

Canadian Sleep  
Society



Société Canadienne  
du Sommeil

# CANADIAN SLEEP SOCIETY CONFERENCE

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ABSTRACTS

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## YOUNG INVESTIGATORS SYMPOSIUM

Sunday, April 30, 2017 10:30 am – 12:00 pm

Listed in Presentation Order:

- P80:** **Sara Pintwala**  
*Activation of glutamate cells in the subcoeruleus nucleus triggers cataplexy-like attacks in wild-type mice.*
- P98:** **Matthew Tucker**  
*Spatial and declarative learning and memory in children evaluated for sleep disorders*
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*Waking EEG connectivity changes differently in young and Elderly adults after a total night of sleep loss*
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*Naps containing rem sleep increase stimulus-preceding negativity in anticipation of threat judgements*
- P109:** **Thomas Lehoux**  
*Nonrem sleep EEG slow waves in children with autism*
- P101:** **Cheryl Laratta**  
*The impact of air pollution on obstructive sleep apnea and systemic inflammation*
- P74:** **Veronica Guadagni**  
*Left anterior insula activity and functional connectivity are modulated by sleep quality in an emotional empathy task*
- P79:** **Mazen El-Baba**  
*Dynamic functional connectivity analysis reveals temporal features that vary between wake and stage 2 sleep*
- P93:** **Clo Blanchette-Carrre**  
*Effects of transcranial alternating current stimulation (tacs) on the nap dreams of frequent lucid dreamers, frequent nightmare sufferers and controls*
- P54:** **Antoine Benoit**  
*Spectral EEG correlates of emotional valence during rem sleep mentation*
- Oral:** **Kaiyin Zhu**  
*Effect of head position on the apnea-hypopnea index in patients with obstructive sleep apnea*
- P50:** **Kenneth Anujuo**  
*The contribution of short sleep duration to ethnic differences in cardiovascular disease - the helius study*

## POSTER LIST BY TOPIC

### Basic Neuroscience

#### P1

#### The role of the translational repressors 4E-BP1 and 4E-BP2 in sleep regulation

Areal, Cassandra <sup>1,2</sup>; Cao, Ruifeng <sup>3</sup>; Sonenberg, Nahum <sup>4</sup>; Mongrain, Valrie <sup>1,2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Several studies support an implication of synaptic proteins in sleep regulation. Nonetheless, little is known about the role of the protein synthesis machinery in sleep. 4E-BP1 and 4E-BP2 are translational repressors, which once phosphorylated by mTORC1, release inhibition of protein synthesis. 4E-BP1 is highly expressed in the suprachiasmatic nucleus and has been implicated in circadian rhythms. 4E-BP2 that is widely expressed in the brain is critical for memory and plasticity. In addition, 4E-BP2 knockout (KO) mice exhibit autistic behaviors. However, there is no data on their implication in sleep regulation. Hence, the aim of this study is to verify the contribution of 4E-BP1 and 4E-BP2 in sleep regulation. Methods: Wild-type (WT), 4E-BP1 and 4E-BP2 KO mice were implanted with electroencephalography (EEG) and electromyography (EMG) electrodes and recorded continuously for 48 h including a 24-h baseline followed by a 6-h sleep deprivation (SD) starting at the beginning of the second day. Behavioral states were assessed based on EEG/EMG traces. Changes in mRNA expression after SD in the cerebral cortex were assessed by qPCR in the same three genotypes. Results: 4E-BP1 KO mice exhibit less wakefulness during the night without changes in sleep fragmentation. Changes in EEG activity were observed for wakefulness and NREM sleep, including less overall delta activity during baseline. However, after SD, the sleep of 4E-BP1 KO mice is similar to WT mice. Analyses for 4E-BP2 KO mice and of the gene expression response to SD are underway. Because 4E-BP2 is more expressed in the brain, a stronger phenotype is expected. Conclusion: Our findings support a role for the protein synthesis machinery in the regulation of sleep and wakefulness. More precisely, our results indicate that the translational repressor 4E-BP1 regulates vigilance state duration and EEG activity.

## P2

### GSK3 responds to sleep loss and is involved in sleep regulation

O'Callaghan, Emma<sup>1,2</sup>; KHLGHATYAN, Jivan<sup>3</sup>; Lu, Emilie<sup>1</sup>; BEAULIEU, Jean Martin<sup>3</sup>; Mongrain, Valerie<sup>1,2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Sleep is required for normal brain function, and sleep loss detrimentally impacts cognitive functions and brain health. Moreover, most psychiatric conditions are characterized by sleep disturbances. However, molecular mechanisms underlying sleep regulation and disease-associated sleep disturbances are poorly understood. Glycogen Synthase Kinase 3 beta (GSK3) plays roles in the neuronal plasticity thought to underlie sleep, and is associated with cognitive functions and mood. We investigated how sleep loss impacts GSK3 level in the brain and assessed the contribution of GSK3 to sleep regulation. Methods: 1) Protein levels of GSK3 and phosphorylated-GