right and left sleep positions, respectively. Time spent in supine sleep position was not correlated with AHI or mean SpO2. Significant negative correlation was found between time spent in supine sleep position and SpO2 nadir (r=-0.2, p=0.026). Thirty two women (22%) had OSA. No differences in the distributions of sleep positions were were found between women with OSA comapred to women without OSA. There were no differences in gestational age, apgar1 and apgar5 scores, and birthweight percentile between women who spent most of their sleep in the supine position (the upper quartile) compared to women who spent most of their sleep in the non-supine position (lower quartile). In multivariable linear regression analyses, supine position and BMI were significantly associated with SpO2 nadir (p=0.02 and p< 0.01 respectively)

Conclusion: In the third trimester, pregnant women spent half of their total sleep time in the supine position. Supine position was found to be associated with SpO2 nadir, but not with AHI. No differences in the distributions of sleep positions were found between pregnant women with OSA compared to those without OSA.

RESPIRATORY OUTCOME AFTER ONE-YEAR TREATMENT OF OBSTRUCTIVE SLEEP APNEA WITH BIBLOC VERSUS MONOBLOC ORAL APPLIANCES: A MULTICENTER, RANDOMIZED EQUIVALENCE TRIAL

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Background: The benefit of bibloc over monobloc appliances in one-year obstructive sleep apnea (OSA) has not been evaluated in randomized trials. We hypothesized that these types of appliances are equally effective.

Methods: In this multicenter, randomized equivalence trial patients with OSA were assigned to either bibloc or monobloc appliance treatment. At baseline a one-night home respiratory polygraphy was done without respiratory support, and at one-year follow-up examination iterated with the appliance in place. The outcome was the change in the apnea-hypopnea-index (AHI) and the equivalence limits were set at ±5.

Results: *Out of 302 patients* 146 were randomly assigned to bibloc and 156 to monobloc. In 88 and 104 patients, respectively, were analysed per-protocol with a significant reduction of AHI with a mean change -16.7 (95% CI -19.4 to -14.1) in the bibloc and -11.8 (-14.9 to -8.7) in the monobloc and not significantly equivalent. The proportion of responders defined as AHI < 10 at the follow-up was 68% and 65% for bibloc and monobloc, respectively. Treatment related adverse events were generally mild and transient and occurred similar in frequencies between groups.

Conclusions: Bibloc and monobloc appliance treatment gave a significant positive effect in treating OSA. The treatment modalities were not statistically equivalent, with a numerically greater reduction with bibloc, and, were associated with a similar degree of adverse events.

NOCTURIA IS COMMON IN SOUTH EAST ASIAN CHINESE WITH OSA AND IMPROVES WITH CPAP

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Introduction: Nocturia is common in patients with Obstructive Sleep Apnea (OSA) but its prevalence in South East Asian patients with OSA is unknown. Nocturia is a common sleep complaint, often resulting in significant sleep disruption. Nocturia may be a marker of more severe OSA, and it is not known if CPAP treatment can ameliorate nocturia in this patient population.

Materials and methods: 25 patients consecutive who were diagnosed with OSA (AHI≥5) via Level 1 inpatient polysomnography at a tertiary sleep center in an academic hospital in Singapore, who were started on a 1 month trial of CPAP treatment, were recruited for the study.

Baseline demographic, clinical and polysomnographic data were recorded, including nocturia frequency. A face to face or phone interview was conducted immediately prior to CPAP initiation, at 2 weeks and at 4 weeks post initiation and the CPAP compliance, efficacy and clinical response to CPAP, including nocturia frequency was recorded.

Analyses were performed to determine the factors associated with nocturia and its response to CPAP treatment. CPAP compliance was defined as average usage >4hr/night.

Results: 25 patients with OSA (AHI>5) were identified, 20 were male and 5 were female, with majority of them being Chinese (23/25). Average age(yrs), BMI(kg/m2) and baseline AHI are 48.1 ± 13.7, 28.2 ± 4.8 and 34.9 ± 22.6 respectively, (Mean+/-SD).

88% of all patients had nocturia of at least 1x per night, with 28% complaining of 2 or more episodes of nocturia per night. Predictors of nocturia at baseline are age (rho 0.501, p=0.01); AHI was borderline significant (rho 0.376, p=0.064). Gender (rho 0.016, p=0.94), BMI (rho -0.099, p=0.638) and ESS (rho 0.163, p=0.43) were not significantly correlated with nocturia.

48% (12/25) of subjects showed improvement in their nocturia when started on CPAP therapy. Nocturia improved in 10/16 (62.5%) patients who are compliant with CPAP vs 2/9 (22%) who were noncompliant (p=0.053).

Conclusion: In a predominantly Chinese South East Asian population, nocturia is common in patients with OSA, with advanced age and possibly higher AHI being significant risk factors. Compliance with CPAP treatment predicted improvements in nocturia.

Acknowledgment: The authors of this study would like to thank patients and their families, and the team of sleep technologist from Singapore General Hospital, Sleep Disorders Unit.

NASAL MASK AVERAGE VOLUME-ASSURED PRESSURE SUPPORT VERSUS CONVENTIONAL BILEVEL RESPIRATORY SUPPORT IN A 10-MONTH-OLD INFANT WITH CONGENITAL CENTRAL HYPOVENTILATION SYNDROME: A CASE REPORT

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Introduction:
• Congenital central hypoventilation syndrome (CCHS) is a rare lifelong disorder characterised by alveolar hypoventilation and autonomic dysregulation secondary to mutations of the PHOX 2B genes.
• Previous case studies have reported successful ventilation with early use of conventional nasal non-invasive bilevel positive airway pressure (BPAP) in infants with CCHS without the need for tracheostomy.
• The case we describe is the first to report the use of average volume assured pressure support (AVAPS®) feature through a nasal mask on an infant with CCHS.

Report of case:
• A term female infant was noted to have respiratory distress, hypoxia and hypercarbia soon after delivery and was resuscitated using intermittent positive airway pressure ventilation. She was subsequently commenced on non-invasive nasal BPAP for respiratory support in view of unexplained hypercarbia (PCO_2 ranging 70 to 90 mmHg) on capillary blood gas. DNA analysis revealed that she carried a 25-repeat polyalanine expansion mutation of the PHOX 2B gene confirming CCHS. Her sleep study at 9 months of age on BPAP showed high variability in T_cCO_2 tracing (trace A). There was a rise in T_cCO_2 by more than 10 mmHg though it remained only slightly elevated above the normal range (35 to 47 mmHg, measured transcutaneously using *SenTec, Therwil, Switzerland*). A second follow up sleep study, at 10 months of age was performed on the AVAPS feature, enabling the machine to automatically adjust the inspiratory pressures to deliver a constant targeted tidal volume. In our case, this feature led to a better transcutaneous carbon dioxide profile compared to conventional nasal non-invasive BPAP (trace B).
• Top trace: TcCO2 trace on Polysomnography using conventional nasal BPAP. Note the highly regular slow oscillation of TcCO2 of 10 mmHg varying between 35 and 45 mmHg. While the mechanism of this periodicity is uncertain, it may reflect slow oscillations in breathing control induced by the BPAP settings or by slower changes in acid base levels revealed in the absence of usual chemoreceptor control.
• Bottom trace: TcCO2 trace on polysomnography. Arrow indicates change from conventional nasal BPAP to nasal BPAP with AVAPS feature. Note the more consistent control of TcCO2.

Conclusion:
• To our knowledge, this is the first report of the successful use of the AVAPS feature in an infant with CCHS.
• This case highlights that the AVAPS feature may be a reliable alternative to tracheostomy and conventional non-invasive BPAP in infants with CCHS.

AVERAGE VOLUME ASSURED PRESSURE SUPPORT (AVAPS) VERSUS CONVENTIONAL BI-LEVEL PRESSURE SUPPORT IN A COHORT OF PAEDIATRIC PATIENTS WITH NOCTURNAL HYPOVENTILATION

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Introduction: Volume-assured pressure support is a newer feature of non-invasive ventilation that provides a targeted tidal volume by automatically adjusting the inspiratory pressure support within a set range. Paediatric studies evaluating the efficacy of AVAPS (Philips, Murrysville, Pa.) feature in treating nocturnal hypoventilation are confined to case reports. We present a case series of 20 patients demonstrating better control of transcutaneous carbon dioxide compared to conventional bilevel positive airway pressure support (BPAP) using similar inspiratory pressures.
Aim: The aim of the study was to compare AVAPS feature with conventional bilevel in improving hypercarbia in a cohort of paediatric patients with nocturnal hypoventilation.
Methods: Retrospective review of sleep study data for paediatric patients with nocturnal hypoventilation treated with conventional BPAP and AVAPS over a two-year period. Parameters compared included: SaO_2, T_CCO_2, sleep efficiency, delivered pressure, obstructive apnoea/hypopnoea index (OAHI) and respiratory arousal index. Inspiratory pressure and tidal volume delivered were downloaded on final titrated settings. Comparisons were made using restricted maximum likelihood (REML).
Results: A total of 20 patients (11 males, 9 females, median age 11 years, range 1 to 19 years) were identified. Diagnoses included: neuromuscular disease n=9, obstructive hypoventilation n=5, parenchymal lung disease n=4, and central congenital hypoventilation syndrome n=2. AVAPS feature demonstrated significant improvement in peak (p=0.009) and mean (p=0.0017) T_CCO_2 parameters compared to conventional bilevel. Oxygenation on AVAPS feature showed positive trend but did not reach statistical significance. AVAPS delivered higher tidal volumes (p=0.0423) using similar pressures. There was no statistically significant difference in OAHI, respiratory arousal index, sleep efficiency and compliance between the two modes.
Conclusion: AVAPS was more effective than conventional bilevel in improving hypercarbia in our cohort of paediatric patients. Prospective, longitudinal studies are needed to evaluate the benefits of BPAP AVAPS in the paediatric population.

MULTIDISCIPLINARY CARE FOR OBSTRUCTIVE SLEEP APNEA IN THE AGE OF "PERSONALIZED" SLEEP MEDICINE

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Introduction: In Canada, recommendations have been published to guide multidisciplinary collaboration between sleep physicians and dentists. However, the responsibility of managing treatment outcomes often falls to primary care physicians (PCPs). P4 medicine has recently been proposed to improve care for obstructive sleep apnea (OSA)[1], but the role of the PCP and interprofessional collaboration have not been addressed. This case study demonstrates a multidisciplinary, P4 medicine treatment protocol for a patient with OSA and co-morbid insomnia.

Materials and methods: A PCP referred a 78-year-old male with chief complaints of excessive daytime sleepiness and GERD to a dentist for oral appliance (OA) therapy. The patient had previously been referred to a sleep clinic, completed a home sleep study and was diagnosed with OSA (AHI=38) and co-morbid insomnia. CPAP therapy was problematic and was ultimately abandoned. CBTi therapy was started and did not produce any beneficial results. The patient felt discouraged following his experience at the sleep clinic and was reluctant to return.

At baseline, the dentist administered the Epworth Sleepiness Scale (ESS) and Insomnia Severity Index (ISI) questionnaires as well as a validated sleep screening with a single-lead ECG. Two non-invasive treatment options were presented: elevating the head of the bed to reduce GERD and a trial OA to stabilize the airway and protect the teeth. The patient agreed to systematically test each intervention using the sleep screening device.

Results: Baseline screening confirmed daytime sleepiness (ESS=20) and insomnia symptoms (ISI=18). Sleep screening results showed total sleep time (4h31min), sleep latency (1h48min), sleep fragmentation (eLFCbb=28%), stable sleep (2%), unstable sleep (91%) and Sleep Quality Index (.02; norm=1.67). The dentist alerted the PCP that breathing patterns suggested possible central events (eLFCnb=49%). She subsequently referred the patient for a PSG, which was scheduled 9 months later.

Meanwhile, head-of-bed elevation improved the SQI slightly (.11) yet increased sleep fragmentation (37%). Risk for central sleep apnea (CSA) pathology was still evident (eLFCnb=47%). Although the addition of OA therapy increased sleep fragmentation (44%), there was a dramatic drop in CSA-related pathology (11%). Head-of-bed elevation plus OA therapy did not produce further sleep quality improvements (SQI=.11). Six months later, a follow-up sleep screening showed that sleep parameters had returned to baseline levels.

Conclusions: Non-invasive interventions, such as head-of-bed elevation and oral appliance therapy, can improve conditions that otherwise disturb sleep quality and continuity; however, clinicians should not rely on immediate outcomes. Regular follow-up testing is needed to ensure long-term treatment efficacy. At least one member of the multidisciplinary team should assume responsibility for routine monitoring, and regular interprofessional communication is essential.

By involving the patient in collecting his own sleep data, he became re-engaged in his care and was more willing to return to the sleep clinic for further assessment. Small, yet robust, sleep screening devices help facilitate personalized, patient-centered care and multidisciplinary collaboration.

Reference: [1]Pack, A. (2016) Application of Personalized, Predictive, Preventative, and Participatory (P4) Medicine to Obstructive Sleep Apnea. A Roadmap for Improving Care? An Am Thorac Soc, 13(9), 1456-1467.

POOLED ANALYSES FROM 12-WEEK RANDOMISED, CONTROLLED STUDIES OF SOLRIAMFETOL IN THE TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN PARTICIPANTS WITH OSA OR NARCOLEPSY

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Introduction: Solriamfetol (formerly JZP-110), a dopamine and norepinephrine reuptake inhibitor, has been approved in the United States to improve wakefulness in adult patients with excessive daytime sleepiness (EDS) associated with narcolepsy or obstructive sleep apnoea (OSA). The approved dose range of solriamfetol in the US is 75 to 150 mg once daily for patients with narcolepsy and 37.5 to 150 mg once daily for patients with OSA. A Marketing Authorisation Application for these indications is under review with the European Medicines Agency. This study evaluated the overall efficacy and safety of solriamfetol using pooled data from studies of participants with EDS associated with OSA or narcolepsy.
Materials and methods: Data from three 12-week studies (2 narcolepsy, 1 OSA) were pooled. Efficacy assessments included change from baseline to week 12 on mean sleep latency on the Maintenance of Wakefulness Test (MWT), Epworth Sleepiness Scale (ESS) score, and patient-reported improvement on the Patient Global Impression of Change (PGI-C) scale. Safety was also assessed.
Results: Compared with participants with OSA (n=113 placebo, 343 solriamfetol [combined doses]), participants with narcolepsy (n=105 placebo, 215 solriamfetol) were younger, predominantly female, and had lower body mass index. Baseline MWT mean sleep latency and ESS scores were more severe for narcolepsy compared with OSA. Change from baseline to week 12 in MWT mean sleep latency increased in a dose-related manner compared with placebo, with least squares (LS) mean differences of 2.2, 7.4, and 10.4 for 75, 150, and 300 mg, respectively, for narcolepsy, and 4.7, 9.0, 11.1, and 13.0 for 37.5, 75, 150, and 300 mg, respectively, for OSA. Dose-related effects were also observed for change from baseline to week 12 in ESS score, with LS mean differences of -1.8, -3.8, and -5.2 for 75, 150, and 300 mg, respectively, for narcolepsy, and -2.0, -1.9, -4.5, and -4.8 for 37.5, 75, 150, and 300 mg, respectively, for OSA. At week 12, the percentage of participants reported as improved on PGI-C was increased relative to placebo; results were similar in the 2 populations. In the overall population, the most frequent (≥5%) adverse events were headache, nausea, decreased appetite, anxiety, nasopharyngitis, diarrhea, and dry mouth; incidences were comparable in OSA and narcolepsy.
Conclusions: Similar efficacy findings were seen on patient-reported (ESS and PGI-C) and objective (MWT) outcomes, independent of the underlying diagnosis. The safety profile was generally similar between participants with narcolepsy and with OSA.

THE IMPACT OF INCLUDING AROUSALS SCORED IN AWAKE EPOCHS OF POLYSOMNOGRAPHY ON THE AROUSAL INDEX

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Introduction: The arousal index (AI) in polysomnography (PSG) allows for quantification of sleep disruption and current American Academy of Sleep Medicine (AASM) guidelines recommend including arousals in awake epochs when calculating the AI. This approach is inconsistent with AASM recommendations for respiratory events, where respiratory events entirely in awake epochs are not included in the apnoea hypopnoea index (AHI). Additionally, there is an internal contradiction in that arousals are counted in awake *and* sleep epochs and divided only by sleep time. However, the impact of including arousals in awake epochs in the AI has not been formally evaluated. The aim of this study was to investigate the impact of including arousals scored in awake epochs on the AI.
Materials and Methods: Seventy consecutive diagnostic PSG's for investigation of OSA were reviewed. Two different arousal indices were calculated from each PSG; one excluding (AI^{exc}) and one including (AI^{inc}) arousals scored in awake epochs.
Results: The median (IQR) increase in AI^{inc} was 5.2/h (3.3, 7.8) as compared to AI^{exc} (AI^{in}=29.0 (19.4, 39.1) vs. AI^{exc}=23.6 (14.1, 32.8)). The increase in AI was greater with increasing AHI; 73% of patients with AHI >30/h (n=22) had an increase in AI of >5/h, compared to 57% with an AHI 15-30/h (n=23), and 32% with an AHI < 15/h (n=25).
Conclusions: There was a 22% increase in arousal index by including arousals during awake epochs with this discrepancy being greatest for those with a high AHI. This investigation informs clinical practice, highlights the pitfalls of scoring sleep with epochs, and informs future standards for the scoring of sleep and associated events.

CPAP USAGE IS INCREASED AFTER A PSYCHOEDUCATION PROGRAM AT 1 MONTH, BUT NOT AT 4 MONTHS

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Introduction: Continuous Positive Airway Pressure (CPAP) is a first line treatment for Obstructive Sleep Apnoea (OSA), in many patients usage is sub-optimal. A previous study found a group cognitive behavioural therapy intervention improved CPAP uptake and usage, 30 days after CPAP initiation. The aims of this study were to determine whether a novel psychoeducation program could improve 1) CPAP usage, and 2) scores on the Self-Efficacy Measure for Sleep Apnea (SEMSA) questionnaire, compared to a treatment as usual program, up to 4 months after CPAP titration.

Materials and methods: Eighty-one OSA patients commencing CPAP were randomised into 2 groups: treatment as usual (TAU; N=43) or a psychoeducation program (PSY CPAP; N=38). TAU participants underwent the standard laboratory protocol to commence CPAP, including; OSA/CPAP education, mask/CPAP trial, overnight CPAP titration and a follow-up phone call 2 weeks post CPAP titration, with further reviews as required. PSY CPAP participants underwent the same protocol, plus (i) 1.5 hour psychoeducation session, 2 weeks prior to commencing CPAP; (ii) follow-up calls at 1 and 7 nights post CPAP titration; (iii) in laboratory review, 2 weeks post CPAP titration, including a 'booster' psychoeducation session; and (iv) further reviews as required. All participants completed the SEMSA at baseline, on the evening of CPAP titration (post intervention) and at 1 and 4 months post CPAP titration. The SEMSA consists of 3 subscales; risk perception, outcome expectancies and treatment self-efficacy. CPAP usage data (hrs/night) were downloaded at 1 week, 1 month and 4 months. Repeated measures ANOVAs were conducted to compare SEMSA scores from baseline to each timepoint. Independent t-tests were used to examine differences in CPAP usage between groups at each timepoint.

Results: PSY CPAP group had significantly higher CPAP usage compared to TAU group at 1 week (mean±SD=5.6h±2.4 vs 4.2h±3.0; p=0.03) and at 1 month (mean±SD=5.0h±2.8 vs 3.8h±2.8; p=0.04), but not at 4 months (mean±SD=4.6h±2.9 vs 3.5h±2.9; p=0.11). A significant interaction was found, with scores on the SEMSA outcome expectancies subscale improving pre/post intervention, in the PSY CPAP group compared to the TAU group (p=0.007). No other interaction effects were significant. There was a main effect of time for the SEMSA subscales, with risk perception scores improving from baseline to post intervention (p=0.002), outcome expectancies scores improving from baseline to post intervention (p< 0.001) and from baseline to 1 month (p=0.034), and treatment self-efficacy scores improving from baseline to post intervention (p< 0.001) and from baseline to 1 month (p=0.025) across both groups.

Conclusions: CPAP usage was higher in the group that underwent the psychoeducation program compared to standard laboratory care, at 1 week and 1 month. At 4 months, CPAP usage in both groups was consistent with usage in clinical practice. Extra support could be provided to patients who have been deemed as at risk of ceasing treatment, within the first month. Ongoing psychoeducation sessions, provided after 1 month of usage, may help to sustain an increased level of CPAP usage over the longer term.

IMPACT OF EARLY INTERVENTION USING TELE-MONITORING OF CPAP FOR PATIENTS WITH OBSTRUCTIVE SLEEP APNEA IN JAPAN

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Introduction: Previous studies have suggested that tele-monitoring provides good adherence to continuous positive airway pressure (CPAP). Whether we also benefit in Japan has not been elucidated, because Japanese patients are supposed to come to see the doctors regularly. We therefore investigated the effect of early telephone coaching using tele-monitoring on the adherence to CPAP.

Materials and methods: We compared the drop-out rate and the average usage in 1 month between the patients who initiated CPAP with tele-monitoring from January to December in 2018 (tele-monitoring group) and the patients who initiated CPAP without tele-monitoring from January to December in 2017 (conventional group). In the tele-monitoring group, we tried to make a phone call during the next week after initiation of CPAP regardless of the adherence in the first week. We compared baseline characteristics and CPAP usage at 1 month between tele-monitoring group and conventional group. In the tele-monitoring group, we also compared variables according to the success of phone call and their adherence at 1 month.

Results: We included 169 patients in the tele-monitoring group and 231 patients in the conventional group. Four patient dropped out in the tele-monitoring group, while eight patients did in the conventional group (p = 0.127). In all the tele-monitoring group, we compared 44 patients who did not answer our phone call (no-communication group) with the rest of 125 patients (telephone-coaching group). Drop-out rate was statistically significant (7% vs 1%, p = 0.024), while the average usage at 1 month was not (288 and 299 min, p = 0.208). In all the tele-monitoring group, the number of patients who used CPAP for more than 4 hours per night on more than 70% of nights was 72 (43%). The characteristics of these patients included older age, higher apnea-hypopnea index in the diagnostic polygraph, and high rate of more than 4 hours usage at 1 week. Whether patients answered our phone call was unrelated (p = 0.062).

Conclusions: We might avoid dropout by early telephone coaching to the patients. We did not find the importance of early telephone coaching on the adherence to CPAP at 1 month. However, the results admit us to intervene earlier than 1 week, because good adherence in the first week was associated with the adherence at 1 month.

Acknowledgements: We thank for all the patients who are involved in the study.

AN INVESTIGATION INTO THE DIFFERENCES IN THE PHENOTYPIC CAUSES OF OBSTRUCTIVE SLEEP APNOEA IN OBESE VERSUS NON-OBESE PEOPLE

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Introduction: Non-obese people with obstructive sleep apnoea (OSA) are more difficult to treat with continuous positive airway pressure (CPAP), and likely have different phenotypic causes compared to obese people with OSA. However, this has not been well characterised. Accordingly, the goal of this study was to compare the 4 key phenotypic causes of OSA in non-obese versus obese people with OSA.

Materials and methods: This retrospective case-control study compared OSA phenotype data from 49 non-obese (Normal weight BMI< 25kg/m^2 and overweight BMI 25-30kg/m^2) versus 80 obese (BMI >30kg/m^2) people with OSA (AHI>5/hr sleep). Data was acquired from 6 different detailed physiology studies that used similar methodology. Primary sleep outcomes were genioglossus muscle responsiveness, upper airway collapsibility (Pcrit), arousal threshold and loop gain. Breathing parameters were also compared.

Results: Normal weight individuals had a lower arousal threshold compared to overweight and obese people (-13[-15,-9] vs. -18[-23,-15] vs. -17[-22,-14]cmH$_2$O, p=0.04). Pcrit increased with increasing body weight category (-2.3 [-3,0.2] vs. -1.3 [-3,0.1] vs. 0.6 [-1.4,2.6]cmH$_2$O, p< 0.05). However, genioglossus responsiveness and loop gain were not different between groups. Obese people had a higher minute ventilation and breathing frequency on CPAP during sleep, and off-CPAP awake compared to non-obese people with OSA.

Conclusions: The upper airway is less collapsible, but arousal occurs more easily in non-obese people compared to obese people with OSA. These are likely important distinguishing factors in OSA pathophysiology between obese versus non-obese people as the other traits (i.e. upper airway muscle responsiveness and loop gain) are not systematically different between groups. Higher breathing frequency and minute ventilation in obese OSA may reflect increased metabolic demand and compensation in response to increased mechanical load to breathing.

Sleep Breathing Disorders
Board #218 : Poster session 3

DETERMINATION OF THE MAIN REASONS FOR DIFFICULT NASAL BREATHING IN CHILDREN IN PRIMARY AND MIXED DENTITION

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Introduction: According to the literature, the prevalence of mouth breathing children vary from 5% to 75%. As to gender, there is a slight predominance of this pathology in females when compared to their male counterparts. A wide range of groups of study children are described in the literature and different rates of mouth breathing in children are obtained. This makes comparisons between them problematic. Nevertheless, most authors have similar results on the causes that lead to mouth breathing.
Aim: The aim of this article is to determine and analyze the main reasons for difficult nasal breathing in children in primary and mixed dentition.
Material and methods: For the purposes of this article 412 children between the ages of 3 and 12 were studied. All of the studied children were examined by the same doctor of dental medicine, and were consulted and diagnosed by an ear-nose-throat specialist as well. We used the methods of anterior and posterior rhinoscopy. The children were further divided according to their gender and type of dentition.
Results: The main reason for the difficult nasal breathing in primary dentition is allergic rhinitis (n=30). The second cause in this studied age group is adenoid hypertrophy (n=25). In the early mixed dentition the most common cause of the difficult nasal breathing is adenoid hypertrophy (n=184). A significantly small percentage of children in early mixed dentition (n=17, 3,80%) the cause of difficult nasal breathing is hypertrophy of the palatine tonsils. The percentage of children in late mixed dentition (n=224) with adenoid hypertrophy decreases (n=26), allergic rhinitis occurs in only 31 of the studied children and the percentage of children with hypertrophy of the palatine tonsils increases.
Conclusion: The main reason for the difficult nasal breathing in primary dentition is allergic rhinitis (54,50%), whereas in early mixed the main cause of mouth breathing is adenoid hypertrophy.

SLEEP APNEA PATIENTS EXHIBIT INCREASED NOCTURNAL PLASMA LEVELS OF IL-6 AND TNF-α: EFFECTS OF CPAP, OXYGEN & ANTIOXIDANTS

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Introduction: Sleep apnea patients exhibit increased plasma levels of IL-6 and TNF-α and this response may be implicated in increased cardio-cerebrovascular morbidity.
Aims: We hypothesized that this inflammatory response is causatively related to the intermittent strenuous diaphragmatic contractions and the episodes of arterial oxygen desaturation and oxidative stress associated with apnoeic events and can be attenuated by the administration of oxygen, n-CPAP and antioxidants.
Methods: 29 patients suffering with OSAS and 11 healthy individuals underwent a standard polysomnographic study. The OSAS cohort underwent 3 additional PSG studies: 1) with concurrent oxygen administration, 2) with n-CPAP therapy and 3) after 2 months of antioxidant supplementation (Vitamins A, E C, N-acetysysteine, allopurinol).
Plasma was sampled at 20-minute intervals throughout the night via an indwelling intravenous catheter for measurement of IL-6 and TNF-α protein levels (ELISA). Intracellular expression of IL-6 and TNF-α protein levels in monocytes was detected by flow cytometry. IL-6 and TNF-α gene promoter polymorphisms were determined on the purified DNA using a commercially available cytokine genotyping tray (One Lambda, Inc., CA, USA).
Results: OSAS patients exhibit higher plasma IL-6 but not TNF-a levels compared to controls. The IL-6 upregulation is nocturnal and exhibits variation over time.
The IL-6 variation is predicted independently by the duration of the apnoeic episodes and the average oxygen saturation.
The IL-6 response to OSAS is not uniform but exhibits 2 patterns: One group of patients exhibits IL-6 upregulation and a second group does not. The different response cannot be attributed to IL-6 gene promoter polymorphisms. The two groups exhibit different sleep incident patterns.
There is no correlation between the expression of IL-6 and TNF-α in monocytes and the iso-time plasma cytokine levels.
Oxygen supplementation and n-CPAP therapy reduced the nocturnal IL-6 upregulation. Antioxidant administration has no effect on IL-6 levels.
Conclusions: OSAS patients can exhibit nocturnal IL-6 upregulation triggered by apnea related strenuous diaphragmatic contractions and oxygen desaturation.
Funded by the Thorax Foundation

SLOPE OF THE OXYGEN DESATURATION REFLECTS THE PHARYNGEAL COLLAPSIBILITY IN OSA

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Introduction: We recently demonstrated that patients with "deep" respiratory events (i.e., complete apneas, suggesting a more collapsible pharynx) were less likely to respond to oral appliance therapy. However, event depth, which requires accurate airflow measurements, can be difficult to determine due to movement of the nasal cannula or oral breathing. Oxygen saturation is an alternative signal for potentially characterizing respiratory event depth that is not impacted by these challenges in airflow measurement. In general, the reduction in ventilation during a respiratory event is proportional to the rate of change in oxygen saturation; deeper events cause a more rapid drop in oxygen saturation per unit time. Therefore, the aim of this abstract was to demonstrate that the slope of the oxygen desaturation curve is proportional to event depth and can be similarly associated with oral appliance treatment efficacy.

Methods: Eighty-one OSA patients (AHI>10 events/hr) were assessed via polysomnography during one night off and one night on treatment with oral appliance. Event depth and desaturation slope were measured from the "average" ventilatory and saturation profiles, respectively, as follows. The time-series signal (e.g. oxygen saturation) from all respiratory events were aligned at event termination and ensemble averaged to output a signal profile of the average respiratory event. Event depth was calculated as the mean reduction in ventilation from the ventilatory profile of the average respiratory event. Desaturation slope was measured as the change in oxygen saturation from the 10th (i.e. event start) to the 90th (i.e. event end) percentile of the saturation profile of the average respiratory event, divided by time between these points. Correlation between event depth and desaturation slope was assessed using Pearson's correlation. Bivariate logistic regression tested differences in both variables between oral appliance responders (>50% reduction in AHI from baseline plus treatment AHI< 10 events/hr) vs. non-responders. Cohen's d (effect size) was used to measure the standardized difference of both variables between oral appliance responders vs. non-responders.

Results: Median baseline AHI was 34.0[22-54] events/hr with a percent reduction of 54.9[38-76]%. Of the 81 patients, 31 were oral appliance responders. Slope of oxygen desaturation was correlated with event depth (r=0.45, p< 0.001). In oral appliance non-responders, events were significantly deeper (p< 0.01) and the slope of the desaturation curve was steeper (p< 0.001), compared to responders. Effect size of the differences between oral appliance responders and non-responders was greater with desaturation slope compared to event depth (1.0[0.39-1.34] vs. 0.66[0.20-1.13]).

Conclusion: Correlation between event depth and desaturation slope during respiratory events indicates that desaturation slope is a potential replacement for event depth as a surrogate measure of pharyngeal collapsibility. Furthermore, oxygen desaturation slope is unaffected by cannula movement or oral breathing, and it is much easier to measure. This new metric might be an important component in simplified OSA phenotyping.

VALIDATION OF THE INDIAN SLEEPINESS SCALE TO ASSESS EXCESSIVE DAYTIME SOMNOLENCE

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Introduction: Excessive daytime sleepiness is a prominent and oftentimes the presenting symptom of obstructive sleep apnea (OSA). Of the various tools used for the assessment of subjective sleepiness, Epworth sleepiness scale (ESS) is a widely accepted tool. However, some of the drawbacks of this questionnaire are that most of the situations presented are passive, responses are graded on a scale of 0-3 and equal weightage is given to active and passive situations alike. In addition, some of the situations in ESS (like driving and reading) may be inapplicable in a proportion of patients.

To overcome these limitations of the ESS, an Indian Sleepiness scale© (ISS) was developed by us. This scale is easier to administer as it has yes-no responses, situations are relevant to Indian subjects and multiple redundant active situations have been incorporated. A weighted score is assigned to each question based on whether it denotes an active or passive situation. In the present study, we aimed to validate the ISS in patients with suspected OSA.

Materials and methods: Consecutive patients attending the Sleep Clinic with suspected OSA were administered both ESS and ISS at initial evaluation. Polysomnography was performed in all and severity of OSA was classified as mild, moderate and severe based on apnea-hypopnea index (AHI). Sensitivity and specificity were calculated for both ESS and ISS and cut-off values for ISS were derived using receiver operating characteristic (ROC) curve.

Results: We analysed 270 patients visiting the out-patient clinic with a history suspicious of OSA. There were 186 (68.8%) males and 84 (31.2%) females. The mean±SD age was 50.5±13.9 years and mean BMI was 31.8±7.8 kg/m^2. The median (IQR) ESS score was 10 (5-14) and ISS score was 8 (4-15.5) respectively. OSA was diagnosed in 229 (84.8%) with a median AHI of 31 (13.9-62.3) per hr. The severity of OSA was mild in 34 (12.6%), moderate in 57 (21.2%) and severe in 138 (51.2%) patients respectively. At the accepted cut-off value of >10, the sensitivity and specificity of ESS were 46% and 70% respectively. A cut-off of ≥ 6 was derived for ISS, at this cut-off, the scale yielded a sensitivity of 72% and specificity of 53%.

Conclusion: The Indian Sleepiness scale is an easy to administer tool which proved to be more sensitive than ESS as a screening questionnaire for excessive daytime sleepiness in patients with suspected OSA.

PREDICTIVE SYMPTOMS OF EARLY ADHERENCE TO AUTOTITRATING POSITIVE AIRWAY PRESSURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Obstructive Sleep Apnea (OSA) is a highly prevalent disease, representing an important burden on health systems. Autotitrating Positive Airway Pressure (APAP) is an effective treatment for obstructive sleep apnea and its associated symptoms, however therapy adherence is a problem for a large group of patients. We aim to characterize the most frequent difficulties reported by patients starting therapy with APAP, and strategies used to overcome them.

We retrospectively studied 313 patients who attendedtwo follow-up sessions, one and three months after starting treatment with APAP, respectively. Adherence and tolerance to APAP were evaluated.

After 1 month of treatment 242 out of 313 (77%) of patients reported an overall improvement on OSA-associated symptoms. 62% were adherent to treatment. Only 132 patients (42%) had treatment-related complaints. The most frequently ones were oronasal dryness (n=88), significant air leak (n=59), multiple awakenings (n=35) and insomnia (n=22). However only initial and intermediate insomnia and awakenings were significantly predictive of worse adherence after 1 and 3 months (p< 0.005).

The most commonly proposed measures were heated humidification (n=74), mask switch (n=65), interface adjustment (n=62), switch to fixed-pressure PAP (n=17). Out of 279 who attended the second follow-up session, 88% reported a significant improvement of symptoms under APAP treatment, and 76% required no further adjustment. Paired t-test showed a significant improvement in adhesion to 77%.

Our study shows that despite some initial difficulties, the vast majority of patients can achieve adequate adherence and tolerance to APAP with proper follow-up and early intervention. Insomnia and multiple awakenings are associated with worse adherence and should warrant a closer follow-up and early intervention.

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PREVALENCE AND FACTORS ASSOCIATED WITH POSITIONAL OBSTRUCTIVE SLEEP APNEA IN AN OBESE PAEDIATRIC POPULATION

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Introduction: Positional obstructive sleep apnea (POSA) is a phenotype of obstructive sleep apnea (OSA) where sleep-related apneas occur predominantly in the supine position. While OSA is highly prevalent among obese children, limited knowledge exists regarding the presence of POSA. The objective of this study was to determine the prevalence of POSA and to identify factors associated with POSA in an obese paediatric population at The Hospital for Sick Children.

Methods: This was a prospective study of obese children aged 8 to 18 years old whom had a baseline polysomnogram. Positional OSA was defined as an overall obstructive apnea-hypopnea index (OAHI) ≥ 5 events per hour, and a supine AHI to non-supine AHI ratio of ≥ 2. Patient demographics, anthropometrics, and polysomnography data were recorded and compared in subjects with and without POSA.

Results: Of the 114 obese children referred for a polysomnogram, 69 (61%) did not have OSA and 45 (39%) had OSA. In the OSA group, 25/45 (56%) were defined as having POSA (mean age 14.6 ± 2.3 years, mean BMI 37.7 ± 7.6 kg/m^2, 53% male) and 20/45 (44%) had non-POSA (mean age 13.7 ± 2.8 years, mean BMI 38.8 ± 7.4 kg/m^2, 47% male). For the POSA and non-POSA groups, the mean waist circumference was 112.9 ± 18.5 cm and 111.0 ± 15.8 cm, respectively. The mean waist to height ratio was 0.7 ± 0.1 for both groups. Among those with POSA, 13/25 (52%) had mild OSA, 7/25 (28%) had moderate OSA and 5/25 (20%) had severe OSA. No significant differences were found in age (p=0.29), gender (p=0.61), height (p=0.10), weight (p=0.64) or BMI (p=0.63) between POSA and non-POSA groups. No significant differences were also found with supine AHI (p=0.43) and non-supine AHI (p=0.62) between groups. Similarly, time spent in supine (p=0.28) and non-supine (p=0.48) sleep did not differ significantly between groups.

Conclusions: In obese children with OSA, POSA was found to be highly prevalent, occurring among 56% of the cohort. Moreover, similar to an adult population, obese children with POSA appear to have milder forms of OSA. There were no significant risk factors identified for POSA. However, there remains a lack of literature describing effective alternative therapies for obese children. As obese children are known to have low rates of CPAP adherence, the use of novel targeted therapies should be addressed. More importantly, given the high prevalence of POSA in an obese paediatric population, further research should evaluate the efficacy of positional therapy as a potential targeted therapy for clinical management.

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH RHEUMATOID ARTHRITIS

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Introduction: It has been suggested that the risk of developing obstructive sleep apnoea (OSA) in patients with rheumatoid arthritis (RA) is to be particularly high irrespective of BMI. The prevalence of OSA in RA was reported in 30-50% of patients based on subjective measures. Therefore our aim in present study is to assess the prevalence of OSA among patients with RA using a standard objective measure i.e. polysomnography, its impact on the quality of life of these patients, snd its relationship to RA disease severity.

Methods: All patients with rheumatoid arthritis presented to the rheumatology clinics at King Abdulaziz University Hospital, Jeddah in the period from (June 2017 - September 2018) were screened using Disease Activity Score 28 (DAS28 score) to asses activity of RA, Berlin questionnaire to assess the risk of OSA syndrome, Epworth Sleepiness Scale (ESS) to asses daytime sleepiness, and health assessment questionnaire (HAQ) to asses quality of life. Subsequently polysomnography (PSG) was performed to confirm the presence of OSA and to assess the role of the different contributing risk factors.

Results: Two hundreds and two patients with RA were recruited, 103 (51%) patients had polysomnography (PSG) performed successfully. The mean age of the participants was 48.4±13.7 years, and the mean BMI was 31.87±9.83 kg/m2, with 94.1% of them were females. Sixty-seven (33.2%) of the participants were of high risk for OSA (35 [52.2%] had PSG done), while 135 (66.8%) were of low risk (67 [49.6%] had PSG done). Participants with OSA defined as apnea hypopnea index (AHI) of ≥ 5 were 64/103 (62.1%) while those with obstructive sleep apnea syndrome (OSAS) defined as AHI of ≥5 and excessive daytime sleepiness (ESS ≥10) were 21/103 (20.4%). A conservative estimate of at least 31.7% and 10.4% were calculated for the overall prevalence of OSA and OSAS respectively for the study population. However, OSA was not found to be associated with activity of RA (*P* value = 0.113) nor with the quality of life (*P* value = 0.200).

Conclusion: Obstructive sleep apnea is more common among patients with RA than in the general population. However, it was not found to be associated with RA activity nor with quality of life.

EFFECTS OF ENDOCANNABINOID RECEPTOR CB1 AND CHRONIC INTERMITTENT HYPOXIA ON THE EXPRESSION OF AUTOPHAGY RELATED PROTEINS LC3 II AND BECLIN-1 IN RAT NERVE CELLS

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Introduction: By means of establishing Chronic intermittent hypoxic rat model and measuring the expression of autophagy related proteins LC3 II and beclin-1 in rat nerve cells, this paper has explored the effect of CIH on autophagy expression. Meanwhile, endogenous cannabinoid CB1 receptor antagonist was used to confirm the effect of CB1 on autophagy.

Materials and methods: 40 healthy male rats were selected to establish a CIH model, and were randomly divided into 5 groups: normal control group（CG）, CIH4-week group（CIH4）, CIH6-week group（CIH6）, CIH+intervention 4-week group (CIH4+I)and CIH+intervention 6-week group(CIH6+I). The intervention group was given intraperitoneal injection of CB1 antagonist (rimonabant) 1.5mg/kg/d before modeling. At the fourth and sixth weeks of the experiment, half of the rats in each group were randomly selected and sacrificed, and then the hippocampal tissues of the rats in each group were isolated. Morphological changes of nerve cells after HE staining were observed by optical microscope, and the expressions of autophagy related proteins LC3 II and beclin-1 in nerve cells of rats were detected by immunohistochemistry (SABC).

Results:

1) Pathological changes of HE staining: The nerve cells in the control group were orderly arranged with regular morphology, clear edges and full cytoplasm. The above changes were reduced in both CIH4 and CIH6 weeks after intervention with CB1 receptor antagonist before modeling, suggesting that CB1 receptor antagonist has a protective effect on intermittent hypoxic nerve cell injury.

2）Expression of LC3II and beclin-1: Compared with the control group, the expression of LC3II and beclin-1 protein in nerve cells in the CIH group was significantly increased, and the difference was statistically significant ($P < 0.05$), especially in the cih4-week group. Compared with CIH group, the expression of LC3II and beclin-1 protein in nerve cells in the intervention group was significantly decreased, and the difference was statistically significant ($P < 0.05$).

Conclusions:

1) CIH can induce autophagy in rat nerve cells, especially in the early stage of CIH.

2) CB1 antagonist can inhibit the autophagy of rat nerve cells induced by CIH.

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NOVEL METHOD FOR UPPER AIRWAY RESISTANCE EVALUATION BY USING DIAPHRAGMATIC ELECTROMYOGRAPHY

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Introduction: Patients with respiratory diseases may develop hypoventilation during sleep. Few methods are clinically available to distinguish hypoventilation due to increased upper airway resistance (UAR) from that due to reduction of neural respiratory drive. Airway resistance can be defined as R = (pressure at hypopharynx- atmosphere)/flow. Atmosphere pressure outside the nose is zero and pressure at hypopharynx relates to esophageal pressure (Pes), therefore the above function could be simplified as R= Pes/flow. Our preview studies show that there was a good relation between Pes and diaphragm EMG（EMGdia）, the aim of the present study is to determine whether the ratio of EMGdia to airflow could be reliably quantify UAR in patients with obstructive sleep apnea（OSA）, which is a nature model of UAR.

Materials and methods: Fifteen OSA patients were recruited in the study. Full polysomnography was performed including EEGs (C3A2, C4A1) EOGS (LOC, ROC), chin EMG, oxygen saturation, snoring and airflow from pnenmotachgraphy connecting to full-face mask. We also recorded the EMGdia and Pes from a diaphragm function catheter. Data were recorded during wakefulness，snoring and hypopnea events during sleep stage 2. More than 120 respiratory cycles were analyzed.

Results: There is significant decrease in peak-flow, average flow and ventilation in all OSA patients from wakefulness to hypopnea ($p < 0.05$). Good relationship between Pes and diaphragmatic were found, and both the EMGdia and Pes increased in snoring and hypopnea compare with wakefulness. However, there is no significant difference from snoring to hypopnea.The upper airway resistance are defined as follows，UAR=EMGdia/Peak-flow，UAR=EMGdia/Average-flow and UAR=EMGdia /Ventilation. In OSA patients, all the three equation defined UAR increased from wakefulness to snoring and highest at hypopnea. (EMGdia/Peak-flow, wakefulness 0.64±0.31, snoring 1.47±0.93, hypopnea 2.69±1.45, $p < 0.05$; EMGdia/Average-flow, wakefulness 0.83±0.42, snoring 2.01±1.22, hypopnea 4.48±2.57, $p < 0.05$; EMGdia /Ventilation, wakefulness 1.3±0.38, snoring 2.83±1.37, hypopnea 6.14±2.89, $p < 0.05$).

Conclusions: We conclude that diaphragm EMG combined with recording airflow could be used to quantify upper airway resistance.

EXPERIENCE OF MANAGING RECURRENCE AFTER MAXILLOMANDIBULAR ADVANCEMENT SURGERY FOR OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Maxillomandibular advancement (MMA) is considered the most effective surgical procedure for adult obstructive sleep apnea (OSA) treatment that achieves enlargement of the upper airway. During the follow up of post-MMA patients, recurrence of apnea symptoms might occur. These cases were retrospectively reviewed and discussed for the risk factors, managements and long-term results.
Materials and methods: Two cases of recurrent symptoms during follow up and the different revision surgeries for correction. Both were male patients with severe OSA and related symptoms.
Results: One 36-year man with normal BMI and class II occlusion showed typical symptoms of severe OSA. Initial respiratory disturbance index (RDI) was 46. He received MMA and RDI decreased to 5 after surgery. Since post-operative 1 year, the obstructive symptoms gradually presented and AHI returned to 56.5. Three years later, he received second MMA surgery with a larger amount of maxillomandibular complex advancement. Successful results then kept for 10 years. Another 33-year man with similar OSA presentation and class II occlusion. Pre-operative AHI was 23. After MMA, AHI improved to 1.7. However, post-operative one year, follow-up AHI went up to 18.9. The cephalogram showed stable bone position and acceptable diameter of pharyngeal airway. After examination, redundant uvula was noted. Uvula reduction surgery was done and obstructive symptoms tapering off. Stable result as low AHI was found for 10 years.
Conclusions: Adequate secondary treatment led to long-lasting and stable surgical success. The factors of relapse of bone and soft tissue might due to complex multifactorial phenomenon, including the amount of advancement, previous palatal surgery and scarring, and body weight changing. Comprehensive evaluation of the patients while regular follow up was the key to reach a better outcome.

DOES SLEEP DISORDERED BREATHING AFFECT MOTOR DEVELOPMENT OF CHILDREN WITH DOWN SYNDROME?

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INTRODUCTION: Poor sleep quality negatively affects the growth and development of children. Children with Down syndrome (DS) are at high risk for sleep-disordered breathing (SDB) and show delayed motor development time. We hypothesized that the presence of SDB may aggravate the motor development impairment of this population.

OBJECTIVE: To evaluate the impact of sleep disorders on motor development of DS children.

METHODS: Eighteen DS children, mean age 3±3 years, were evaluated. The impact of SDB on child´s quality of life was assessed by the OSA-18 questionnaire, with scores < 60 indicative of low impact, 60-80 of moderate, and >80 of high impact. Motor development was assessed by the PEDI scale. Normative scores obtained for functional performance was considered for analysis.

RESULTS: According to OSA-18 results, participants were divided into 2 groups: Group 1 (n=9, OSA-18 score < 60), and Group 2 (n=9, OSA-18 score ≥60). Group 1 presented mean PEDI scores of 26±16 for the self-care area, 22±17 for mobility and 46±22 for social function. Group 2 presented scores of 19±10, 20±17 and 29±16, respectively; social function being statistically different (p=0.03).

CONCLUSION: DS children at higher risk for SDB show a greater delay in motor development (especially in relation to social function). These findings point to the need of proper diagnosis and treatment of sleep disorders in this population.

COMPARISON OF THE SLEEP CLINICAL RECORD PROTOCOL BETWEEN BRAZILIAN AND ITALIAN CHILDREN

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Introduction: Obstructive breathing disorders (OBD) are common in childhood, and are associated to negative impact on neurocognitive functions, cardiovascular and metabolic systems. Accurate screening methods, as Sleep Clinical Record (SCR), help to recognize the child at risk and to determine treatment.
Aim: The objective was to compare the SCR protocol applied to Brazilian and Italian children with respiratory complaint and identify variables of the different phenotypes.
Methods: Children, both genders, aged 4 to 11 years, with complaints of OBD, from the southern region in Brazil and from Rome/Italy were matched for age, gender, weight and Apnea Hypopnea Index (AHI). All children were submitted to clinical evaluation scored by the sleep clinical record (SCR). The SCR score ranges from 0 to 18 points, the score $\geq$ 6.5 points indicating risk for OSA.
Results: 51 Brazilian and 102 Italian children, mean age 6.92±2.08 years, were included. Brazilian children showed a higher SCR score than Italian (10.21 ±3.44 versus 8.95 ±2.55; p=0.002). Similar, obese Brazilian children had a significantly higher SCR score (p=0.01) when compared to obese Italian (10.84±3.58 vs 9.14±2.79, respectively). Brazilian children presented more tonsillar hypertrophy (69%), alteration of Friedman palate position (88%) and malocclusion (84%), while the Italian children showed more nasal septum deviation (23%), nasal obstruction (68%) and arched palate (86%).
Conclusion: The results suggest different phenotypes for OSA in Brazil and Italy, hypertrophy of the tonsils being the most frequent in Brazil, and long-face pattern in Italy.

SLEEP-DISORDERED BREATHING IN GESTATIONAL HYPERTENSION AND PREECLAMPSIA: IMPACT ON MATERNAL AND FETAL OUTCOMES

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Introduction: Hypertensive Disorders of Pregnancy (HDP) include Gestational Hypertension (GH) and Preeclampsia (PE), which are both associated with worse maternal and perinatal outcomes. Sleep-disordered breathing (SDB) is reported to occur more commonly in HDP, although the confounding effect of obesity has been variably accounted for. SDB could amplify the adverse consequences of HDP given similar pathological pathways. We aimed to (i) confirm if the link between SDB and HDP persists after controlling for obesity, and (ii) determine if SDB increases the risk of adverse maternal and fetal outcomes among women with HDP.

Materials and Methods: Women diagnosed with HDP and normotensive BMI-and gestation-matched controls underwent PSG with time-synchronised fetal heart rate monitoring in the third trimester. Fetal growth was assessed by ultrasound and maternal venous and fetal cord blood were sampled at delivery for markers of HDP severity and fetal growth. Medical records were reviewed for indices of hypertensive disease.

Results: Forty women with HDP and 40 matched controls were recruited. The frequency of SDB (RDI≥5) in the cases was 52.5% compared to 37.5% in the controls (p = .18), but more severe SDB (RDI≥10) was twice as common in women with HDP (35% vs 15%, p = .04). SDB had no impact on hypertension outcomes for GH and PE women, including gestation at diagnosis, severity of hypertension or biomarkers of disease severity. There was no temporal relationship between maternal apnoea and fetal distress on CTG, but severity of SDB was weakly related to overall fetal heart rate decelerations in controls with well-grown fetuses (r = .44, p = .02). The presence of SDB had no effect on birthweight centile, third trimester fetal growth trajectory or regulators of fetal growth in cord blood. Among the HDP women, infants of those with SDB were larger at birth
(p = .02).

Conclusions: Mild SDB occurs in half of women with HDP, but also in over a third of BMI-matched normotensive women, suggesting the link between SDB and HDP is in part due to the confounding effect of obesity. SDB did not affect the course of GH or PE nor adversely affect fetal health. Given the high prevalence of mild SDB and that only more severe SDB was related to HDP, a threshold for clinical significance likely exists. Future research needs to identify the relevant threshold for SDB in pregnancy, and the proposed causative pathways to inform clinical trials investigating the role of CPAP to improve pregnancy outcomes.

Sleep Breathing Disorders
Board #074 : Poster session 1
THE IMPACT OF UPPER AIRWAY SURGERY ON THE PATHOPHYSIOLOGICAL TRAITS CAUSING OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Upper airway surgery (UAS) is often recommended as a treatment for patients with OSA who cannot tolerate continuous positive airway pressure (CPAP). Unfortunately, the efficacy of UAS can be highly variable and there are no reliable clinical predictors of which patients are likely to have their OSA resolved following UAS. The key to providing robust predictors of OSA resolution following UAS is to recognise that OSA is caused by multiple interactive anatomical and non-anatomical traits [i.e. i) ability of airway muscles to reopen the airway; ii) respiratory arousal threshold; and iii) ventilatory control system sensitivity - loop gain]. Importantly, it is unknown how surgery alters these traits which may impact treatment efficacy. Therefore, we aimed to examine the effect of UAS on the OSA trait(s) and whether knowledge of these traits can assist in predicting success to surgery (i.e. responder analysis).

Materials and Methods: In an on-going prospective study, 19 OSA patients scheduled for UAS (i.e. uvulopalatopharyngoplasty ± tongue coblation ± tonsillectomy ± nasal surgery) have been studied before and 3-months post-surgery. In each condition, participants underwent clinical polysomnography to determine OSA severity and research polysomnography to measure the OSA traits using a validated technique that manipulates a participant´s CPAP level and assesses the accompanying changes in ventilation. Values are presented as mean ± standard error of the mean (SEM). For the responder analysis, responders were defined as having a reduction in apnea-hypopnea index (AHI) ≥50% from baseline.

Results: Surgery reduced both the AHI (44.2±6.1 vs 25.5±5.8 events/h; p=0.02) and Epworth sleepiness scale (median [interquartile range]:11 [10-14] vs 7 [3-10]; p< 0.001). There was a strong trend for surgery to improve upper airway collapsibility (-15.6±12.8 vs 22.0±15.3 %eupneic ventilation; p=0.07) but had no impact on the non-anatomical traits. Notably, the improvement in AHI was positively correlated with improvement in collapsibility (pre and post-surgery values available in n=17; p=0.005; r^2=0.42). Responder analysis is underway.

Conclusions: Our preliminary findings suggest that UAS likely improves upper airway collapsibility but has no impact on the non-anatomical traits causing OSA. A final analysis with the remaining 4 participants (i.e. n=23) and responder analysis will be conducted and presented at the conference.

ALTERATION OF COUPLING OF SLOW-WAVES AND SIGMA IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Sleep-dependent memory consolidation has been observed for declarative and procedural memory. A potential mechanism of sleep-dependent memory consolidation is the coupling of sleep spindles to slow-waves (SW) during non-REM sleep. Individuals with obstructive sleep apnea (OSA) commonly have fragmented sleep and impairments in memory consolidation. To investigate whether electrophysiological mechanisms involved in memory consolidation are impaired in OSA, phase-amplitude coupling in SW concurrent with a spindle was compared between healthy controls and OSA patients. We hypothesised that OSA patients would have weaker phase-amplitude coupling with the sigma band than healthy controls. Additionally, we investigated the relationship between this phase-amplitude coupling and cognitive performance.

Materials and methods: Thirty-eight subjects with OSA and no cognitive impairment (30 M; mean age 65 ± 6.4 years; apnea-hypopnea index (AHI) ≥ 15 events/hour) and thirty-nine healthy controls (25 M; mean age 64 ± 7.1 years; AHI < 15 events/hour) underwent a night of polysomnography with 18 EEG electrodes. To identify SW, PSG signals were filtered in the delta band (0.16 to 4 Hz). Within this band, voltage criteria for SW detection included PSG events having a peak-to-peak amplitude > 75 µV and a negative amplitude > 40µV. Duration criteria included a hyperpolarisation phase lasting 125-1500 ms and a depolarisation phase lasting less than 1000 ms. Within the sigma frequency band (10-16 Hz), sleep spindles were defined as events with an amplitude at or above the 75th percentile with a duration of 500-3000 ms. Phase-amplitude coupling (PAC) was quantified by mixing the amplitude of the filtered sigma with the phase of any SW concurrent with a spindle. A modulation index (MI) was then calculated and normalised via resampling of the sigma band at the same phase of the SW for each instance of PAC. This generated a mean and variance associated with the resampled distribution, allowing for a z-score for each instance of PAC (zPAC). Larger zPAC values indicate stronger coupling.

Results: There was a significant Group x Topography interaction, $F(2, 2)=7.96$, $p < .001$. Follow-up comparisons indicated zPAC scores were significantly greater at Fz for OSA patients. Within both groups, zPAC scores were significantly larger at Pz than at Fz and Cz ($p < .001$, all comparisons). This effect of topography appeared to be larger for healthy controls than OSA patients. The groups did not differ statistically on neuropsychological tests. No significant correlations were observed between zPAC scores and neuropsychological performance within healthy controls. OSA patients showed a significant correlation between total time to complete an executive task (Tower of London) and zPAC scores, $r = .435$, $p < .006$. Finally, apnea-hypopnea index was not a significant predictor of zPAC scores, beta = .01, $p < .59$.

Conclusions: Surprisingly, we found that OSA patients had stronger PAC in frontal regions than healthy controls. Strong spontaneous PAC in OSA patients in frontal areas may preclude any improvement in connectivity when plasticity is required, acting as a constraint on the system´s dynamics. Future studies should investigate whether PAC differences underlie lower sleep-dependent consolidation in OSA patients.

OBJECTIVE ADHERENCE TO DENTAL DEVICE VERSUS POSITIVE AIRWAY PRESSURE TREATMENT IN ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Mandibular advancement device (MAD) and positive airway pressure (PAP) treatment of adults with obstructive sleep apnea (OSA) are associated with similar patient-centered outcomes. However, MAD treatment is generally less efficacious than PAP treatment in reducing the apnea hypopnea index (AHI). It is unknown if the reduced efficacy of MAD treatment is offset by greater adherence to the treatment. This study compared objectively measured adherence to MAD and PAP treatment in adults with OSA.

Materials and methods: In this multicenter, parallel group study, adults with OSA [age 54.3 ± 11.3(SD) years, BMI 33.8 ± 6.21 kg/m^2, AHI 31.0 ± 22.3 events/hour, 71.4% male] were randomized to MAD (n=95) or PAP (n= 94) treatment for 3 to 6 months. Objective adherence was assessed with a microsensor thermometer embedded in the MAD and a pressure sensor in the PAP unit. The primary outcome measure was average daily treatment use over all days. Treatment efficacy was determined by a polysomnogram with MAD in participants using a MAD and by PAP download in participants using PAP. Functional outcomes were evaluated using the Epworth Sleepiness Scale (ESS), Functional Outcomes of Sleep Questionnaire, and Health Survey Short Form 36.

Results: No difference was observed in average daily use over all days between MAD (n=42) and PAP (n=62) treatments (4.47 ± 2.96 hour/day and 4.87 ± 1.71 hour/day respectively; p=0.434) when days with missing data were included as days without use. Participants using MAD showed a lower percentage of days used (62.4% vs. 81.5%, p=0.003), but greater average daily hours of use on days used (6.57 hour/day vs 5.78 hour/day, p=0.021). Average daily use in the first week was associated with long-term adherence for MAD (Pearson correlation r=0.75, p< 0.0001) and PAP (r=0.53, p=0.0002). Similar results were obtained when days with missing data were excluded from analysis. The AHI determined on polysomnogram in participants using a MAD was higher than the AHI on PAP download in participants using PAP (11.40 ± 9.97 events/hour vs 2.75 ± 2.55 events/hour respectively; p< 0.0001). Functional outcomes significantly improved with both treatments, but no differences were observed between groups.

Conclusions: No significant difference in objectively measured average daily use hours was observed between MAD and PAP treatment in adults with OSA. First week adherence to PAP and MAD treatment predicted long-term adherence.

VISION-BASED CONTACTLESS RESPIRATORY RATE MONITORING DURING SLEEP

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Introduction: A reliable, convenient, and non-intrusive method for tracking respiratory rate during sleep can improve diagnosis and monitoring of sleep apnea. Previously, we have developed a non-contact computer vision technique to track respiratory motion and estimate respiratory rate (Li et al. 2017, in IEEE J Biomed Health Inform). Performance of this algorithm was validated in a dark room in awake subjects who simulated sleeping condition by staying still, as other body movements unrelated to respiration would introduce significant noise. Those with sleep apnea experience multiple arousals during sleep and move more during sleep. Therefore, we improved the algorithm such that unrelated body movements were automatically identified. We further validated the proposed method for motion based respiratory rate estimation during unconstrained nocturnal sleep in those who are suspected of having sleep apnea.

Materials and Methods: Adults between the ages of 18 to 85, who were referred for clinical overnight polysomnography (PSG) were recruited. A near-infrared camera mounted 1.5 m directly above the bed captured movement of head, torso, and arms, at resolution of 640×480 and 30 frames per second. Gold standard respiratory rate was derived from respiratory inductance plethysmography of chest and abdomen. Respiratory rate estimation was obtained by tracking displacements of selected feature points over moving window of 30 seconds with 29 seconds overlap, and applying signal processing techniques as described by Li et al. (2017, in IEEE J Biomed Health Inform). When a large spike in displacement of the tracked feature points was detected, new reference set of feature points was applied. The 30 seconds windows including and following a large motion were labelled as 'movement' and excluded from error analysis. Kruskal-Wallis statistical test was performed with multiple comparison tests to determine whether average root mean square error (RMSE) of respiratory rate estimation was different between various sleep positions or sleep stages.

Results: Fifty participants (53.0 ± 14.9 years) were included:12 had no sleep apnea, 13 had mild, 11 had moderate, and 14 had severe sleep apnea. 6.28 ± 1.17 hours (mean ± SD) of video were captured for each participant, 0.81 ± 0.65 hours were identified as movement and 4.60 ± 1.51 hours of sleep. Compared to the gold standard, 89.9 % ± 10.9 % of the overnight respiratory rate estimation for each participant was accurate within 1 breath per minute, with an average RMSE of 2.10 ± 1.64 breaths per minute. No significant difference in estimation of RMSE was found according to various body position, sleep stage, or amount of the body covered by blankets. Respiratory rate estimation was less accurate during apneas/hypopneas compared to periods of normal breathing during sleep ($p < 0.0001$). For periods including and void of apneas/hypopneas, 83.04% ± 13.46 % and 94.20 % ± 8.88% of the estimated respiratory rate were accurate within 1 breath per minute, respectively.

Conclusions: The vision-based algorithms can be used for accurate, non-contact monitoring of respiratory rate in patients with sleep apnea during sleep.

THE EFFICACY OF NASAL SURGERY ON PHARYNGEAL AIRWAY

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Introduction: Nasal surgery is known to improve the quality of life in patients with obstructive sleep apnea. However, its effect on airway structure is not known. So, authors try to identify the impact of nasal surgery on pharyngeal airway structure in this study.
Materials and methods: Patients who underwent nasal surgery from July 2015 to March 2018 due to their nasal obstruction with severe snoring or sleep apnea were enrolled in this study. Patient with palate surgery or previous history of airway surgery were excluded. Demographic factors, symptoms regarding nasal obstruction, sleep study, preoperative cephalometry, and postoperative 3-month cephalometry were taken and analyzed. In addition, subgroup analysis according to the severity of sleep apnea was performed.
Results: Sixty-three patients were enrolled in this study. Soft palate thickness showed no significant change. Pre and postoperative soft palate thickness were 10.82 ± 3.00 and 11.22 ± 3.35 (p=0.261), respectively. However, pharyngeal airway space was enlarged via nasal surgery from 12.05 ± 3.35 to 13.04 ± 3.35 (p=0.006), respectively. Subgroup analysis showed that pharyngeal airway was mainly enlarged in the patients with lower AHI.
Conclusions: Although nasal surgery does not reduce the soft palate thickness, the pharyngeal airway space is enlarged by nasal surgery. It is more prominent in the patients with AHI lower than 15 event/hour (p=0.005). However, nasal surgery alone does not affect the pharyngeal airway of patients with AHI greater than 15.

Sleep Breathing Disorders
Board #219 : Poster session 2
FAMILY AGGREGATION OF PEDIATRIC OBSTRUCTIVE SLEEP APNEA

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Introduction: To analyze the family risk factors of children with obstructive sleep apnea (OSA).
Materials and methods: 80 chinese children who underwent polysomnography (PSG) at the sleep center of Beijing Tongren Hospital from June to December 2018 were recruited, and the heights, weights, as well as the quality of life (assessed using the obstructive sleep apnea-18 (OSA-18) quality of life questionnaire) were analyzed retrospectively. According to ICSD-3 standard and the score of OSA-18 quality of life questionnaire, the children were divided into three groups: (1) the normal group (19 cases);(2) the habitual snoring group (28 cases) ;(3) the OSA group (33 cases). Neck circumference, body mass index(BMI),the incidence of snoring, allergic diseases and chronic tonsillitis ,as well as history of adenoidectomy and/or tonsillectomy (AT) were compared in 3 groups.
Results: Compared with the habitual snoring group, the incidence of adenoidectomy and/or tonsillectomy (AT) or chronic tonsillitis in either parents was higher (P=0.011) in the OSA group. In the subjects who were older than 6 years old, the neck circumference (P=0.038) and body mass index (P=0.021) of the mothers were significantly higher, and the fathers had louder snoring (greater than talking) (P=0.044) in the OSA group than in other 2 groups.
Conclusions: A history of of adenoidectomy and/or tonsillectomy (AT) or chronic tonsillitis in either parents, the mother´s neck circumference and BMI and the father´s loud snoring were associated with an increased risk of obstructive sleep apnea in children. And there exists family aggregation of pediatric obstructive sleep apnea.

GLYCOLIPID METABOLISM INVOLVED IN THE STAGE SPECIAL ASSOCIATION WITH NOCTURNAL CARDIAC AUTONOMIC CONTROL IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Cardiac autonomic dysfunction (CAD) is common and leads to cardiovascular diseases and even mortality. Dyslipidemia or hyperglycemia, as the common complications, whether involved in the cardiac autonomic function (CAF) in OSA remained unclear.

Materials and methods: A total of 4152 subjects with suspected OSA were consecutively recruited in our sleep center. Data for standard polysomnography, biochemical and anthropometric variables were collected. Heart rate variability (HRV) of electrocardiographic signal was used to evaluate cardiac autonomic function and variation. The relationship between OSA severity and the risk of CAD was evaluated via restricted cubic spline (RCS) analysis and multivariate linear regression (MLR) model was used to explore the risk factors for HRV indices in different OSA stages.

Results: The RCS showed CAD risk had nonlinear dose response from fluctuation stage to rapidly change stage with OSA severity increasing. After integrating the clinical definition and RCS selected knots, we obtained the new four OSA stages. The segmented MLR showed that the glycolipid metabolism and the covariates were differentially associated with special HRV indices across different OSA stages. Glucose markers were significantly associated with mean heart rate (MEANHR) in all stages. Glycolipid markers were negatively associated with standard deviation of all normal RR intervals (SDNN), while MAI had a positive association with SDNN.

Conclusions: Our study indicated that both OSA and glycolipid disorders play an important role in the CAF in different stages. This stage-special association demonstrated that the glycolipid metabolism involved in variation in CAF among the different stages of OSA.

Sleep Breathing Disorders
Board #334 : Poster session 2
SLEEPING POSITION DURING UNATTENDED HOME POLYSOMNOGRAPHY COMPARED TO HABITUAL SLEEPING POSITION AND THE POTENTIAL IMPACT ON MEASURED SLEEP APNEA SEVERITY

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Introduction: Obstructive sleep apnoea (OSA) commonly manifests with greater severity in the supine position. Over 60% of patients with OSA have supine predominant OSA (supine apnoea-hypopnoea index [AHI] greater than twice of non-supine AHI) and 25% have supine isolated OSA (non-supine AHI< 5 events/hour). Therefore, for the majority of patients, the proportion of total sleep time in the supine body position necessarily impacts on the severity of OSA assessed by polysomnography (PSG). We previously reported that the proportion of time in the supine position is significantly higher during laboratory PSG compared to habitual sleep. Here we report the interim results of our current study comparing sleeping position during unattended home PSG to habitual sleeping position.

Materials and methods: This is a prospective observational study of patients referred for unattended PSG through our tertiary academic sleep unit. We use the Night Shift™ positional therapy device to record body position during the unattended PSG and subsequently for up to three additional nights to sample habitual sleeping position. The Night Shift™ was programmed to record only; the feedback intervention function was disabled. A paired t-test was used to compare the mean difference in proportion of sleep time in the supine position during unattended PSG compared to habitual sleep. We then calculated a modified AHI "corrected" for habitual sleeping position. Night-to-night variability in habitual sleeping position was assessed using a correlation matrix, and a repeated measures one-way ANOVA.

Results: To date, fifty-two patients have been recruited, out of a target of 79 patients. 38.5% female, age 47 ± 12.8 years, body mass index 30.9 (range: 27.5-37.5) kg/m^2. Median total AHI 19 (range: 3.2-27.9) events/hour, supine AHI 22 (0.9-45.3) events/hour, non-supine AHI 9.4 (1.3-24.9) events/hour. Fifteen patients (29.4%) had supine predominant OSA and 1 (2%) had supine isolated OSA. Proportion of sleep time in the supine position, assessed with the Night Shift™ device, was 37.6 ±28.7% (mean±SD) during unattended PSG vs. 31.2 ±20.2% during habitual sleep (p=0.05). Thirty patients (57.6%) spent less time supine during habitual sleep compared to the night of the unattended PSG. There was no significant difference between AHI measured on unattended PSG and AHI "corrected" for habitual sleeping position; however, 6 patients changed category from moderate (AHI>15 events/hour) to mild OSA (AHI< 15 events/hour). There was low night-to-night variability in habitual sleeping position, based on both the Pearson correlations (r=0.615-0.734, p< 0.001) and ANOVA results (F=0.31, p=0.719).

Conclusions: Our preliminary data demonstrate a strong trend towards a greater proportion of sleep time in the supine position during unattended home PSG compared to habitual sleep. Results from this study may help inform the clinical interpretation and application of PSG results, particularly in the management of patients with supine predominant or supine isolated OSA.

SLEEP QUALITY IN CHILDREN WITH BRONCHIOLITIS OBLITERANS SYNDROME

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Introduction: The incidence of sleep disordered breathing increases in patients with chronic lung diseases. Our aim was to evaluate sleep disordered breathing and sleep quality in children with bronchiolitis obliterans syndrome.

Materials and methods: Pittsburgh Sleep Quality Index (PSQI) questionnaire was used to assess the presence of sleep disordered breathing and the quality of sleep in the patients with bronchiolitis obliterans syndrome after hematopoietic stem cell transplantation between September 2017 and June 2018. The PSQI questionnaire is a self-rated questionnaire which assesses sleep quality and disturbances over a one month interval. A score of ≥ 5 indicates poor sleep quality.

Results: Twelve patients were performed questionnaire. Ten patients were male (83.3%) and median age was 21 years (IQR: 16-22.3). Four patients (33.3%) had poor sleep quality. The score of subjective sleep quality (mean 2.25) was highest in the components of PSQI. Sleep latency, sleep disturbances, daytime dysfunction over the last month score increased in these patients.

Conclusions: Children with bronchiolitis obliterans syndrome have the risk of poor sleep quality. Sleep disordered breathing and sleep quality should be assessed in these patients.

THE RELATIONSHIPS BETWEEN HYPOXIA AND OXIDATIVE STRESS AS WELL AS ANTI-OXIDANT ACTIVITY IN PATIENTS WITH SEVERE SLEEP DISORDERED BREATHING

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Introduction: It is known that oxidative stress increases cardiovascular events and some markers of oxidative stress is reportedly increased by nocturnal intermittent hypoxia induced by sleep disordered breathing (SDB).
On the other hand, the effect of SDB on oxidative stress and antioxidant activity, especially the changes after continuous positive airway pressure (CPAP) therapy that reduces oxidative stress has not fully determined yet. Accordingly, the aim of our study was to clarify 1: the relationship between oxidative stress marker (diacron reactive oxygen metabolites: d-ROMs), antioxidant activity marker (biological antioxidant potential: BAP) and various markers of SDB: apnea hypopnea index (AHI), oxygen desaturation index (ODI) and 2: the effect of the 3 months CPAP treatment on such oxidative stress and antioxidant markers (d-ROMs and BAP) in severe SDB patients. Also, as the oxidative stress caused by SDB would result reduction of endothelial function and improve by treatment by CPAP, we examine vascular endothelial function (flow mediated dilatation: FMD) to determine the relation between FMD and d-ROMs and BAP.
Materials and methods: We measured d-ROMs, and BAP by blood samples and FMD in the severe SDB patients (AHI≥30) without coronary heart disease, diabetes mellitus, dialysis nor history of treatment of SDB (N=42). After 3 months of CPAP treatment, we measured d-ROMs and BAP again and analyzed the relationship between the changes in SDB index and them.
Results: At baseline, average apnea hypopnea index (AHI) was 57.9/h, average 3% oxygen desaturation index (3% ODI) was 48.6/h, average d-ROMs was 317.4 CARR U and average BAP was 2121 μmol/L. There were no significant relationships between the SDB indexes and baseline d-ROMs and BAP. After CPAP treatment, there were no significant changes in d-ROMs and BAP as a whole. However, there were significant negative relationships between the change of oxidative stress marker d-ROMs and the baseline values of AHI (r=-0.31, p=0.046) and 3% ODI (r=-0.33, p=0.03). Furthermore, the degree of reduction in AHI by treatment had significant positive relationship with the decrease in d-ROMs, while the change in anti-oxidant marker BAP had significant negative relationship with the change in Sp02< 90% time which is considered as oxidative stress.
Conclusions: Although there were no significant relationships between the baseline severity of SDB and the markers of both oxidative stress and antioxidant activity; d -ROMs and BAP, CPAP treatment reduced d-ROMs more in those with the baseline high frequency of respiratory events. Oxidative stress represented by D-ROMs was improved by the decrease of frequency of respiratory events, whereas anti-oxidant marker BAP decreased according to the degree of reduction in hypoxia time. These results indicate, the baseline levels of oxidative stress and anti-oxidant level represented by d-ROMS and BAP were affected by various factors including hypoxia by SDB and changes in d-ROM and BAP could show the reduction of oxidative stress by CPAP treatment.

MECHANISM OF EXCESSIVE WAKE TIME WHEN ASSOCIATED WITH OBSTRUCTIVE SLEEP APNEA AND/OR MOVEMENT DISORDERS

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Introduction: Obstructive sleep apnea and/or movement disorders are commonly associated with excessive wake time. It is uncertain if these disorders contribute to the excessive-wake-time. This uncertainty complicates management decisions. In particular, it is not clear whether to treat these disorders first expecting that insomnia will be relieved. We wished to determine if the excessive-wake-time in such cases is independent of the associated pathology and related to central regulation of sleep depth.

Materials and methods: 145 patients were divided into three groups: 1) Excessive-wake - time with associated pathology (EWT+P): n=82, 56(68%) with apnea-hypopnea-index >5 /hr, 31 (38%) with periodic-limb-movements-index >10 /hr, 42(51%) with restless-legs, wake-time (mean (5%, 95%)) 158 (74, 306) minutes. 2) Excessive-wake-time with no associated pathology (EWT-NP): n=30, wake-time 160 (75, 329) minutes. 3) Normal wake time: n=33, 19 with and 14 without associated pathology, wake-time 40 (20, 64) minutes. Sleep depth was evaluated by the odds-ratio-product (ORP) (Sleep. 2015; 8(4):641-54); range 0 (deep sleep) to 2.5 (fully alert). ORP is determined from the relation of EEG power in four frequency ranges to each other. We also measured ORP in the 9 seconds following arousals (ORP-9) to distinguish between peripheral and central mechanisms of light sleep (J Appl Physiol. 2016;120(7):801-8). Presence of insomnia disorder was determined from the patient's history.

Results: There was no difference in wake time between EWT+P (160(75, 329)) and EWT-NP (158(74, 306) minutes). EWT+P had more arousals than EWT-NP and NWT (arousal index 34(18, 70) vs. 27(11, 46) and 23(9, 36), respectively) with no difference between EWT-NP and NWT. ORP in total sleep time was higher (lighter sleep; $p < 0.00001$) in EWT+P (1.13(0.76-1.76)) and EWT-NP (1.08(0.82-1.55)) than in NWT (0.81(0.51-1.21)). It was also higher in stage wake (less sleep propensity) in EWT+P (2.21(2.01, 2.35)) and EWT-NP (2.21(2.00, 2.35)) than in NWT (2.07(1.79, 2.26); $p < 0.00001$). Post-arousal ORP was higher in EWT+P (1.33(0.93-1.90)) and EWT-NP (1.31(0.88-1.91)) than in NWT (0.94 (0.62-1.32)), indicating that the lighter sleep in EWT patients, with and without pathology, is of central origin. There were highly significant correlations between ORP and ORP-9 and wake time across all groups ($p < 1E-13$). There were 97 patients with insomnia disorder and excessive wake time, corresponding to insomnia with short sleep duration (I-SSD), 20 with insomnia and normal sleep duration (I-NSD) and 28 with no Insomnia. Wake ORP was significantly higher in patients with I-SSD (2.21±0.14) than in the other two groups (I-NSD: 2.09±0.16, $p < 0.001$; No-I: 2.12±0.14, $p < 0.005$) but not between I-NWT and No-I ($p < 0.5$). ORP-9 in patients with I-SSD was significantly higher ($p < 0.0001$) than in patients with I-NSD or No-I and in 24 I-SSD patients it was above the highest value seen in I-NSD and No-I groups.

Conclusions: Excessive wake time associated with sleep apnea and/or movement disorder is independent from the associated pathology and, akin to insomnia with short sleep duration, is related to abnormal central regulation of sleep depth. The higher ORP during wake times and in all sleep stages suggests that ORP may reflect the hyperarousal state.

Sleep Breathing Disorders
Board #335 : Poster session 2
TONGUE PRESSURE DISTRIBUTION OF NON-SNORING PEOPLE

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Introduction: Many patients of sleep-related breathing disorders have abnormal morphology or function of tongue muscles, but there is a lack of normal values. The purpose of this study was to provide parameters for tongue muscle pressure and its surface distribution in resting and functional state.

Materials and methods: With conditions as snoring, oral habits, etc. excluded, 9 males and 10 females (aged 24 to 27 years) of individual normal occlusions were selected out of 189 volunteers. Tongue pressure was measured with a force-sensing resistor device at rest (in sitting and supine position) and during swallowing. Tongue pressure at anterior(Ch.1), posterior(Ch.2) and lateral sides (Ch.3, Ch.4) were observed. Differences of tongue pressure were analyzed according to gender. And we explored correlation relationship between 3D dental arch form (width and length), weight-related indicators and tongue pressure.

Results: In rest, tongue pressure increased from front to back in both sitting and supine position, with no gender differences. The pressure at lateral sides of females were significantly higher than that of males when swallowing saliva. Bivariate correlation analysis revealed that swallowing duration was positively correlated with weight and BMI at Ch.2-4 and positively correlated with palatal length at Ch.1. The greater the dental arch width, the smaller the pressure of swallowing in Ch.1, Ch.3 and Ch.4.

Conclusions: In rest, a correct tongue position provides constant pressure against hard palate. The pressure increased significantly during swallowing, especially in females. Tongue pressure was related with form of hard palate, indicating that there may be an adaption between function and morphology. Besides, tongue pressure was also related with BMI and weight.

A CPAP CLINIC MODEL TO IMPROVE TREATMENT ADHERENCE

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Introduction: Obstructive sleep apnea (OSA) is a common disorder associated with cardiovascular disease and cognitive abnormalities. Effective treatment with CPAP is associated with improved outcomes in moderate to severe OSA, yet CPAP adherence is often suboptimal. Many payers now require face-to-face evaluation and 90-day CPAP adherence for payment of CPAP. Models are needed to enhance adherence, potentially improve clinical outcomes, and support coverage of treatment.

Materials and methods: A single-center, retrospective analysis of patients diagnosed with OSA and prescribed CPAP using an intention to treat model. Patients received clinician evaluation, focused training on OSA, treatment options, role of CPAP, and adherence and follow up requirements. Patients were advised of insurance requirements for payment of CPAP, including (1) patient need to use CPAP >= 4 hours per night for >= 21 of 30 (70%) consecutive days during initial 90 days, and (2) need for face-to-face sleep follow-up within 90 days of receipt of CPAP to evaluate adherence. Adherence was measured with cloud-enabled CPAP download of usage, AHI, and mask leak. Patients were advised of cloud-based technology and clinician monitoring.

Results: 179 patients (27% women), mean age 60.1 (+/- 13.8) years, BMI 31.3 (+/- 7.3) kg/m^2, pre-treatment Epworth score 9.2, and AHI 38.5(+/- 24.8) were included in analysis. 171 patients had OSA, 7 had central sleep apnea, and one complex sleep apnea. Treatment included APAP (n = 82); CPAP (n = 66), bi-level (n = 23), bi-level S/T (n = 7) and auto-bi-level (n = 1). Based on insurance adherence requirements (PAP use >=70% of nights for >=4 hours), 90.5% of patients met adherence requirements. Mean AHI based on PAP download was 4.4 (p = < 0.0001) during initial 90-day assessment and mean PAP usage was 374 minutes per night.

Conclusions: Use of a CPAP clinic model utilizing a behavioral approach to patient involvement, training on disease and potential negative impact, treatment options, adherence and follow-up requirements, and re-assessment within 90 days of treatment initiation resulted in 90-day adherence of 90.5%. Patient awareness of disease impact on health, potential benefits and challenges of CPAP, treatment alternatives, insurance requirements for PAP coverage and clinician evaluation of adherence and AHI appear to favorably influence adherence and potential for improved clinical outcomes. Limitations include single center, non-randomized, retrospective short term analysis . Further investigation is needed to determine factors influencing successful CPAP adherence, impact on long term adherence and long term outcomes.

Acknowledgements: none

THE ANALYSIS OF RISK FACTORS OF NOCTURNAL BLOOD PRESSURE CHANGES IN OBSTRUCTIVE SLEEP APNEA PATIENTS IN CHINA

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Introduction: Obstructive sleep apnea (OSA) is a cause of systemic hypertension (HTN), is strongly associated with HTN. OSA can induce blood pressure (BP) fluctuations during sleep. We aimed to investigate the profile of nocturnal BP changes and to evaluate the effects of different parameters on the development of hypertension and nocturnal blood pressure changes in OSA patients in China.

Methods: We retrospectively analyzed demographic data, clinical characteristics, PSG data and nocturnal BP changes of 906 patients with OSA underwent a full-night PSG and performed BP measurements at three time points (daytime, evening and morning) at a university teaching hospital in China. All subjects were divided into dippers group (defined by a ratio of morning BP/evening BP ≤0.9), non-dippers group (defined by a ratio of morning BP/evening BP ≥1.1) and no-change group.

Results: 461 patients (50.9%) of 906 subjects had hypertension (HTN) and 445 patients (49.1%) had not. Only 195 (21.5%, Dippers group) of all 906 subjects had a physiological nocturnal blood pressure drop. On the contrast, 78.5% (No-change group and non-dippers group) of all subjects had a loss of the BP decline during nighttime, and 305 of them (33.7%, non-dippers group) even had a rise in morning blood pressure. The prevalence of HTN and non-dippers were higher in severe OSA compared to mild and moderate OSA based on AHI ($P< 0.05$). The higher prevalence of hypertension (compared to dippers group and no-change group, P< 0.05, respectively) and higher neck circumference, waist circumference, BMI and ESS scores (P< 0.05) were observed in non-dippers group. Sleep disturbance assessed by AHI (P=0.0012), ODI (P=0.0045), T90% (P=0.0052), minSpO2 (P=0.0171) and meanSpO2 (P=0.0041) was more severe in non-dippers group. The multiple logistic regression analysis showed factors including BMI, evening SBP, maximum time of hypopnea and rapid eye movement sleep latency time were independently correlated with the prevalence of non-dippers.

Conclusions: our data suggest that 1) there was a high prevalence of diminished nocturnal BP dipping both in OSA patients with and without HTN in China; 2) there would be more patients with non-dipping BP and with elevated morning BP when the severity of OSA increases; 3) BMI, evening SBP, maximum time of hypopnea and rapid eye movement sleep latency time might be responsible for nocturnal blood pressure fluctuations in OSA patients. More research is need to understand the risk factors and pathogenesis of nocturnal blood pressure changes in OSA patients.

ADIPONECTIN PROTECTS LIVER AGAINST INTERMITTENT HYPOXIA INDUCED HEPATIC INJURY VIA ALLEVIATING HEPATOCYTE MITOCONDRIAL AUTOPHAGY

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Introduction: Our study was aimed to investigate cytoprotective mechanisms of adiponectin (Ad) in chronic intermittent hypoxia (CIH)-induced hepatic injury focusing on mitochondrial autophagy associated with phosphoglycerate mutase family member (PGAM) 5 signaling. which plays critical role in mitochondrial antophagy and homeostasis.

Materials and methods: Thirty rats were randomly divided into three groups: the normal control (NC), CIH, and CIH plus Ad supplement (CIH+Ad) groups. The rats in the CIH and CIH + Ad groups were exposed to a intermittent hypoxic environment for 2 months. The rats in CIH + Ad groups were treated with an intravenous injection of Ad at a dosage of 10 μg per injection, twice a week, for 2 successive months.

Results: Compared with rats in NC group, the rats in CIH group were found with impaired hepatocyte mitophagy, as indicated by decreases in Parkin protein expression and the number of mitophagic vacuoles. These changes were attenuated by supplement of adiponectin in CIH+Ad group, in which there was an attenuated CIH-induced increase in mitochondrial fission-related protein, dynamin-related protein 1, and the decrease in PGAM5 protein expression.

Conclusions: Our findings suggest that adiponectin protects against CIH-induced hepatic injury via regulation of mitochondrial autophagy by PGAM5 signaling

Sleep Breathing Disorders
Board #335 : Poster session 3
AROUSAL DURING SLEEP IS ASSOCIATED WITH HYPERTENSION IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Repetitive asphyxia events in obstructive sleep apnea (OSA) result in brain arousal, intermittent hypoxemia, and increased sympathetic nervous system activity, which is associated with sleep fragmentation. Arousal index could reflect the severity of sleep fragmentation. In normal humans, arousal which is associated with sympathetic hyperactivity results in transient increases in blood pressure. However, the association of arousal during sleep with hypertension has not been explored in OSA.

Materials and methods: A total of 11218 patients with apnea-hypopnea index (AHI) ≥ 5/h were included in this study (83.7% males, mean age = 45.26±12.05 years). All patients underwent an overnight PSG. OSA patients were divided into four groups based on the interquartile of arousal index (< 18.40 (n=2822), 18.40-30.85 (n=2787), 30.85-49.5 (n=2788), and >49.5 (n=2821)). Hypertension was defined based either on direct blood pressure measures or on diagnosis by a physician. Linear and logistic regression models were used to estimate the associations between arousal index and hypertension prevalence in OSA.

Results: Logistical regression analysis revealed that OSA combined with arousal index > 49.5 increased the odds of hypertension by 17.8% (odds ratio, 1.781; 95% confidence interval, 1.022-1.358) compared with OSA patients combined with arousal index < 18.40. Multiple linear regression analysis revealed that arousal index was significantly positive associated with systolic blood pressure (B=0.028, $p< 0.001$) and diastolic blood pressure (B=0.030, $p< 0.001$) in OSA. These results were independent of major confounding factors such as sex, age, body mass index, tobacco, alcohol drinking, coffee use, sleep efficiency and subjective daytime sleepiness, OSA severity and nocturnal oxygen desaturation. In addition, there was significant interactive effect between age and arousal index on blood pressure in OSA patients.

Conclusions: We conclude that an increased arousal index is associated with hypertension in OSA patients, indicating that sleep fragmentation in OSA may actually be detrimental in terms of hypertension risk.

DIFFERENT ASSOCIATIONS OF OBESITY WITH SUBJECTIVE AND OBJECTIVE DAYTIME SLEEPINESS IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Previous studies indicated that daytime sleepiness is associated with obesity in patients with obstructive sleep apnea (OSA). However, whether there are different associations of obesity with subjective and objective daytime sleepiness in OSA is still unclear. In this study, our goal was to examine the associations between subjective daytime sleepiness and obesity, and between objective daytime sleepiness and obesity. We also examined the joint effect of subjective/objective daytime sleepiness and OSA on obesity.

Materials and methods: A total of 5669 patients with OSA (85.1% males, mean age = 44.15±11.71 years) and 846 primary snorers (59.3% males, mean age = 38.15±12.26 years) were included in the study. All subjects underwent one night polysomnography followed by multiple sleep latency test (MSLT). Data of Epworth Sleepiness Scale (ESS) was also collected to evaluate subjective daytime sleepiness. The MSLT and ESS values were classified into 4 categories: ESS< 10 and MSLT>8, ESS≥10 and MSLT>8, ESS< 10 and MSLT≤8, ESS≥10 and MSLT≤8. Obesity was defined based on body mass index≥28 kg/m^2.

Results: OSA patients with ESS≥10 and MSLT>8 showed a significant increased odds of obesity compared with those with ESS< 10 and MSLT>8 in mild (odds ratio: 1.569; 95% confidence interval (1.023-2.407)), moderate (odds ratio: 1.563; 95% confidence interval (1.011-2.418)), and severe OSA groups (odds ratio: 1.254; 95% confidence interval (1.001-1.571)). By comparison, OSA patients with ESS< 10 and MSLT≤8 did not show an increased odds of obesity compared with those with ESS< 10 and MSLT>8. However, OSA patients with ESS≥10 and MSLT≤8 showed a significant increased odds of obesity compared with those with ESS< 10 and MSLT>8 in mild (odds ratio: 2.284; 95% confidence interval (1.426-3.660)), moderate (odds ratio: 1.992; 95% confidence interval (1.252-3.171)), and severe groups (odds ratio: 1.767; 95% confidence interval (1.442-2.166)). These results were independent of age, sex, tobacco, alcohol drinking, coffee use, hypertension, diabetes, N3 (%TST), and sleep efficiency, apnea hypopnea index and nocturnal oxygen desaturation. When considering the joint effect of OSA and daytime sleepiness, we only found that OSA patients with ESS≥10 and MSLT≤8 (but not in those with ESS≥10 and MSLT>8, those with ESS< 10 and MSLT≤8, and those without subjective and objective daytime sleepiness) showed a significant increased odds (odds ratio: 1.708; 95% confidence interval (1.286-2.267)) of obesity compared with those with primary snoring.

Conclusions: The findings of this study showed that the subjective, but not objective daytime sleepiness is independently associated with obesity compared with those without subjective and objective daytime sleepiness in OSA patients. However, for OSA patients simultaneously show subjective and objective daytime sleepiness, their odds of obesity could be more higher compared with OSA patients with subjective daytime sleepiness alone. In OSA patients, the roles of subjective and objective daytime sleepiness on obesity are different.

ENDOTHELIAL DYSFUNCTION IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

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Objectives: Endothelial dysfunction(ED) is one of the initial pathological changes ultimately leading to atherosclerosis and consequent cardiovascular disease. Children with endothelial dysfunction are at higher risk of developing systemic and pulmonary hypertension, atherosclerosis, and cardiac remodeling, with potential long-term adverse outcomes into adulthood. Obstructive sleep apnea syndrome (OSAS) has been found to cause impaired endothelial function in adults. However, the evidence in paediatric OSAS is limited. The aim of the study is to evaluate endothelial function in a large cohort of children clinically referred for suspected OSAS, and to identify risk factors contributing to the presence of ED.
Methods: Children aged 3-11 years old with habitual snoring (snoring ≥3 nights per week) were recruited to this study between 1st June 2015-1st March 2016.All subjects underwent an overnight polysomnography (PSG), as well as endothelial function testing using peripheral arterial tonometry (PAT) to derive the reactive hyperemic index (RHI). Subjects were then divided into OSAS and primary snorers (PS) group according to their obstructive apnea-hypopnea index (OAHI).
Results: A total of 355 cases completed the study, with 248 children being diagnosed as OSAS, and 107 children assigned to the PS group. There were no differences in age, gender, BMI Z-score and systolic and diastolic blood pressure between the two groups (all P >0.05).OSA group had lower RHI than that of PS (P< 0.05). Univariate correlation analysis showed that RHI was linearly correlated with age, gender, OAHI, oxygen desaturation index, respiratory related arousal index, and oxygen saturation nadir. The relationship between BMI Z-sore and RHI was quadratic. RHI and BMI Z-sore was positively correlated when BMI Z-score< 1.67 while negative correlated when BMI Z-score≥1.67 [RHI = 1.1286 + 0.0338*BMI Z-score - 0.0147*(BMI Z-score)^2]. Multivariate correlation analysis showed that age was independently positively correlated with RHI(P=0.006), while BMI Z-score^2 and respiratory related arousal index were negatively correlated with RHI (P=0.03 and P=0.004 respectively).
Conclusion: Children with OSAS have significant lower endothelial function comparing with PS. Frequent arousals due to obstructive respiratory event during sleep may be a candidate risk factor for endothelial dysfunction in children with OSAS. Age and BMI are also factors influencing the endothelial function in children. The relationship between BMI and endothelial function was quadratic.

SEVERE OBSTRUCTIVE SLEEP APNEA AND ORTHOGNATHIC SURGERY: A CASE OF SUCCESS

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Introduction: The first-line treatment for severe obstructive sleep apnea is CPAP. Recently, it has been reported that maxillomandibular advancement surgery can improve or eliminate obstructive sleep apnea in severe cases, however the results between studies are conflicting.

Results: The authors describe the case of a 39-year-old man, BMI 27.1 kg/m^2, with history of arterial hypertension and anxiety and depressive syndrome. He had complaints of snoring, excessive daytime somnolence (Epworth 19/24) and witnessed apneas. He presented class II retrognathism and class III Mallampati. He performed polysomnography (PSG) that revealed a disturbance respiratory index (RDI): 79.6 events/h, compatible with the diagnosis of severe OSAS and started CPAP.

Due to marked nasal obstruction, he was observed by a ENT specialist and because of the associated presence of tonsillar hypertrophy, redundant flaccid soft palate with long uvula, was submitted to septoplasty, bilateral partial inferior turbinectomy and uvulopalatopharyngoplasty. After surgery, the patient presented an improvement of diurnal somnolence (Epworth 10/24) and performed a new non-CPAP PSG that showed a RDI 27.8 events/h.

After ENT surgery, the patient was referred to our Sleep Unit. PAP therapy was again proposed and despite the optimization of its parameterization and correction of adverse effects, CPAP adherence has not improved. Due to refusal of the first line treatment and due to class II retrognathism, he was referred to the Plastic and Maxillofacial Surgery Unit and was submitted to ortognathic surgery with bimaxillary advancements - Le Foret I and osteotomy plus bilateral sagital split osteotomy of rams of mandibula. Before surgery, the anteroposterior dimensions of airway levels (palate, tongue base and hyoid bone) were 15.5mm, 14.8mm and 15.7mm, respectively. After surgery, all suffered a positive variation (2.1mm, 1.5, and 1.1mm, respectively).

There was a significant symptomatic improvement (absence of snoring or daytime somnolence- Epworth 2/24) and a reevaluation sleep study, without CPAP, presented an AHI 1.4 events/h. The patient only reported paresthesia of the lower lip as adverse effect of surgery.

Conclusions: This clinical case showed that an approach by a multidisciplinary team is essential for the therapeutic success of severe patients who can't adapt to CPAP, thus allowing a more personalized medicine.

ASSESSING PHYSICIAN-PATIENT COMMUNICATION AROUND SLEEP EXPERIENCE, HABITS AND BEHAVIORS THROUGH A NOVEL SLEEPLIFE® APPLICATION-A PILOT, FEASIBILITY STUDY

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Introduction: Sleep tracker data have not been utilized routinely in sleep disorder management. Sleep disorders are common in primary care practice and incorporating sleep tracker data may improve care. We conducted a pilot study to assess the feasibility of a sleep program using Fitbit and SleepLife® application incorporated within primary care.
Materials and methods: A prospective, randomized, parallel group, observational pilot study in patients and physicians' clusters from 20 primary care clinics in Indianapolis, IN June 2018-February 2019 was conducted. Patients were>18 years, with an insomnia diagnosis, and had a sleep aid prescription. Established patients of the already enrolled primary care doctors were approached.
Each primary care clinic, with physicians and patients enrolled from that clinic, was randomized to either Sleeplife® intervention or the control arm. All patients were provided with Fitbit Charge 2™ and patients in the intervention arm were educated on how to use the SleepLife® application. Physicians in the intervention arm had the SleepLife® portal on their computers. The primary aim of the study was to examine whether a program using a commercially available wearable sleep tracker device is feasible in primary care settings. Secondary aims included physician-patient communication regarding sleep and related behaviors and habits, physician and patient satisfaction and sleep outcomes.
Results: 49 physicians and 75 patients were enrolled in the study. Patients had a mean age of 57 (SD12.8) years and 61% were females. Mean age of physicians was 47 (SD10.6) years. Patients showed high rates of engagement with 83% completing all survey questions. Physician survey completion rate was 55%. Only one physician logged into the sleep life portal to check their patients' sleep status. At the end of the six-week intervention, patients' composite general satisfaction scores with sleep management decreased significantly in the intervention arm as compared to controls (p=0.03). Patients' satisfaction with communication also decreased significantly in the intervention group (p=0.01). The sleep outcomes on the sleep health questionnaire improved significantly in the intervention group as compared to the control group (p=0.04). Physician communication satisfaction scores remained unchanged (p=0.12).
Conclusions: Physician-patient communication and patient general satisfaction regarding sleep and related behaviors and habits outcomes can be collected through the SleepLife® application. Patients engagement levels were high with the program in contrast with the physicians. The minimal engagement of physicians in the program could explain the lack of improvement in physician-patient communication and patient general satisfaction. Sleep quality scores on the other hand showed an improvement among SleepLife® users suggesting that awareness with sleep may help patients implement good sleep practices on their own. To promote the growth of technology into primary, and especially sleep care, our findings need to be explored further in a larger study, which utilize learnings from this pilot study and incorporate physician engagement techniques as part of the intervention.

wearable device donation.

SLEEP AUTOSCORING BASED ON A SINGLE EEG CHANNEL: COMPARISON WITH VISUAL SCORING IN PATIENTS

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Introduction: Visual scoring (VS) of polysomnographic recordings (PSG) is time consuming, experience-dependent, and requires a long learning time. Moreover, full PSG equipment is bulky and requires a time-consuming hook-up. Thus, the search of reliable alternatives needing less parameters to discriminate sleep stages is relevant. The single-channel automatic sleep scoring (AS) software ASEEGA has been previously validated in healthy individuals. The aim of our study was to evaluate this software in adult patients suffering from various sleep disorders.

Materials and methods: A total of 95 patients (38 women, 40.4+/-13 years) was included: insomnia (N=23), idiopathic hypersomnia (N=24), narcolepsy (N=24) and obstructive sleep apnea syndrome (OSA) (N=24). Visual scoring was performed by two experts (VS1 and VS2) according to the AASM rules. AS analyzed the single EEG channel CzPz, without any information from EOG nor EMG. Sleep parameters (sleep onset latency, SOL; wake after sleep onset, WASO; total sleep time, TST; time spent in REM/N3/N2/N1, tREM/tN3/tN2/tN1; sleep efficiency, SE; REM latency, REML) and epoch-by-epoch agreements (concordance and Conger's kappa coefficient, k) were compared between VS1 and VS2, between AS and VS1 or VS2 and between AS and consensual VS (where epochs of disagreement between expert were discarded). For each parameter, a two-way ANOVA was computed with scorers and pathologies as within and between subject factors, respectively.

Results: Overall agreement between the 3 scorings was k = 0.69. Pairwise agreements were, between AS and VS1: 78.6% (kappa=0.70), AS and VS2: 75.0% (0.65), VS1 and VS2: 79.5% (0.72). Agreement between AS and consensual VS was 85.6% (0.80), with the following distribution: insomnia 85.5% (0.69), narcolepsy 83.8% (0.68), idiopathic hypersomnia 86.1% (0.69), OSA 87.2% (0.69). Hypnograms obtained with AS and VS exhibited very close sleep organization. In the narcoleptic group, 8/10 of REM Sleep Onset (SOREM) detected by VS1 were missed by AS, while 5/10 were detected by both VS. Regarding sleep parameters, no significant interaction was found except for tN1. Scorer effect was driven by AS (SOL, tREM) by VS2 (SE, TST, tN1 except in narcolepsy) or by all scorers (WASO, tN1 in narcolepsy, tN3). No scorer effect was found for tN2, REML.

Conclusions: The agreement between AS and VS is comparable to that reported in healthy subjects, to the inter-expert agreement in patients and is consistent in the four sleep disorders investigated. These results support the use of the scoring algorithm ASEEGA in clinical routine. Additional work should be done to ensure usability, such as improving SOREM detection by further developing the algorithm or by a dedicated editing process, and to evaluate medico-economic impact.

IDENTIFYING COMMON SLEEP DISORDERS VIA A DIGITAL SURVEY USING MACHINE LEARNING PREDICTION MODELS

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Introduction: Over their lifetime, most adults experience transient sleep disturbances, over 30% of which become chronic. Inadequate access to medical care and inefficient screening methods have resulted in most sleep disorders remaining undiagnosed or untreated, increasing the public health burden from these sleep conditions and their sequelae. This study addressed this critical unmet need by developing a well-validated, time-efficient, scalable approach to identify sleep disorders in the public-at-large. To achieve this goal, we applied Machine Learning (ML) methods to train and test the performance of separate statistical models for four high impact diagnoses: insomnia, delayed sleep phase syndrome (DSPS), insufficient sleep syndrome (ISS), and risk for obstructive sleep apnea (OSA).
Methods: A 30-item online survey instrument was administered to 3,799 community volunteers, of which 2,113 were eligible and consented to participate in the study. Of those, 252 (149F; 39.9±12.4 years) were invited for a medical interview by expert sleep physicians at the Johns Hopkins Sleep Disorder Center, Baltimore, MD. Each participant was diagnosed with up to two clinical sleep disorders. ML approaches were used to generate new features, non-linear functions on combinations of variables from original survey responses, which were systematically tested for their statistical reliability and explanatory power, to avoid overfitting and reduce possibility of statistical artifacts. Regularized linear models ("Elastic Net") were used to train predictive models based on these features, with regularization further selecting features and reducing the potential dangers of overfitting and multicollinearity. Both feature generation and model building used cross-validation to further validate outcomes. Lastly, we used the bootstrap method to select probability thresholds that optimize sensitivity and specificity of the model predictions. The final models included between 15 and 200 features. All analyses were performed using R.
Results: For Insomnia, the final Elastic Net model yielded a sensitivity of 80.3%, a specificity of 69.4%, an accuracy of 72.9.0%, and an AUC of 0.83 on the validation dataset. For DSPS, the final model yielded a sensitivity of 80.5%, and a specificity of 62.9%, an accuracy of 67.9%, and an AUC of 0.80. For ISS, the final model yielded a sensitivity of 82.3%, a specificity of 63.6%, an accuracy of 69.7%, and an AUC of 0.82. For OSA risk, the final model yielded a sensitivity of 83.3%, a specificity of 66.5%, an accuracy of 73.2%, and an AUC of 0.85.
Conclusions: Our findings suggest that a brief sleep survey presented via a digital platform is a feasible means of diagnostic screening of sleep disorders, with moderate to high degree of accuracy compared to gold-standard physician diagnosis. In contrast to applying traditional regression models, aimed at explaining the contribution of each variable to the outcome, we leveraged modern ML statistical approaches, geared at optimizing the models' accuracy and truly estimating the predictive power (generalizability) of our models in forecasting four highly prevalent sleep disorders. Importantly, our methods and results are easily reproducible, with future data collection and validation aimed at refining and improving the models we propose.

A PRELIMINARY STUDY OF IDENTIFYING THE SITE OF UPPER AIRWAY COLLAPSE IN OSA USING SNORING SIGNALS

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Introduction: Snoring is a hallmark feature of Obstructive Sleep Apnoea (OSA), and is caused by vibration of tissues such as soft palate, lateral walls, tongue, epiglottis in the upper airway (UA). Depending on the shape and physical dimensions of the UA, different snoring sounds with diverse acoustic features are produced. Therefore, the snore signal may carry information related to the site and the degree of obstruction of the upper airway and may improve OSA treatment by allowing more individualized or structure-specific therapy. In this study we investigated if audio signals carry information related to the site of obstruction of the upper airway.

Materials and methods: Full night polysomnography (PSG) and audio data was collected from 13 patients who attended the Sleep Investigation Unit at Royal North Shore Hospital Sydney and received a diagnosis of OSA. We used an indirect process of labelling the site of collapse using the airflow signals. Using the shape of the flow signal (flattening or scooping of the airflow contours) according to the degree of negative effort dependence, three sites of collapse (lateral wall, palate and tongue base related obstruction) were determined. Eighteen time and frequency features were calculated from each one second epoch of the audio signal and a gaussian mixture model (GMM) classifier was developed for categorizing the site of collapse based on the snoring audio.

Results: To evaluate the performance, the data set was randomly divided into two subsets 15 times; a training set (80%) and a test set (20%). The average overall accuracy was 78.9%, the sensitivity was 89.3%, 73.2% and 61.3%, and the positive predictivity was 78.0%, 83.2% and 71.8% for lateral wall, palate and tongue base related collapse respectively.

Conclusion: Our preliminary results suggest that the snoring signal may be helpful in identifying the site of obstruction. Future work will look at widening our analysis epoch to include more of the audio signal per respiratory event.

IMPROVED ALERTNESS AND SUSTAINED ATTENTION FOLLOWING ACOUSTIC SLOW WAVE SLEEP STIMULATION IN CHRONICALLY SLEEP-DEPRIVED ADULTS

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Introduction: Daytime sleepiness arising from chronic sleep restriction has been linked to occupational errors, motor vehicle crashes and poorer health outcomes. To determine whether sleep and subsequent performance can be enhanced without changing the sleep period, we examined whether acoustic enhancement of slow wave sleep (SWS) improved sleep outcomes, and subsequent measures of daytime sleepiness, in a sleep-restricted population.

Materials and methods: Twenty-five healthy adults (16 female) provided data in a randomized, single-blind, cross-over study. Participants wore a closed-loop automated acoustic stimulation device for two consecutive nights. Acoustic tones were delivered during N3 (STIM), or at inaudible decibels during equivalent N3 periods (SHAM). Participants rated their fatigue and alertness following both Night 1 and Night 2, (Karolinska Sleepiness Scale; KSS, Samn-Perelli Fatigue Scale), and completed a series of subjective (KSS, Samn-Perelli Fatigue Scale) and objective measures of alertness (Multiple Sleep Latency Test; MSLT) and sustained attention (Psychomotor Vigilance Task, PVT) throughout the day following Night 2.

Results: Overall, the majority of participants had higher slow wave activity (power in the 0.5-4Hz band) over two nights of STIM compared to SHAM, with an average improvement of 38.0±33.23% in cumulative slow wave activity (CSWA). Minutes of SWS also increased following STIM compared to SHAM. Following STIM, participants responded faster on the PVT and had fewer lapses. There were no changes in the MSLT. Participants reported feeling more alert and less fatigued on the KSS and Samn-Perelli Fatigue Scale following STIM compared to SHAM following both nights.

Conclusions: Consecutive nights of acoustic stimulation led to increased CSWA and minutes of SWS, and improved subjective alertness and objective attention outcomes. In conclusion, the use of an automated, closed-loop acoustic device to enhance slow wave sleep may alleviate some of the cognitive deficits associated with sleep-restriction in chronically short sleepers.

DRUG-INDUCED SLEEP ENDOSCOPY IN ASSESSING AIRWAY PATENCY - OWN EXPERIENCES

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Introduction: Obstructive sleep apnea is a disorder of breathing during sleep. Lack of clinical improvement after previously performed laryngological procedures is an indication for endoscopic examination during drug - induced sleep. Drug-induced sleep endoscopy (DISE) provides important information about functional upper airways patency.

Material and methods: The study was performed in patients in whom other treatment methods had not been effective. DISE was performed in these patients. Continuous intravenous propofol infusion was given as general anesthetic to ensure the safety of the procedure.

Results: From 2007 to 2017, 2897 procedures for snoring and sleep apnea were performed at the MML Medical Center. At this time, 176 DISE examinations were performed. Causative treatment methods were determined by the means of questionnaire, CBCT, laryngological examination, and DISE examination. Subjective improvement of apnea symptoms was achieved in 80% of patients. In 70% of cases, snoring decreased. The rest of the patients are required to look for systemic causes of cardiological, neurological gastrological, or endocrine origin.

Conclusions: In our patients, the use of the DISE examination enabled to precisely determine the location of the vibration and of the collapse of the respiratory tract. DISE enables to effectively diagnose the cause of sleep disorders when other methods, such as cone beam computed tomography (CBCT) or cephalometry are not sufficient.

RESPIRATORY INDUCTANCE PLETHYSMOGRAPHY FOR THE RELIABLE ASSESSMENT OF VENTILATION AND SLEEP APNEA PHENOTYPES IN THE PRESENCE OF ORAL BREATHING

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Introduction: Sleep apnea is a common chronic disease characterized by periodic loss of ventilation during sleep. Reliable measures of the phenotypes causing sleep apnea (pharyngeal collapsibility, muscle responsiveness, loop gain, arousal threshold) would enable clinicians to predict and monitor effectiveness of various therapeutic options in individual patients.

Currently, patient-specific phenotypes are calculated from a surrogate ventilation signal in routine polysomnographic (PSG) sleep studies (Sands SA et al, 2018), for which nasal cannula airflow has been used extensively. Yet sleep apnea patients exhibit substantial oral breathing during sleep, with ~20-60% of airflow occurring through the mouth (Gleeson, K et al, 1986). Since oral breathing is not captured with a nasal cannula, a switch to oral breathing will likely lead to major errors in physiological phenotype calculations and downstream treatment decisions.

By contrast, thoracoabdominal respiratory inductance plethysmography (RIP) provides a surrogate measure of ventilation unaffected by breathing route, and intuitively would provide a reliable ventilation signal in the presence of oral breathing. Accordingly, we assessed the reliability of capturing changes in ventilation with RIP versus nasal cannula in the context of intermittent oral breathing.

Methods: Breathing route experiment: Four subjects, age 23-40, performed an intermittent breathing route test encompassing nasal, oral, and combined oronasal breathing for ~5 min during supine wakefulness. Breathing was recorded using concurrent oronasal pneumotachograph (gold standard) plus RIP (true DC-coupled signals) and nasal cannula. Nasal cannula flow was linearized and the RIP calibrated using a modified iso-volume method. Ventilation (tidal volume x rate, presented as percent local average) was calculated for each sensor. RIP and nasal cannula measures were compared against the gold standard.

Case patient: In a patient with sleep apnea (apnea hypopnea index=59 events/hr) in whom pervasive, intermittent oral breathing was recognized on a specialized PSG (discrepancy between cannula and oronasal flow), we assessed changes in nocturnal ventilation as above. Ventilation from the three sensors were assessed during the course of respiratory events using ensemble averaging.

Results: Breathing route experiment: Across the N=88±14 (mean±SD) breaths measured, RIP ventilation correlated strongly with the gold standard oronasal ventilation (mean r=0.97, range 0.95-0.98). By contrast, a weaker correlation was seen between nasal cannula ventilation and the gold standard (mean r=0.25, range −0.04 to 0.46; p=0.0003 within-subject comparison).

Case patient: Across the 4620 breaths measured on PSG, cannula ventilation correlated modestly with the gold standard (r=0.84); the correlation was improved with RIP (r=0.90). The nasal cannula—but not RIP—systematically underestimated ventilatory recovery after events (ensemble-average; nasal cannula=147%mean, RIP=191%mean, gold standard=203%mean), leading to the interpretation of lower loop gain (low overshoot).

Conclusions: In the context of intermittent oral breathing seen pervasively in sleep apnea, changes in ventilation can be more accurately measured with RIP than with a nasal cannula. Careful assessment of RIP ventilation may provide reliable sleep apnea phenotyping for the

clinical setting.

BODY SLEEP - ESTIMATING SLEEP STAGES FROM TYPE 3 HOME SLEEP STUDIES USING FEATURE EXTRACTION AND RECURRENT NEURAL NETWORKS

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Introduction: We propose a novel method, BodySleep, to automatically estimate sleep stages (wake, REM, NREM) from polygraphy (PG) sleep studies, using physiological signals recorded during a conventional type 3 home sleep study. No guidelines on how to classify sleep stages in the absence of electroencephalography (EEG) exist, but studies show that various changes occur in the body during sleep. This includes changes in cardiac function, respiration, and body movements such as the decrease in muscle tone. Our method aims to estimate the stages of sleep using these factors.

Methods: A total of 61 features were engineered to capture physiological changes known to occur during sleep, as well as describing their statistical properties. The features were calculated over 30 second epochs, with some of the features being calculated on breath-by-breath basis and averaged over 30 seconds. The features were fed into a 5-layer neural network, where the last hidden layer is a recurrent layer with 50 Gated Recurrent Units (GRU). GRU takes a sequence of data as an input, in our case a sequence of length 25, and thus provides the network the ability to capture the time variance of the data. The output layer of the network consists of 3 nodes, representing for each timestep the class probabilities that the given 30 second input window belongs to the sleep stages wake, REM and NREM, respectively. The method was developed and validated on two data sets, one containing 179 clinical polysomnography (PSG) and the other containing 189 self-applied somnography (SAS) recordings. Final validation was reported on the clinical dataset.

Results: The average F1-score on a hidden test set of 27 recordings, randomly selected from the clinical PSG studies, was 0.88, and per-class F1-scores were 0.71 for wake, 0.83 for REM and 0.93 for NREM. Five-fold cross-validation on the same dataset resulted in an average F1-score of 0.88, F1-score of 0.73 for wake, 0.83 for REM and 0.92 for NREM. Cohen's Kappa score was 0.74 for the test set and 0.75 for the cross-validation set. When the BodySleep method was used to estimate the sleep time, we can see that the AHI values are comparable to AHI values of PSG studies, and more robust to outliers than when estimating AHI using only position, as is the standard method for PG studies.

Conclusion: PG studies are simpler and easier than performing a full PSG, and being able to estimate sleep stages from PG studies has the potential to make PG studies more accurate and definitive and reduce the need for PSG. Our method succeeds at estimating sleep stages from PG recordings with comparable results to manually scored PSG recordings. The results show that it is possible to estimate sleep time and differentiate between REM and NREM sleep using BodySleep, which suggests it being possible to detect REM related apneas using PG studies.

DROWSINESS CHARACTERIZATION BASED ON THE COMBINED ANALYSIS OF EYE MOVEMENT AND HEART RATE VARIABILITY

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Introduction: Drowsiness is characterized by an irresistible urge to sleep that can be dangerous when an individual performs a task that requires a certain level of attention and performance. In order to characterize this phenomenon objectively, non-invasively, and in real-time, two techniques stand out, i.e. the analysis of eye movements and the analysis of heart rate variability (HRV). The eye is indeed the best indicator of brain activity and ocular parameters, especially those related to eyelid movements, are known to be reliable markers of drowsiness. Moreover, drowsiness is also associated with a decrease in heart rate associated with a change in variability. Indeed, when drowsiness increases, the activity of the autonomic nervous system transits from sympathetic to parasympathetic and this transition can be measured by differences in the power spectrum of the HRV signal. In this study, we hypothesize that the combination of these two techniques provides a more robust and reliable drowsiness characterization than using each technique alone.

Materials and methods: We have therefore developed a drowsiness characterization system based on the combined analysis of eye movements and HRV. Eye movements can be captured by a camera taking images of one or both eyes. Then, from images of the eye and via sophisticated image processing algorithms, we can extract and compute several ocular parameters indicative of drowsiness. On the other hand, the heart rate can be obtained via different sensors, i.e. a camera, electrodes on the chest (to record the electrocardiogram (ECG)), a smart watch, etc. and from the HRV, we can extract and compute several cardiac parameters indicative of drowsiness. Then, by smartly combining ocular and cardiac parameters, we can determine a level of drowsiness (LoD) between 0 (well awake) and 10 (very sleepy).

Results: In order to validate the LoD determined by our system based on ocular and cardiac parameters, we conducted a study in which 33 participants (16M, 17F, mean age of 39.8 years, range of 21-66 years) had to perform a driving session in a simulator in various sleep deprivation conditions. During this study, we recorded the images of the eye via a remote camera, the HRV via the ECG, and we also collected signals of brain activity (electroencephalogram (EEG)) and ocular activity (electrooculogram (EOG)) via electrodes on the scalp and around the eyes. The analysis of EEG and EOG signals is recognized as the "gold standard" for drowsiness characterization. Therefore, we have compared the LoD determined by our system using (1) only cardiac parameters, (2) only ocular parameters, (3) the combination of ocular and cardiac parameters, with the LoD determined by visually analyzing EEG and EOG signals. Preliminary correlation results are (1) 0.53, (2) 0.79, and (3) 0.82 respectively.

Conclusions: The combined analysis of eye movement and HRV to characterize drowsiness provides a slightly better correlation with EEG and EOG than using each modality separately. In addition, the use of ocular and cardiac parameters enables to be more robust in the event of momentary loss of ocular or HRV data in operational environments.

Acknowledgements:

DEVELOPMENT OF SPINDLE DETECTION ALGORITHM BY WAVELET SYNCHROSQUEEZED TRANSFORM AND RANDOM UNDER SAMPLING

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Introduction: Polysomnography (PSG) is a gold standard test of sleep disorders; however, it is burdensome even for experts to score EEG. In particular, sleep spindle detection is difficult, and in fact, it is reported that the concordance rate of spindle detection is about 70% even in the same expert. Automatic sleep spindle detection has been investigated. The conventional methods divide the EEG data into multiple segments and calculate the similarity between the divided EEG data in each segment and spindle waveforms. The segments with sleep spindles are detected when the calculated similarities exceed the predefined threshold. Since there is individuality in EEG data, the threshold needs to be tuned for individual adaptation, which is a laborious task. The present work aims to develop a new precise sleep spindle detection method which does not require threshold tuning.

Methods: The present work proposes a sleep spindle detection method by integrating the wavelet synchrosqueezed transform (SST) and random under sampling boosting (RUSBoost), which is referred to as SST-RUS.

SST is a time-frequency analysis method suitable for analyzing multicomponent signals with oscillating modes. Since SST decomposes a signal into multiple frequency components with high-resolution, it extracts the features of spindle waveforms, specifically.

Although the numbers of positive and negative samples should be balanced to construct a good classifier in ordinal machine learning problems, the volume of the EEG data without sleep spindles is usually much larger than with sleep spindles in sleep spindle detection. Random under sampling (RUS) is a framework for coping with such an imbalanced data problem through discarding randomly selected majority samples so that the numbers of positive and negatives samples become balanced when a classifier is built. Boosting is one of ensemble methods that constructs multiple weak classifiers and combines their outputs into the final output by majority voting. RUSBoost is a combination of RUS and Boosting for coping with the imbalanced data problem. Since sleep spindle detection is the imbalanced data problem, adopting RUSBoost is reasonable.

In the proposed SST-RUS, multiple features are extracted from the EEG data by SST, and sleep spindles are detected from the extracted features by RUSBoost. Spindle detection performance is improved by combining STS and RUSBoost.

In addition, SST-RUS does not require threshold tuning for individual adaptation because RUSBoost uses the majority voting of weak classifier outputs for discrimination, which is an advantage of the proposed method.

The performance of the proposed SST-RUS was validated using a subset SS2 in an open-access database called Montreal archives of sleep studies cohort 1 (MASS-C1), which consists of PSG recordings obtained from 19 subjects.

Results: The proposed method obtained an F1-score of 0.754 with a sensitivity of 77.8% and a positive predictive value of 73.5%, which outperformed conventional SST-based methods. Since SST-RUS can detect sleep spindles automatically and accurately, it contributes to reduce the burden of EEG scoring in PSG.

Conclusions: The present work proposed a new accurate sleep spindle detection method based on SST and RUSBoost.

CORRECTIVE PROCEDURES OF THE TONGUE BASE USING SHAVER AND PLASMA-PK TECHNIQUES IN THE TREATMENT OF SNORING AND SLEEP APNEA - OWN EXPERIENCE

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Introduction: A special group of patients with sleep apnea and snoring are people with a large mass of tongue, which is an obstacle to proper sleep breathing. In this group of patients, after radiological and endoscopic examination of the lower throat during a pharmacological sleep, a technique involving the reduction of muscle tissue with a Shaver was used, simultaneously with plasma generator PK.
We wanted to show the advantages of the Shaver/PK technique compared to other techniques used to reduce of the tongue root.
Material and methods: The study material included 36 men with confirmed obstructive sleep apnea, aged 32 to 57 years.
Surgery was performed by introducing a 4 mm diameter Shaver in the midline, the muscle mass of the tongue was reduced using plasma coagulation at the same time.
Results: There was a subjective improvement. In the questionnaire survey, all the patients experienced improvement.The radiographic examination of the tongue and lower throat areas performed 90 days after surgery revealed a reduction in its mass and an increase in the distance from the posterior wall to the root of the tongue in the study group. In the polysomnographic study, improvement of respiratory parameters was observed in 90% of patients. In one patient a complication in the form of haemorrhage from the arterial vein was observed. Embolisation was used.
Conclusions: The technique of using Shaver/PK in the reduction of the tongue root may be complementary to the method of fibrinolysis/RF/harmonic/laser and can extend the scope of otolaryngology, especially where other treatments have not yielded the expected results. In addition, it is worth noting that the expected therapeutic effect and convalescence of patients after surgery is much faster.

END-TO-END MACHINE LEARNING ON RAW EEG SIGNALS FOR SLEEP STAGE CLASSIFICATION

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Introduction: We present a method for automatic sleep stage classification. Sleep stage classification is the process of classifying 30 second epochs of EEG signals into 1 of 5 sleep stages. Methods that use machine learning to automate this process exist and are used in the industry. Most of these rely on handcrafted statistical and spectral features. These methods suffer from being computationally expensive, they are sensitive to artifacts due to feature normalisation, and they cannot be applied to classify sleep stages in real time. Furthermore, people designing the features impose their views on the signals into the classification task, while using the raw time series may allow us to learn something new about the time series. This paper explores methods that utilize recent advances in machine learning to bypass pre-calculated features and use EEG data directly. These methods are compared and combined to improve the current state of automatic sleep stage classification. The proposed method was developed using >400 anonymised 8-10 hour night recordings from different subjects. Tests show results of similar predictive quality as methods relying on pre-calculated features. Indicating that models using raw EEG data are a realistic replacement to methods relying on pre-calculated features.

Materials and methods: Recently scientists have obtained promising results in sleep stage classification using convolutional and recurrent neural networks (Chambon et.al 2018, Bresch et.al 2018, Zhang et.al 2019). Here we explore methods from this work, directly implementing the architectures described and test modifications to the models. Predictive power is compared as well as computational cost of each method. A recurring hypothesis in recent literature is that results would improve significantly if more data were available. Chambon et al. and Bresch et al. used 60 and 147 recordings respectively, fewer than the >400 recordings available here.

Results: Model testing was done by using 80% of the recordings for model training and 20% for testing. A baseline F1-score of 0.77 was achieved on the test data by a feed forward neural network (FFNN) trained using ~200 pre-calculated EEG features. Tests using the proposed method result in a F1-score of 0.75 not far from the baseline score. More architectures are yet to be tested and we expect our results to move even closer to the baseline. Computational time tests for the baseline model resulted in a run time of ~300 seconds for a single recording, including both feature calculation and model prediction. The proposed method classified the same recording in 0.35 seconds, or 0.1% of the time required by the baseline model.

THE APPLICATION OF CINEMRI IN EVALUATION OF UPPER AIRWAY OBSTRUCTION LEVELS IN COMPLICATED PEDIATRIC OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: To explore the role of cineMRI in the localization of upper airway obstruction in complicated pediatric OSAS.

Materials and methods: Eleven persistent OSAS and 11 complex OSAS underwent cineMRI from June 2017 to March 2018. Each patient was imaged midline sagittal and axial magnetic resonance cine image. The obtained sagittal and axial images were displayed in cine format, creating a real-time "movie" of airway motion, to make a personalized treatment for each child. Polysomnography was performed to evaluate the effectiveness of cineMRI directed treatment for pediatric OSAS.

Results: CineMRI could effectively define the upper airway obstruction level. There was a significant improvement in AHI (P=0.019) and saturation nadir (P< 0.005).

Conclusions: The cineMRI is useful in evaluating the upper airway obstruction in those patients who have persistent OSA symptoms after tonsillectomy or adenoidectomy, or in those patients who have complex systemic disease.

Acknowledgements: Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA

EVALUATION OF SLEEP APNEA DETECTION FROM A SMARTWATCH IN A PILOT STUDY

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Evaluation of Sleep Apnea Detection From a Smartwatch in a Pilot Study

Introduction: Smartwatches and wearable trackers are increasingly popular devices in the US and worldwide, with approximately 20% of the adult US population estimated to own a smartwatch or tracker. A recent innovation is the inclusion of red and infrared sensors in these devices, which allows some estimation of blood oxygen levels, based on pulse oximetry technology. This abstract presents the results of an algorithm for estimating AHI, developed on pilot data measured on subjects undergoing home sleep testing for apnea.
Materials and methods: An algorithm to estimate AHI was developed by asking 22 subjects to wear a smartwatch (Fitbit Versa, Fitbit, San Francisco) while undergoing an in-lab sleep test. For the sleep test, each minute was scored as apneic or non-apneic based on the scored results. The smartwatch includes a red and infrared LED which was used to estimate changes in blood oxygenation, as well as an optical heart rate sensor. A set of features was calculated every minute based on estimated changes in oxygenation and in heart rate variability. Additional training data was generated by taking overnight sleep recordings from 24 healthy subjects believed to be free of sleep apnea by questionnaire. A machine learning algorithm was developed which optimised the agreement on a per-minute basis between a predicted label (apneic/non-apneic) and the ground truth. The accuracy of this system on a per-patient basis was evaluated on a separate testing data set of 51 subjects (28M/23F, age 41± 11 yrs) not used in the development of the algorithm, but who also underwent an in-lab sleep test. Some subjects undertook two nights of testing so that a total of 82 nights were available for evaluation.
Results: Using a cut-off of AHI=15, the automated algorithm had a sensitivity of 95% and a specificity of 87%.
Conclusion: A smartwatch has the potential to recognize moderate-severe apnea with a high degree of accuracy.
Acknowledgements: Sleep test data acquisition and scoring was carried out by SleepMed and Bluesleep.

EVALUATION OF A SLEEP QUALITY SCORE METRIC

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Introduction: The last number of years has seen an increased use of consumer smartwatches and trackers for self-assessment of sleep habits. Such devices typically report objective metrics such as sleep duration and wake time, as well as giving an overall "sleep score" which is intended to give a user a sense of the quality of their sleep. This abstract reports on the comparison between the sleep score generated by a commercial sleep tracking software product (Fitbit, San Francisco, CA) and the contemporaneous self-rating on quality by the user.

Materials and methods: 9802 subjects participated in a test of a sleep quality metric based on recording from compatible sleep-tracking Fitbit devices over the period from Oct 2018 to Feb 2019. The sleep quality metric provides a number between 0 and 100 and is based on three aspects of sleep:
a) total sleep time and WASO,
b) relative percentages/durations of deep and REM sleep, and
c) other physiological metrics (heart rate during sleep and movement).
The total sleep time and sleep architecture scores were generated relative to cohorts of similar age and gender. Participants were asked to rate their energy and mood on a five point scale, and their overall perceived quality (bad, average, good) prior to receiving their objective sleep score. Participants also answered surveys on perceived stress, exercise, alcohol use, room temperature, noise and caffeine use.

Results: 473493 sleep scores were generated over the study period, with 38616 user surveys completed. There was a strong correlation between relative sleep score and overall rating (assessed by a Cohen's d value of 0.99). There was relatively little variation in sleep score with age (reflecting the fact that the score allows for the fact that percentage of deep and REM sleep varies with age and gender). Sleep score declined with BMI. Alcohol usage had a noticeable impact on sleep score, and in particular on the component of the score related to heart rate and restlessness during sleep.

Conclusion: An objective sleep quality metric based on duration, sleep architecture, and physiological metrics was well correlated with subjective perceptions of sleep quality. The sleep score metric reflected expected behavior in response to known sleep quality disturbances due to alcohol and perceived stress.

WHOLE-BRAIN IMAGING TO PROFILE NEURONAL AND MICROGLIAL ACTIVITIES ASSOCIATED WITH INFLAMMATION-MEDIATED SLEEP

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Introduction: Whole-brain imaging has the potential to globally investigate the brain state under a given experimental condition. To this end, our group has developed whole-brain clearing and staining techniques (CUBIC-HistoVIsion; Susaki *et al*., in prep.), which allow us to identify and quantify the cells expressing target proteins. In particular, quantitative analysis of c-Fos or Iba1 as a marker of neuronal or microglial activation could be a powerful tool to implicate sleep/wake behavior in the whole-brain level.

Activation of the immune system causes some physiological responses including drowsiness. Administration of lipopolysaccharide (LPS), a component of the outer membrane of bacteria, can mimic systemic infection and activate the immune system. To explore the relationship between inflammation-mediated sleep and neuronal/microglial activity in the whole-brain level, we conducted the whole-brain analysis of c-Fos and Iba1 expression in LPS-administered mice.

Materials and methods: Administration of LPS and Sleep Phenotyping:

Sleep phenotyping was conducted for 4 days under 12-hr light/12-hr dark condition using the respiration-based non-invasive system (SSS; Sunagawa *et al*., 2016). On the fourth day, C57BL/6N mice (8-week-old; male) received an i.p. injection of LPS in 150 μg/kg at ZT14. Whole-brain analysis of c-Fos and Iba1 expression:

For the analysis of c-Fos, 150 μg/kg of LPS was i.p. injected to 8-week-old mice at CT14 under the constantly dark condition to avoid light effect on c-Fos signals. Mouse brains were collected 1-2 hrs after injection (CT15-16). For the analysis of Iba1, 1 mg/kg of LPS was i.p. injected to 8-week-old mice at ZT4. Brains were sampled 24 hrs after injection. Collected brains were cleared and stained using CUBIC-HistVIsion methods.

Results: First, we confirmed that administration of LPS acutely induced drowsiness and hence caused prolonged sleep duration in mice. Next, we analyzed whole-brain c-Fos expression profile after the injection in a replicate experiment. We found that LPS administration caused the decrease of c-Fos expression in cerebral cortex, whereas the expression was increased in some brain nuclei. In addition, the amount of Iba1 expression was increased in cortex by LPS administration, while no significant change in the Iba1-positive cell density was displayed.

Conclusions: From the analysis of c-Fos, it suggests that acute activation/suppression of some specific brain parts can be involved in LPS-induced sleep. Furthermore, from the profile of Iba1 expression, it indicates that microglial activation might be concerned with LPS-induced sleep through the modulation of neuronal activity in cerebral cortex. Here we demonstrated the capability that whole-brain profiling can make a connection between sleep/wake behavior and the activities of neuron and microglia with non-biased view.

VIEWS OF PATIENTS WITH EPILEPSY ON WEARABLE SEIZURE PREDICTION SYSTEM; IMPACT OF TWO DIFFERENT TYPE OF DEVICES ON SLEEP QUALITY

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Introduction: Unwitnessed nocturnal epileptic seizures and postictal respiratory depression can cause sudden death in epilepsy (SUDEP), thus lack of nocturnal supervision is listed as one of the risk factor of SUDEP. The development of epileptic seizure prediction/alert system could contribute to prevent SUDEP in intractable epilepsy. We have developed a wearable epileptic seizure prediction system based on heart rate variability (HRV) monitoring. We here report on a survey of patients´ views on the wearable HRV monitoring system focusing on quality of sleep.

Materials and methods: Twenty-eight epilepsy inpatients under long-term video-electroencephalogram (EEG) monitoring for the clinical assessment of epilepsy was included in the survey. The subjects participated the practical implementation test of the wearable prediction system prototype, which consists of a wearable electrocardiogram (ECG) sensor and a smartphone app with R-R interval (RRI) monitoring function. Fourteen patients were tested on small-sized RRI telemetry system transmitter with cable and patch type ECG electrode, while other fourteen subjects wear garment type ECG sensor with a with textile electrodes and transmitter attached on epicardial region. All the participants were asked to complete a questionnaire designed to assess their views on the usability of the system. The answer was compared between the patch type sensor group and garment type sensor group. The study was approved by the ethics committees of Tokyo Medical and Dental University. Written informed consent was given by all the subjects.

Results: In both groups, 86 % of the subjects did not complain of any significant discomfort or inconvenience. While 4 people (29%) of the patch type sensor group developed a mild rash or skin irritation at the site where the electrodes were placed, only one subjects did in the garment type group. Regarding the impact of sleep, 71 % of the garment type sensor group maintained the usual sleep quality while only 54 % of the patch type sensor group did. Who complained sleep disturbance during the attachment of the system was 28 % in the garment group and 39 % in the patch group. More subjects (50 %) felt the system favorable in garment group than in the patch group (16 %).

Conclusions: A garment type sensor with textile electrode would be more favorable for epilepsy monitoring than patch type sensor in the respect of maintaining the sleep quality and low risk of skin reaction. The systems need to assessed in outpatients to exclude the influencing factors such as EEG equipment and hospital environment.

AUTOMATIC SLEEP SCORING SYSTEM USING A PATCH-TYPE EEG SENSOR BASED ON DEEP LEARNING

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Introduction: Analyzing sleep stages from electroencephalograms (EEGs) has been playing an important role in health monitoring and there has been many researches tackling on this field of study. Scoring the sleep stages were highly dependent on experts' knowledge or hand-crafted features by experts, however, recent advance in deep learning successfully automated the scoring process with human-level accuracy. Previous studies were less convenient in that they employed the specific EEG device designed for experiments. Such devices are usually expensive and require special arrangements to use. Here in this research, we propose automatic sleep stage scoring system using a patch-type wearable EEG sensor based on deep learning. The proposed sensor is light weight, low cost, and easy to use. As for the training architecture we implemented a model on the basis of DeepSleepNet.

Materials and methods: EEG sensor: The device we proposed is a multi-channel patch-type EEG sensor. The EEG sensor consists of a wireless sensing device and a disposable electrode sheet. The device is light weight, 27 g, and just attached on a forehead by a double-faced tape. The device is controlled by wireless communication interface based on Bluetooth Low Energy (BLE) protocol. The battery lasts for around 12 hours long with 200 mAh capacity. Dataset: We collected simultaneous EEG recordings with PSG and our sensor from healthy 15 participants (age 20-50s). Each data was recorded according to PSG protocol, 9 hours each with 6 channels with sampling frequency of 125 Hz. The sleep stages were annotated on each 30-s epoch, according to the American Academy of Sleep Medicine (AASM), by the experts on the basis of the results of the PSG analysis. EEG recordings were pre-processed using notch filter of 50 Hz and band-pass filter with cutoff frequencies of 0.5-40 Hz.

Results: We evaluated our method using a k-fold validation scheme. Due to the small number of the dataset, we set k to 15 - as same as the number of participants - and conducted tests on every participants' recordings. For evaluation metrics, we computed micro-averaged per-class precision, recall, and F1-score, averaged over all foldings. As the results show, we get overall accuracy of 74%, with the highest accuracy of 79% and the lowest of 64%. The results show the difficulty in predicting N1 stage, which is compatible with previous studies.

Conclusions: We propose an automatic sleep scoring system using a patch-type EEG sensor. Our patch-type sensor is light weight, low cost and easy to use, compared to specific EEG devices designed for experiments. We collected EEG recordings and trained with the state-of-the-art deep learning model in end-to-end fashion. The result shows that our proposed system is capable of scoring the sleep stage comparable to previous studies using specific EEG devices.

Acknowledgements: The authors would like to thank Ota Memorial Sleep Center for providing the annotated results and the EEG recording environment.

SLEEP/WAKEFULNESS DETECTION USING THE TRACHEAL RESPIRATORY SOUND AND MOVEMENTS

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Introduction: Current gold-standard to assess sleep/wakefulness is based on electroencephalogram which is inconvenient. Therefore, many portable sleep diagnosis devices cannot detect sleep time. Compared to wakefulness, sleep is associated with reduction in the activity of pharyngeal dilator muscles and ventilation that result in lower respiratory drive and more regular breathing patterns. Also, it has been shown that the respiratory activity can be assessed conveniently using respiratory related sounds and movements recorded over the trachea. Hence, the goal of this study was to detect sleep/wakefulness by analyzing tracheal sounds and movements compared to the scores derived from polysomnography (PSG).

Materials and Methods: Participants with suspected sleep apnea who were referred to the sleep laboratory of Toronto Rehabilitation Institute were included in this study. Simultaneously with full PSG, tracheal sounds and movements were recorded with a small wearable device attached to the suprasternal notch. Dominant autocorrelation peak and standard deviation of autocorrelation peaks of tracheal sound which show the periodicity of respiration were extracted. Additionally, movement spikes, zero-crossing rate and absolute velocity of tracheal movements were calculated to estimate spontaneous and respiratory related movements. Features were extracted from 30-second epochs. Principal component analysis was used to extract the components that represent the maximum variability in features. Principal components were used to classify each epoch into sleep or wakefulness. Pearson or Spearman's correlation were used to compare the estimated total sleep time (TST) and sleep efficiency (SE) from our proposed model to those based on PSG.

Results: Sixty three subjects (31 females, age: 51 ± 16 years, BMI: 29.6 ± 6.4 kg/m^2 and AHI: 12.6 (0.6 -146)) were included in this study. The accuracy of sleep/wakefulness detection was $82.3 \pm 8.66\%$ with sensitivity of 87.6 ± 8.0 % (sleep), specificity of $68.4 \pm 18.2\%$ (awake), F1 of $88.2 \pm 7.9\%$ and Cohen´s kappa of 0.49. The correlation between the estimated and gold standard PSG based measures for TST and SE were 0.75 ($p < 0.001$) and 0.55 ($p < 0.001$), respectively.

Conclusion: These results show that reliable features related to sleep/wakefulness status can be extracted from the tracheal sound and movements. Previously, we have shown that tracheal sound analysis can be used as a reliable method to diagnose apneas and hypopneas during sleep. The results of this study combined with our previous studies provide strong evidence that respiratory sounds analysis can be used to develop robust, convenient and cost-effective portable devices for sleep apnea monitoring.

SLEEP IMPROVING EFFECT OF A NOVEL MOTION MATTRESS

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Introduction: Gentle motion of rocking like a cradle or a hammock is considered as a good way to promote relaxation and provide a better sleep. It is also known that stretching exercise before bedtime promotes sleep. In order to utilize these activities into daily sleep environment without too much self efforts, we developed a novel motion mattress which gives a user a gentle swing, stretching and other movements. In this study, we verified its effect on sleep quality.

Experimental Procedures: Twenty subjects who do not have sleep and other disorders, but were not fully satisfied with their sleep were recruited. Seventeen of them performed all the experiments. The study was performed for three periods, each of which was a week with a distinct condition. The first period was assigned as pre-experimental (PRE) period, when the subjects sleep using their own mattress. The other two periods were assigned as motion mattress active (MM1) period and motion mattress control (MM0) period, when the subjects sleep using the motion mattress with or without the motion. During MM1, the subject was given about 10-min motion after getting into bed. During MM0, the subject was not given the motion. All the subjects were randomly divided into two groups, and one group took MM1 and MM0 in order, and the other group took MM0 and MM1, thus the order of the experimental periods were reversed. At least one week was intervened between the experimental periods. The subjects recorded electroencephalograms (EEG) at home for themselves during these three weeks. EEG was measured by a portable single-channel EEG monitoring device (Sleepwell Co., Ltd., Japan). The subjects were asked to perform sleep questionnaires, such as OSA sleep inventory MA version, Epworth Sleepiness Scale (ESS), and 3 Numerical Rating Scale (NRS) questions about sleep after each session.

Results: Out of 17 subjects, 6 were removed due to the lack of sufficient number of data or other reasons, and the data of 11 subjects (age = 49.5±8.2, 6 men, 5 females) were analyzed. All 11 subjects exhibited no abnormality in their sleep recordings. As for the objective sleep parameters, the average sleep period time (SPT) were not significantly different between PRE, MM1 and MM0 periods. Sleep efficiency (SE) and NREM sleep stage 3 length significantly increased ($p < 0.05$) during MM1 compared with PRE. Wake time after sleep onset (WASO) significantly decreased ($p < 0.01$) during MM1 compared with PRE and MM0. As for the subjective sleep quality, subjects gave significantly higher value to the NRS questions about "falling asleep quickly", "slept soundly" and "woke up refreshed".

Conclusions: Our newly developed motion mattress which generates gentle motion improved the sleep quality both objectively and subjectively. We expect this mattress may lead to one of non-pharmacological therapies for patients with insomnia.

IMPROVED SWEAT ARTIFACT TOLERANCE OF SCREEN-PRINTED ELECTRODES BY MATERIAL SELECTION - IN VIVO COMPARISON OF EEG SIGNAL QUALITY

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Introduction: The lack of self-applicable EEG electrodes has limited the wider deployment of full home polysomnographic (PSG, type 2) studies. To respond to this lack, we recently introduced a self-applicable facial electrode set with screen-printed Ag/AgCl electrodes [1, 2]. Nocturnal sleep recordings are, however, vulnerable to sweating that may cause low-frequency artifacts to the measured EEG signal [1]. To minimize the effect of sweating, we recently investigated whether the sweat artifact tolerance can be improved by a proper material selection of printed electrodes. We compared electrochemical stabilities of nine different screen-printed Ag/AgCl electrode types in electrochemical test bench. Based on the obtained results, we selected the six most stable electrode candidates for the present *in vivo* study. The aim was to investigate the effect of sweating on electrode-skin impedances and the quality of EEG signal as well as to confirm our working hypothesis that the findings of the recent electrochemical tests are transferrable to physiological measurements.

Materials and methods: Two commercial Ag and Ag/AgCl inks manufactured by Engineered Conductive Materials ECM and PPG Industries Inc. were selected for the fabrication of screen-printed electrode sets with three differently shaped ink layers. Altogether six electrode types were tested *in vivo* measurements on 11 healthy adult (6M/5F, 20-40 years) volunteers. EEG electrodes were simultaneously attached to volunteer's forehead and the corresponding reference electrodes were attached on skin behind the ears (mastoid electrode). EEG signals and electrode impedances were measured before and after bicycle ergometer exercise-induced sweating. The quality of EEG signal was assessed by comparing their power spectral densities (PSDs, 0.5-2Hz) before and after exercise.

Results: There was a large variation in the electrode-skin impedances between the volunteers and also between the forehead and mastoid electrodes in the same subject. The impedance of the PPG electrodes on unprepared skin (mimicking self-application at home) varied between 20 kΩ and 180 kΩ and the corresponding values for ECM electrodes were between 10 kΩ and 190 kΩ. Generally, sweating decreased the impedance to 20-90% (PPG) or 10-80% (ECM) of its original value. Sweat artifact was clearly visible in all measured EEG signals. There was not a drastic difference between the ECM and PPG electrodes, but ECM electrodes systematically achieved the lowest PSD ratio (i.e. the smallest increase in the PSD due to sweating).

Conclusion: Our results showed great inter-subject, inter-location and sweating induced variations in the skin-electrode impedances. Consistently with previous bench tests, the smallest sweat artifact was systematically achieved with the ECM electrodes, albeit the overall elimination of sweat artifact was not achieved.

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A NEW SOLUTION TO MAJOR LIMITATION OF HSAT: WEARABLE PRINTED SENSOR FOR SLEEP QUANTIFICATION AND COMORBID DETECTION

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Introduction: Home sleep apnea testing (HSAT) is increasingly used as an alternative to in-lab polysomnography (PSG) to diagnose patients suspected of having obstructive sleep apnea (OSA). However, the major limitation of HSAT is its inability to provide reliable information of total sleep time, sleep stages and cortical arousals, possibly underestimating the severity of OSA [1]. Furthermore, several comorbid conditions, such as comorbid insomnia or sleep bruxism may be totally missed. To resolve these limitations, we recently developed a screen-printed ambulatory electrode set (AES), and shown its accuracy in sleep staging [2]. Here we investigated whether a newly designed AES is suitable for patient self-administration and evaluated the quality of the data from nocturnal home recordings. We also investigated the potential presence of first-night effect in home environment.

Materials and methods: One hundred and one self-administrated sleep recordings with a newly designed AES, wired up to the ambulatory PSG device (Nox A1, Nox Medical), were performed in volunteered subjects (aged 38.8±9.9 years, 81.2% females) with self-reported sleep bruxism. The montage consisted of four EEG derivations (Fp1-T10, Fp2-T9, Af8-T9, Af7-T10), two electro-oculogram derivations, two mental-submental electromyogram (EMG) derivations, two masseter EMG derivations and a modified lead II electrocardiogram. Electrode impedances were continuously monitored. Technical quality of the subset of recordings (n=40) was graded based on the proportions of interpretable data. In a subset of the subjects (n=16), sleep recordings were conducted over three consequent nights to assess possible existence of first-night effect.

Results: Out of 101 sleep studies conducted, four of them (4%) failed. Only one recording (1.0%) was failed due to mistakes in AES appliance, whereas three recordings were failed due to the problems with the recorder. Detailed analysis of the subset of recordings (n=40) revealed that the quality of recordings was as follows - outstanding: 37.5%, excellent: 42.5%, good: 10%, fair: 5%, poor: 2.5% and unsatisfactory 2.5%. The electrode impedances were below 75 kΩ in approximately 90% of the measured data points and generally stable overnight. Good subjective sleep quality was in concordance with determined sleep parameters, such as high sleep efficiency (Night1: 89.2±5.1%, Night2: 90.8±4.9%, Night3: 90.0±7.9%) and awakening index (Night1: 3.2±1.8%, Night2: 3.2±1.0%, Night3: 3.3±1.1%). There were no statistically significant differences in any sleep parameters between the subsequent nights.

Conclusions: The AES was found to be easily wearable and less disturbing tool for portable sleep monitoring. From the perspective of unattended sleep studies, the success rate and technical quality of AES recordings were exceptionally high. No evidence supporting the first-night effect was found in the studied sub-population, possibly eliminating the need for adaptation night often required in in-lab PSG, which further enhances clinical exploitability of the developed system. Overall, self-applicable AES has a great potential to become an integral part of HSAT.

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THE ASSOCIATION BETWEEN SLEEP-DISORDERED BREATHING AND SHORT-TERM FUNCTIONAL OUTCOMES IN ISCHEMIC STROKE PATIENTS: ASSESSED BY CARDIOPULMONARY COUPLING ANALYSIS USING HOLTER-MONITORING

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Introduction: Sleep-disordered breathing (SDB) by polysomnography has been reported to have close association with worsening of clinical outcomes in patients with ischemic stroke. The cardiopulmonary coupling (CPC) analysis using Holter-monitoring is an easily assessable method to evaluate SDB. However, its prognostic impact needs to be investigated.The present study investigated the prognostic impact of SDB defined by CPC analysis using Holter-monitoring at early stage of ischemic stroke on the functional disability at 3-month follow-up.

Materials and methods: Total 692 patients with acute ischemic stroke who underwent Holter-monitoring were enrolled. The CPC analysis was conducted and SDB was defined as the presence of narrow-band (NB) coupling during sleep time. We investigated the association between SDB and functional disability at 3-month measured by modified Rankin scale (mRS).

Results: The NB coupling was present in 216 (31.2%) of 692 patients with mean age of 64.2 ± 12.8 years. The NB group showed significantly higher proportion of severe functional disability (mRS >2; 45.3% vs. 12.3%, p< 0.001) and persistent disability (ΔmRS≤0; 42.6% vs. 56.4%, p< 0.001) after 3-month. In multivariate analysis, the presence of NB coupling was an independent predictor for higher risk of both severe and persistent functional disability (HR: 3.97; 95% CI: 2.37-6.64; p< 0.001; and HR 1.92; 95% CI: 1.34-2.77; p< 0.001, respectively). The results were consistent after propensity-score matched analysis with 175 patient pairs (C-statistics=0.759).

Conclusions: The SDB assessed by CPC analysis at early phase of ischemic stroke was able to predict both greater and persistent functional disability at 3-month. The CPC analysis using Holter-monitor can be a useful modality for predicting functional disabilities in acute ischemic stroke.

Acknowledgements: none

UNOBTRUSIVE SLOW WAVE ACTIVITY MONITORING BY PHASE COUPLING OF RESPIRATORY SINUS ARRHYTHMIA DURING SLEEP USING A PVDF SENSOR

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Introduction: A lack of slow wave sleep (SWS) has been suggested to cause medical problems including cardiovascular disease and diabetes. Thus, accurately detecting the quantity and quality of SWS is of importance and interest. Previous study demonstrated that a change in slow wave activity (SWA) (delta-wave; 0.5-4 Hz) is associated with a phase coupling of respiratory sinus arrhythmia (RSA) during sleep. This study aims to develop an unobtrusive monitoring system for SWA using a PVDF sensor that can detect changes in heart beat-to-beat interval (BBI) and respiration.

Materials and methods: Overnight electroencephalograms (EEG), electrocardiograms (ECG), and ballistocardiogram (BCG) (from the PVDF sensor placed around the calf muscle) were recorded from 11 healthy volunteers. We applied a novel algorithm to the BCG signal for BBI detection and compared ECG derived intervals. The amplitude of the envelope of the extracted EEG delta wave was computed based on an analytic signal using the Hilbert transform. The breath-to-breath interval was obtained by bandpass filtered BCG signal (0.15 - 0.4 Hz) and RSA was extracted from BBI by the same bandpass filter. Next, instantaneous phases of RSA and respiration were obtained, after which the degree of phase coupling between RSA and respiration was quantified every 10 seconds over a sliding 20 -s window.

Results: The BBI correlation between BCG and ECG was r = 0.71 with a root mean squared error of 86 ± 26 ms and bias of 6.8 ± 5.6 ms. Auto- and cross- correlation analyses revealed that overnight profiles of phase coupling of RSA and SWA were related with cross-correlation coefficients (0.40 ± 0.09) with phase coupling of RSA preceding the change in SWA by ~ 5.5 min. The periodicity of the phase coupling was similar to that of SWA (94.9 ± 19.9 vs. 98.9 ± 23.7 min, r = 0.89).

Conclusion: The analysis of phase coupling of RSA has the potential for providing information on SWA period and the proposed approach offers a novel tool in the evaluation of sleep cycles in a home environment.

OBSTRUCTIVE SLEEP APNEA DISORDER SEVERITY CORRELATION WITH BODY FAT MEASURE BY BIOELECTRIC IMPEDANCE ANALYSIS

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Introduction: The bioelectric impedance analysis (BIA) is widely used commercial device for body composition analysis for fat and muscle distribution. The BIA results were analyzed to find out relationship to obstructive sleep apnea disorder (OSAD).

Materials and Methods: The OSA patients with apnea-hypopnea index (AHI) >5 measure by overnight polysomnography were enrolled fort study. The body compositions were measure using segmental bioelectric impedance analysis according to the manufacturer's instructions (InBody, Biospace, Seoul, Korea). The OSAD severity is compared to BIA results. The body composition measure for analysis were: body weight(kg), BMI(kg/m^2), PSQI, ISI, SSS, ESS, BDI, WHO abdominal circumference(cm), body fat(kg), body fat percent(%), body muscle(kg), body muscle percent(%), waist-Hip ratio, visceral fat area(cm^2), arm circumference(cm), arm-muscle circumference(cm).

Results: A total of 155 patients with OSA were finally enrolled (42 females, 27.1%; age, 54.9±15.8 years). Their mean BMI was 25.6±4.0 kg/m^2, and total AHI was 29.1±20.7 /hours. Total AHI showed significant correlation with age (r=0.225, p=0.005), total body weight, BMI, abdominal circumference, and arm circumference. However, there were no significant correlations with total and percent fat percent, and total and percent body muscle. The REM-AHI revealed significant correlation with abdominal circumference (r=0.221, p=0.006), waist to hip ratio (r=0.176, p=0.032), visceral fat area (r=0.175, p=0.033), and abdominal circumference (r=0.163, p=0.047), however age did not correlate with REM-AHI (r=0.157, p=0.52). Partial correlation analysis with adjustment of total body weight and age showed there were significant correlations of REM-AHI with total body fat(r=0.222, p=0.007), percent body fat (r=0.183, p=0.027), visceral fat area(r=0.212, p=0.010), arm circumference (r=0.193, p=0.019), and arm fat measure by total arm circumference-fat circumference(r=0.165, p=0.47).

Conclusions: The BIA results indicated that AHI and REM-AHI severity have different body fat and muscle composition patterns. REM-AHI were more related to visceral fat area, and waist-hip ratio and arm fat distribution. REM-AHI may have more relation with fat distribution than AHI score in OSAD patients.

Technology/Technical
Board #357 : Poster session 2

WITHOUT LIFTING A FINGER: A NOVEL APPROACH TO DETECTING SLEEP STAGES

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Introduction: Abnormal rapid eye movement (REM) sleep is often symptomatic of chronic disorders, however polysomnography, the gold standard and only validated method to measure REM sleep, is expensive and often impractical. Attempts to develop cost-effective ambulatory systems to measure REM sleep have had limited success. As elevated twitching is often observed during REM sleep in some distal muscles, the aim of this study was to assess the potential for a simple finger-mounted device to measure finger twitches, and thereby differentiate periods of REM and non-REM (NREM) sleep. It was predicted there would be more finger twitching in REM sleep than in NREM sleep, and there would be more finger twitching in late REM sleep than in early REM sleep.

Materials and methods: One night of sleep data was collected by standard polysomnography from each of 18 (15m) healthy adults aged 23.2 ± 3.3 (mean ± SD) years. Finger movement was detected using a piezo-electric limb sensor taped to the index finger of each participant. Finger events less than or equal to 3 seconds in duration were defined as finger twitches, and finger twitch densities were calculated for each stage of sleep.

Results: Finger twitch density was found to be greater in REM sleep than in NREM sleep ($p < .001$). Finger twitch density decreased as NREM sleep deepened: twitch density in stage N3 sleep was less than in stage N2 sleep ($p < .001$), which in turn was less than in stage N1 sleep ($p < .001$). Finger twitch density in REM sleep was similar to the higher levels observed in stage N1 sleep ($p = 1.00$). Finger twitch density in REM sleep increased proportionately as sleep progressed, and twitch density was greater in late REM sleep than in early REM sleep ($p = .005$). There was also a time-stage interaction: the difference between REM sleep twitch density and NREM sleep twitch density was greater in middle sleep than in early sleep, $F(1,17) = 12.28$, $p = .003$; but the difference between REM sleep twitch density and NREM sleep twitch density was not different between middle sleep and late sleep, $F(1,17) = 0.003$, $p = .959$.

Conclusions: Finger twitching is higher in REM sleep than in NREM sleep and becomes more distinguishable as sleep progresses. As finger twitches in sleep are relatively infrequent, finger twitch densities appear to be too low to make accurate 30-second epoch determinations of sleep stage. However the observed effects suggest measurement of finger twitches could be used in combination with other variables to provide an ambulatory system capable of detecting REM sleep. As research studies and clinical diagnoses often require accurate temporal measurements of sleep variables, PSG is likely to maintain its gold standard status for objective measurement of sleep in the foreseeable future.

IMPROVED AUTOMATIC CLASSIFICATION OF SLEEP STAGES IN INFANTS USING HIGH-DENSITY EEG RECORDINGS

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Introduction: The classification of sleep stages is important to quantify sleep architecture in sleep research and sleep medicine. However, visual sleep scoring is a time-consuming process that is prone to human error. A particular challenge is sleep scoring the infant EEG, as several features used to distinguish sleep stages only start to develop in infancy. Recent advances leverage deep learning techniques for automatic sleep stage scoring, but only few algorithms have been directly trained and evaluated on infant data. Additionally, most classification algorithms are trained on a small number of EEG channels, despite increasing evidence that sleep patterns are distinct in different brain regions. It is unclear how the inclusion of additional channels impacts automatic sleep scoring accuracy.

Materials and methods: We collected high-density EEG (hdEEG) data (EGI, 124 channels) of 31 infants (17 male) between 5.6 and 7.5 months (M = 6.08 months, SD = 0.43 months). We recorded sleep EEG for 64.9 to 124.2 min (M = 110.2 min, SD = 11.3 min) at the beginning of nighttime sleep. Data was highpass filtered at 0.1 Hz and downsampled to 128 Hz. For training we used a consensus scoring between two raters classifying sleep stages for 20-second epochs according to the manual of the American Academy of Sleep Medicine (F3/F4, C3/C4, O1/2 referenced against the contralateral mastoid). We applied a two-layer Long-Short Term Memory (LSTM) neural network on a training set of 40392 4-sec epochs either using the 9 channels used in manual sleep scoring or all 124 channels (average mastoid reference). The trained LSTM network was then evaluated on a test dataset (10233 4-sec epochs).

Results: The sleep stage assignment accuracy of the LSTM network trained on 9-channel data was moderate (weighted F1 = 0.77), but the accuracy improved when all 124 channels were used (weighted F1 = 0.89). The accuracy was 75% and 88% for Wake, 17% and 36% for N1, 56% and 79% for N2, 87% and 94% for N3 and 73% and 88% for REM (9 channel and 124 channel model, respectively).

Conclusions: Our results show that training on a larger number of EEG channels leads to improved performance in automatic sleep stage detection in human infants. This particularly benefits sleep stages that originally show low accuracy (e.g., N1 and N2). More work is needed to establish the optimal number and configuration of channels. We propose that the higher spatial resolution contains additional information important for differentiating sleep stages. This is particularly the case in infants and young children, in whom EEG features to distinguish sleep stages are still developing. In the future, applying deep learning to hdEEG could offer insight into the changes in local sleep patterns and related brain maturation processes.

THE ACCURACY OF THE THIM DEVICE FOR ESTIMATING SLEEP ONSET WITH GOOD AND POOR SLEEPERS

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Introduction: Accurate measurement of sleep onset in the home environment is difficult. THIM is a wearable device designed to accurately estimate sleep onset for use in the home environment. THIM administers low intensity vibrations to which the user responds with a gentle finger twitch. When responses to the vibrations cease, THIM assumes the user has fallen asleep. While previous research with similar devices has shown that this behavioural response method is accurate method for estimating sleep onset, the use of vibratory stimuli together with finger twitch responses is novel. If found to accurately measure sleep onset, THIM could be used to administer a brief but effective treatment for insomnia called Intensive Sleep Retraining, facilitate the optimal 10-minute power nap, and administer accurate Multiple Sleep Latency Tests (MSLTs). This study assessed the accuracy of THIM for measuring sleep onset compared to the gold standard method, polysomnography (PSG).
Methods: 12 normal sleepers aged 24.9 years (SD = 6.1) underwent overnight PSG recording whilst using THIM on two nights in the sleep laboratory, one week apart. During each night, participants completed sleep onset trials for four hours beginning one hour before their habitual bedtime. In these trials, participants attempted to fall asleep whilst responding to vibrations emitted from THIM. Once they failed to respond to two consecutive vibratory stimuli, THIM woke them with a high intensity alarm vibration. Participants had a short break before attempting the next trial. THIM's estimations of sleep onset was compared to PSG-defined sleep onset for both nights separately.
Results: There was a strong degree of correspondence between PSG-N1 and THIM-sleep onset on the first night, $r_{(s)}$ = .77, p = 003, and the second night, $r_{(s)}$ = .85, p = 001. On average, THIM overestimated PSG-N1 sleep onset on the first night by 0.07 minutes (SD = 0.49). On the second night, THIM overestimated PSG-N1 sleep onset by 0.57 minutes (SD = 1.10) which was not significantly different to the discrepancy obtained on the first night of testing, p = .08. However, on a significant number of trials (23.74% of trials across both nights), PSG-sleep onset could not be determined before THIM prematurely ended the trial with an alarm vibration. This was due to the participant responding to the vibration but THIM not detecting their response on the majority of occasions, 66.78% of trials where PSG-sleep onset was not determined.
Conclusions: THIM is accurate at estimating sleep onset, more so than similar devices. However, small inaccuracies have been detected in the first iteration of its algorithm, particularly with regards to detecting sleep onset whilst the participant is still awake according to PSG. This would be problematic for applications such as Intensive Sleep Retraining, power napping and MSLTs which rely on the accurate detection of sleep onset. Consequently, refinements have been made to the THIM algorithm to improve its accuracy for estimating sleep onset and we will present the most recent data about the accuracy of THIM.
Acknowledgements: Thank you to our participants and team of research assistants.

THE ACCURACY OF THE THIM DEVICE FOR PASSIVELY MEASURING SLEEP AND WAKEFULNESS OVERNIGHT WITH GOOD AND POOR SLEEPERS

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Introduction: There are many consumer sleep trackers which claim to accurately estimate sleep, but few have empirical evidence publicly available to support their efficacy. The evidence that is publicly available suggests that these devices overestimate sleep and underestimate wakefulness. More accurate data collected from sleep trackers could be automatically integrated into online treatment programs without the need for user input, leading to greater personalisation of the treatment program and potentially better treatment outcomes. THIM is a new consumer sleep device that can passively monitor sleep overnight using actigraphy. This project aimed to develop the THIM sleep tracking algorithm (Study 1), and test its accuracy against polysomnography (PSG) with a small independent sample of good and poor sleepers (Study 2).

Methods:
Study 1: 12 normal sleepers aged 25.8 years (*SD* = 7.3) slept overnight in the sleep laboratory with THIM, the Philips Spectrum research actigraphy device, the Fitbit Flex consumer actigraphy device and PSG recording simultaneously. The THIM sleep tracking algorithm was developed by optimising sensitivity and specificity compared to PSG. The accuracy of the newly-developed THIM sleep tracking algorithm and the Philips Spectrum and Fitbit Flex devices was compared to PSG, as well as correspondence for key sleep parameters.

Study 2: An additional 12 normal sleepers aged 25.2 years (*SD* = 5.9) slept overnight in the sleep laboratory with the same devices recording simultaneously as in Study 1. Sensitivity, specificity and correspondence for sleep parameters was calculated for each device compared to PSG.

Results:
Study 1: On average, the THIM sleep tracking algorithm was accurate at estimating sleep (sensitivity = .91) and reasonable accuracy for estimating wakefulness (specificity = .57). THIM underestimated sleep efficiency by 1.21% (*SD* = 6.81). THIM was more accurate than the Philips Spectrum (sensitivity = .94, specificity = .31) and Fitbit Flex (sensitivity = .97, specificity = .40) devices.

Study 2: The analysis of the accuracy of THIM for estimating sleep and wakefulness in this sample is ongoing and will be presented at the conference.

Conclusions: Study 1 suggests that THIM may accurately monitor sleep overnight with good and poor sleepers. Additional sensors could be added to THIM, which may improve the accuracy of the device. Future research will examine the accuracy of THIM for passively monitoring sleep in people with insomnia, with the long-term goal being to incorporate the sleep tracking function into a comprehensive mobile-based treatment program for insomnia.

RESEARCH PROCESS AND SLEEP APP DESIGN LESSONS LEARNED FROM THE REFLECTIVE EXAMINATION OF A SLEEP STUDY

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Introduction: Mobile sleep apps are promising accessible treatments for insomnia. Using them as data collection tools akin to sleep diaries has also been proposed. Most of these apps, however, have not been developed using evidence-based principles; limited research exists on their design as research tools (Bhat et al. 2015) (Yu et al., 2019).

In the present study, we explored the opportunities and challenges experienced when using a mobile app for research with our own team's research study as the unit of analysis. This is an intrinsic case study (Stake, 1995), which can inform other researchers as they use sleep apps in research as an intervention (treatment) or research tool (data collection).

Materials and methods: Data were collected during a larger study, designed to test the effects of serial diverse imagining (Beaudoin et al., 2016), using SomnoTest, on insomnia. Data of 19 controls and 15 insomniacs, aged 18-30 years, were analysed. Participants were assigned to one of two app conditions. Group 1 participants heard a countdown from 99 to 1; Group 2 were prompted to visualise randomly selected brief scenes read by the app at eight-second intervals. Participants completed a one-week sleep diary while using SomnoTest, during the second week.

This was the first study to analyze SomnoTest data using a qualitative approach involving direct interpretation of participants' patterns of mobile app usage based on actions recorded (i.e., press start, end, pause, resume, or cancel; time stamp; count of played items), reorganization of usage patterns into tables (visualisation; tabulation), reflection of researchers on their respective experiences in analyzing the data, and the derivation of themes and selection of exemplars based on participants' usage and researchers' experiences.

Results: Our exploration revealed four themes:
1) unreliability of sleep diaries when triangulated against SomnoTest data, given that 9 participants had not used the app as claimed;
2) complex, intensive qualitative analysis is needed to identify valid data in an unstructured data set;
3) importance of visualisation when examining data to uncover patterns;
4) identification of "fans" who continue to use the app after their participation in the study.
Our findings reveal that data cleaning involves intensive case-by-case analysis of participant data, which proved challenging with 34 participants and would prove prohibitive for larger scale studies. However, these insights can inform future sleep studies involving mobile app.

Conclusion: The development of an algorithm that can efficiently filter valid data usage patterns would facilitate data analysis and researchers' experience. This would increase sleep app usability as a treatment and research tool. Developing a process for increasing efficiency in data analysis is necessary to exploit the advantages of large-scale data collection that a sleep app makes possible. Further, informing participants that app data would be triangulated against sleep diary during data collection and analysis might increase the accuracy of the data that participants provide in sleep diaries.

Acknowledgements:

ACTIGRAPHY BASED ESTIMATES OF SLEEP DURATION IN YOUNG CHILDREN WITH AND WITHOUT A SLEEP LOG ARE COMPARABLE

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Introduction: Actigraphy is often used for assessment of activity, sleep-wake, and circadian functioning. While guidelines exist for clinical use of actigraphy, this technology has also been adopted in large multicentre trials and longitudinal studies. One barrier to broader use has been the convention of referencing sleep-wake logs (typically in the form of a diary or pre-bed questionnaire) to identify sleep periods. This identification is often required by proprietary actigraphy software. However, this approach adds a subjective dimension to objective actigraphy, increases burden to participants, and may conflict with ecological/naturalistic assessment. We compared sleep log versus no-log approaches to sleep duration estimation in young children to determine the agreement.

Materials and methods: data were from 61 children aged 12-40 months recruited from 19 Early Childhood Education and Care (ECEC) services in Brisbane, Australia. Actigraphs (GeneActiv original) were worn on the non-dominant wrist of each child for 1-2 weeks. Data were sampled at 50Hz and processed with GGIR (R Language) open source software (Van Hees et al. 2018, version 1.5-24). This software uses an arm-angle criterion for sleep. GGIR provides five options for sleep time definition: 1) rely on sleep log (conventional), 2) use sleep log as a guide, 3) a 12 hour window centred on the least active 5 hours, 4) a heuristic algorithm based on distributional changes of the Z-angle, and 5) a user specified time window e.g., 6pm to 6am. Sensitivity analyses for each method were conducted across four sleep onset criteria and options were compared directly via Bland-Altman difference plots.

Results: Using the conventional method of relying on the sleep log and 5 minute sleep onset criteria as the baseline, the following bias was observed for the other measures: log as guide (+1.8%), 12 hour window on least 5 active hours (-2.7%), heuristic algorithm (-5.4%) and user specified time window (+2.6%). Sleep onset criteria had large effects on estimated sleep. Using 5 minutes as the baseline the following bias was observed for the conventional method that relies on the sleep log: 10 minutes (-23%), 15 minutes (-37%) and 20 minutes (-47%).

Conclusions: These data show that estimates of sleep duration generated with methods without reference to a sleep log were comparable to a conventional approach using a sleep log. However, the large variability in sleep depending on sleep onset criteria demonstrate sensitivity analysis should be performed. While a sleep log may provide qualitative information important for some types of studies, analyses of large-scale use of actigraphy may be efficiently conducted with reference to actigraphy data only. The comparability of these methods needs to be demonstrated with other accelerometry technologies and scoring algorithms, and certainly in other groups.

SLEEP ANALYSIS WITH SOMNO-ART SOFTWARE AS COMPARED TO SOMNOLYZER, A VALIDATED COMPUTER-ASSISTED SLEEP CLASSIFICATION, IN APNEIC PATIENTS AND HEALTHY CONTROLS: A VALID ALTERNATIVE?

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Introduction: In healthy subjects it was shown that the integrated analysis of heart rate and body movements during sleep with the Somno-Art software provides similar results to the evaluation of sleep architecture performed with the gold standard polysomnography (PSG) (Muzet et al., 2016). The aim of the current analysis was to confirm that the Somno-Art approach of sleep staging could discriminate sleep modulations observed in obstructive sleep apnea (OSA) patients as compared to healthy participants.

Materials and methods: PSG and Somno-Art recordings of 77 nights, 40 from young healthy participants (mean±SD age= 25±12 years), and 37 from OSA patients (mean±SD age=52±1 years), were analysed. PSG data were processed according to the American Academy of Sleep Medicine rules with the Somnolyzer software (Anderer et al., 2010). For each scoring software, extracted sleep parameters were compared between healthy young and OSA patients using unpaired Mann-Whitney U test.

Results: Somno-Art and Somnolyzer characterized similarly the specific sleep modulation due to apnea pathology: total sleep time (Somnolyzer: $p < 0.0001$, Somno-Art: $p < 0.05$), sleep efficiency (Somnolyzer: $p < 0.0001$, Somno-Art: $p < 0.001$) and REM sleep duration (Somnolyzer: $p \leq 0.0001$, Somno-Art: $p < 0.0001$) decreased significantly in OSA patients as compared to healthy participants. The differences observed for wake after sleep onset (Somnolyzer: $p < 0.0001$; Somno-Art: $p < 0.001$)), sleep onset latency (Somnolyzer: $p < 0.0001$; Somno-Art: $p < 0.05$) and REM sleep latency (Somnolyzer: $p \leq 0.01$; Somno-Art: $p \leq 0.01$) in OSA patients were revealed by both methods likewise.

Conclusions: In conclusion, this work provides evidence that, Somno-Art delivers promising results with respect to the calculated sleep parameters. At least in a between-group design the results obtained with Somno-Art are similar to the ones of standard PSG. Somno-Art is a new sleep scoring solution which propose a valid alternative to PSG in OSA patients and healthy controls.

THE DREEM2 HEADBAND AS AN ALTERNATIVE TO POLYSOMNOGRAPHY FOR EEG SIGNAL ACQUISITION, BREATHING AND HEART RATE MONITORING AND SLEEP STAGING IN HEALTHY SUBJECTS

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Introduction: Despite a high prevalence of sleep disorders, they remain largely unidentified and/or untreated with less than 20% of patients estimated to be accurately diagnosed and treated. The development of ambulatory technologies capable of monitoring brain activity during sleep longitudinally is critical to advancing sleep science and facilitating the diagnosis of sleep disorders. We introduced the Dreem2 headband (DH2) as an affordable, comfortable, and user-friendly alternative to polysomnography (PSG). The purpose of this pilot study was to assess the signal acquisition of the DH2 and the performance of its embedded automatic sleep staging algorithms compared to the gold-standard clinical PSG signals scored by 3 sleep experts.
Materials and methods: Twenty-five healthy subjects completed an overnight sleep study at home while wearing both a PSG and the DH2 simultaneously. We assessed 1) the EEG signal quality between the DH2 and the PSG, 2) the heart rate, breathing frequency, and respiration rate variability (RRV) agreement between the DH2 and the PSG, and 3) the performance of the DH2's automatic sleep staging according to AASM guidelines vs. 3 sleep experts manual scoring on PSG.
Results: We showed a strong correlation between the EEG signals acquired by the DH2 and those from the PSG, and the signals acquired by the DH2 enable monitoring of alpha (r= 0.75 ± 0.11), beta (r= 0.74 ± 0.14), delta (r = 0.78 ± 0.16), and theta (r = 0.63 ± 0.15) frequencies during sleep. The mean absolute error for heart rate, breathing frequency and RRV was 1.4 ± 1.9 bpm, 0.4 ± 0.2 cpm and 6.6 ± 3.0 %, respectively. Automatic Sleep Staging reached an overall accuracy of 84.5 ± 3.9% (F1 score : 83.1 ± 4.2) for the DH2 to be compared with an average of 86.0 ± 6.2% (F1 score: 86.1 ± 6.0) for the three sleep experts.
Conclusions: These results demonstrate the capacity of the DH2 to both precisely monitor sleep-related physiological signals and process them accurately into sleep stages. This device paves the way for high-quality, large-scale, longitudinal sleep studies.

YASA (YET ANOTHER SPINDLE ALGORITHM): A FAST AND OPEN-SOURCE SLEEP SPINDLES AND SLOW-WAVES DETECTION TOOLBOX

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YASA (Yet Another Spindle Algorithm) is a fast and open-source sleep spindles and slow-waves detection toolbox written in Python 3 and released under the BSD 3 license. YASA is based on state-of-the-art methods and provides several convenient features to integrate the detection of spindles and slow-waves as part of an analysis pipeline. Some of its main features include: efficient multi-channel detection, seamless integration with the most widely-used Python packages for EEG analysis and visualization (e.g. MNE, Visbrain), and built-in automatic rejection of pseudo-events based on machine-learning. In addition, YASA also extracts a collection of parameters to precisely describe the morphology of each detected spindles and/or slow-waves. YASA comes with an extensive documentation, which is available, together with its source code, on GitHub at https://github.com/raphaelvallat/yasa

CLASSIFICATION OF IN-BED MOVEMENTS USING A MATTRESS-BASED SENSOR ARRAY

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Introduction: Sleep related movements are used to investigate patho-physiology of sleep disorders. Periodic Limb Movements (PLMs), for instance, mostly occurs in the lower extremities and usually involves dorsiflexion of the ankle. Evaluation of sleep disorders is typically done through clinical polysomnography (PSG), occasionally accompanied by night-time video recordings. While PSG remains the most reliable and comprehensive tool for such assessments, the studies are intensive in terms of time, cost and labor. Certain motor indices might be underestimated due to the nature of PSG instrumentation, and for many individuals, these studies could be considered intrusive and uncomfortable. In this work, SleepSmart, a mattress-based sensing system composing of an 8x6 array of 3-D accelerometer sensors, was developed to provide time-series data for machine learning algorithms to classify simulated, in-bed movement activities.

Materials and methods: A study with 11 subjects was conducted. Subjects were asked to perform a predefined movement protocol on the SleepSmart mattress for 15 sets. Each movement set consists of 22 unique in-bed movements that were selected to simulate PLMs and movements that are common during sleep. Four learning algorithms were tested and compared. Random Forest (RF), Support Vector Machines (SVM), Naïve- Bayes (NB), and the k-Nearest Neighbor (k-NN) algorithms were used. The movements were classified into 8 classes: head, torso and limbs, left arm, right arm, left leg, right leg, both legs, both feet.

Results: The classification accuracy averaged across all subjects were 98.00%, 95.58%, 92.07%, and 85.77% for subject-dependent models, and 92.02%, 90.66%, 77.51%, and 72.18% for subject-independent models for the RF, SVM, NB and k-NN algorithms, respectively. In RF models, averaged recall and precision measures were 96.93% and 97.76% for subject-dependent models, and 90.18% and 91.56% for subject-independent models.

Conclusions: In this work, we have proposed a non-invasive sensor system and demonstrated the effectiveness of the mattress sensors in classifying in-bed movements using machine learning algorithms, while considering subject-dependent and subject-independent data sets. RF models showed the best classification performance, followed by SVM, NB, and k-NN models. Further studies need to be conducted to investigate the effect on classifier performances in different patient groups.

Technology/Technical
Board #360 : Poster session 2
EFFECT OF THE INTENSITY OF ROCKING MOVEMENTS ON NAP SLEEP

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Introduction: Rocking has been suggested as one of the most promising approaches on the way to non-pharmacological treatments for sleep disorders. However, studies on humans gave inconclusive results. An animal study testing different stimulation intensities (peak accelerations resulting from a combination of frequency and amplitude) showed that the proportion of time spent in NREM sleep increased at the cost of wake without a reduction of REM sleep when rocking with $0.79 m/s^2$, which is equivalent to $0.2 - 0.26 \, m/s^2$ in humans. This study set out to assess whether the sleep promoting effect of rocking movements is also stimulation intensity dependent in humans.

Methods: Afternoon nap data of 16 healthy young males (M_{age}: 24.1y , SD_{age}: 3.0y) was analysed. Side-to-side rocking motions along a pendulum trajectory were provided using the Somnomat bed. Polysomnography was recorded and scored according to AASM rules (20-s epochs). Sleep architecture during baseline (bed sound), low intensity ($a = 0.15 \, m/s^2$) and medium intensity ($a = 0.20 \, m/s^2$) stimulation naps ($n = 8$) or baseline, medium and high intensity ($a = 0.25 \, m/s^2$) stimulation naps ($n = 8$) was assessed. A linear mixed-effects model for interaction between experimental condition and stage on latency to or duration of a specific sleep stage, with participant as random factor, was compared to a null-model without the interaction term.

Results: Medium intensity rocking motions shortened the median latency to deep sleep by 2.8 min (n.s.), due to a shorter duration of stage N2 during movement (Med: 16.7 min) compared to baseline naps (Med: 21.5 min). A significant interaction[RMvS1] between stimulation intensity and stage on duration of sleep stage was observed in the low intensity group. With the amount of time spent in deep sleep increasing from 12.9% of total sleep period at baseline, to 30.7% with low and 35.7% with medium intensity stimulation. In the high intensity group no significant interaction between stimulation intensity and stage was observed, most likely because a higher proportion of deep sleep was already observed in baseline naps (38.3%). However, similar to the other group participants spent 29.5% in deep sleep during medium intensity stimulation, with an increase to 39.3% with high intensity stimulation.

Conclusion: In line with previous studies on the effect of rocking motions on sleep, we observed that rocking motions increased the time spent in deep sleep and might facilitate the transition from wake to sleep. Moreover, the effect seems to be stimulation intensity dependent with the highest percentage of deep sleep observed in the group with most intense stimulation. This is in line with findings in rodents, but was not yet observed in humans. This finding might explain why studies in humans, which all had different stimulation settings, reported varying effects of rocking on sleep. Future studies in this field should explore higher intensity stimulation, to optimize effects of rocking.

CHEAP OPEN HARD- AND SOFTWARE FOR OPEN- AND CLOSED-LOOP STIMULATION IN 16-CHANNEL PSG

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Introduction: Sleep is a global phenomenon, its study happens locally. But many researchers in poorer regions of the world cannot afford research-grade sleep recording systems. This hinders them to create and reproduce even simple experimental setups to benefit sleep research. Commercial systems often do not work everywhere and are too expensive, but mostly they also suck: they suck our time, our grant money and our expertise. Importantly, they hinder our ability to practice open-science, i.e. to share, replicate and improve our work openly. Thus cheap and open solutions to conduct sleep research matter. While cheap and open hardware for polysomnography exists, we lack proper setups and open software to conduct cutting-edge sleep research. We created an open-science solution for 16-channel polysomnography that includes the software to record and run stimulation protocols during sleep, called COsleep.

Materials and methods: COsleep was coded in python as an open-source software to drive any 8- or 16-channel OpenBCI Cyton system. It records sleep using flexible montages, displays signals, and handles stimulation protocols, all stored in EDF/BDF and CSV data formats. COsleep runs out-of-the-box on any PC with 2 USB ports from a bootable debian-linux image flashed to an USB stick. Various sleep stimulation protocols are implemented for auditory closed- and open-loop stimulation. We parsimoniously tested feasibility and validity of the system on a closed-loop targeted memory reactivation protocol that presents word stimuli during the down- to up-state transition of slow waves during an afternoon nap of 9 participants. COsleep timed the stimuli considering hard- and software delays from brain-to-ear over in-ear buds on the audio jack of a standard laptop. Stimulation onset and termination were manually guided by automatic arousal (dis)engagement algorithms. Loudness of stimuli was controlled with precisely reference to participant's hearing thresholds. Polysomnography setup was created with the OpenBCI device in accordance with the AASM manual including EOG, EMG, ECG, 2 mastoids and up to 11 EEG channels. Setup was housed safely in a plastic box and powered by a 5V-USB-power pack (20'000 mAh capacity) to wirelessly record several meters away. Signal quality was assessed by experienced sleep scorers using SleepTrip.

Results: The Hardware setup was easy to maintain and quick to assemble by a non-technical researcher for less than $500 in parts. The system reliably recorded naps, and test recordings up to 24-hours while draining less than 80 mA/h (~200 hours recording per charge). Slow-wave targeting was successful with ERPs replicating previously published results, including the spectral composition of the signal relative to stimulus onset. Signal quality matched quality of >20-times more expensive commercial systems.

Conclusions: We demonstrated the feasibility to reproduce cutting-edge sleep research protocols using a system based only on open software and hardware. The system was cheap, reliable, safe, flexible and AASM-conform. Thus our solution enables global-scale access to quantitative sleep research using open-science practices.

A SLEEP LAB AT HOME: AN EVALUATION OF TECHNOLOGY TO PROVIDE ACCESSIBLE AND RELIABLE AT-HOME SLEEP ASSESSMENT OF CHILDREN

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Introduction: The BC Children's Hospital (BCCH) sleep lab is the only pediatric sleep assessment in British Columbia. The lab can perform up to 400 tests/year. The waiting time is >1 year. 30% of families live outside of Vancouver, over 2 hours away. There is an urgent need for accessible and reliable sleep assessment tools for children in BC. The objective of this project is to identify and validate sleep assessment technology to screen for Obstructed Sleep Apnea (OSA) in the patient's home.

Materials and methods: A three phase methodology has been implemented: (1) A scoping review of technologies available for at-home sleep studies; (2) Validation of portable devices in children compared with in-hospital polysomnography (PSG); (3) Pilot testing of the validated devices for use in patient homes. Children are being recruited from referrals for sleep assessment at BCCH. Following consent, each subject is assessed by full night PSG in the lab with the in-home portable device recording concurrently. The in-home device and instructions are given to the participant's parent/guardian and a subsequent at-home study with the in-home device is performed within a week. This two-night study protocol will allow for assessment of performance reliability, robustness over time, usability, and acceptability for the portable device at home.

Results: Eight children (2 females, 6 males) have been recruited (average age 6.11 years). The initial in-home device tested is the StarDust II, (Philips Respironics). This measures oxygen saturation, heart rate (from pulse plethysmography), airflow (nasal pressure), respiratory effort (belt, stretch sensor) and body position (supine or non-supine). 80% of parents found the StarDust II easy to operate. The nasal prong pressure sensor was uncomfortable for 60% of the children. Oxygen saturation, heart rate and body position were comparable between the StarDust and PSG (mean SaO2% during sleep - PSG = 95.83%, StarDust = 96.80%, t-stat = -1.103; p = 0.306 (two-tail t-test with unequal variances at 0.05 significance level)). However, apnea and hypopnea events were significantly overestimated by the StarDust (mean apnea hypopnea index (AHI) - PSG = 4.33, - StarDust = 16 (t-stat = -2.5, p = 0.037)).

Home sleep monitors developed for adults have a variety of problems when used in children. Children tend to move more than adults resulting in dislodgement of sensors. Sleep patterns in children are less predictable, resulting in frequent periods of waking. The overestimation of AHI by the Stardust may be due to detachment of nasal prongs, movement artifact or inability to remove wake periods from the study scoring. As the project progresses, these will be evaluated further. We also plan to evaluate other home sleep monitors that are currently used for adults to assess suitability for use in children.

Conclusions: The Sleep Lab At Home is leveraging the BCCH's sleep lab infrastructure to improve accessibility of pediatric sleep assessment and create a platform for ongoing patient involvement in sleep assessment research. Testing with more portable devices is required to validate the feasibility of at-home sleep assessment for children.

UTILITY OF SOMNOLYZER G3 IN JAPANESE SLEEP CLINIC

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Introduction: Somnolyzer (SL)-G3, (Philips Japan,Tokyo) was developed as higher performance auto analyze system for polysomnography than conventional software. Some research about SL-G3 has been reported its applicability in clinical routine. However, no study about usage of SL-G3 in Japanese clinical setting was reported. The aim of this study was to evaluate the utility of SL-G3 by the assessing agreement rates, reliability, and time consumption in Japanese sleep clinical setting.

Materials and methods: The study samples for scoring were 20 polysomnograph data from consecutive outpatients at Gifu Mates Sleep Clinic with seeking treatment for sleep apnea. All data were scored via two procedures by 4 certified polysomnographic technologists of the Japanese Society of Sleep Research. One procedure was single manual scoring (MS), the other procedure was expert reviewing (ER) by the technologists after automatically scoring via SL-G3. The intervals between MS and ER of each sample was more than 2 weeks. The Pearson product-moment correlation coefficients between any pairwise set of technologists, and intraclass correlation coefficient (ICC) derived from MS, and ER were computed to assess utility of SL-G3. Furthermore, time for scoring between two methods were compared.

Results: The Pearson product-moment correlation coefficients of N2, N3 derived from ER were higher than those of MS (both $P = 0.031$), while any other PSG parameters were not difference between two methods. ICC of only N3 derived from ER was higher predominantly than that of MS (0.694 versus 0.983). Time for scoring by ER was shorter than MS (28.8min versus 41.5min, $P < 0.001$).

Conclusions: Using of SL-G3 could provide accurate PSG data, and moreover save labor for scoring in Japanese clinical practice.

DEVELOPMENT OF TABLET-SHAPED INGESTIBLE THERMOMETER WITH GASTRIC ACID BATTERY FOR DAILY MONITORING OF CORE-BODY TEMPERATURE AND ITS RHYTHM

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Introduction: Daily monitoring of core-body temperature and its rhythm is helpful for health care such as management of an inner-body clock (circadian rhythm) or early detection of illness e.g. a type of sleep disorders, hypothermia, depression, infection and dementia.

Various measurement methods have been proposed for measuring core body temperature. A rectal temperature measured by inserting a thermal probe into the anus is regarded as a balancing method with easiness and reliability, and thus practically utilized in a medical field. However, this is even unpractical for a daily measurement.

An ingestible thermometer is one of the promising solutions. However, the general devices use button batteries, which is a significant risk causing severe damages to mucous membranes due to discharge currents, toxic electrolytes or electrodes.

Thus, we have developed ingestible core-body thermometer with a gastric acid battery. This study reports on the prototyping of the tablet-shaped device and the success of proof of concept through an *in vivo* telemetry .

Materials and methods: A pair of Mg and Pt plates was chosen as the negative and positive electrodes of the gastric acid battery, respectively. These plates and electrical components for the system were mounted on two print circuit boards (PCB)s connected with a flexible substrate, and compactly packaged with a resin. Consequently, a tablet-shaped device of diameter 9 mm and height 7 mm was prototyped.

The device was initially swallowed by a dog. After that, the dog was put to sleep by use of a sedating agent. pH of the gastric acid juice measured 1.4 by a commercially-available pH sensor. Then, the telecommunication signal from the device in the stomach was caught by a commercially-available magnetic loop antenna. The distance between the device and the antenna was roughly estimated to be 20 cm.

Results: The device successfully operated in the stomach of a dog due to a gastric acid power generation, measured the temperature, and transferred the data to a loop antenna as a receiver outside the body via magnetic-field coupling telecommunication. The existence of the device in the stomach was also confirmed by X-ray computer tomography. This achievement proved the way to realizing a safe and ingestible core-body thermometer for daily use.

Conclusions: In this study, we prototyped the tablet-shaped ingestible core-body thermometer based on the gastric acid battery with the Mg and Pt electrodes. All electrical components on the circle-shaped PCBs and coil were packaged with the epoxy resin. The *in vivo* telemetry based on magnetic-field coupling telecommunication between the loop antenna and device in the stomach of the dog was demonstrated successfully. We believe that this study provides a significant contribution towards the realization of small and safe ingestible devices for daily use.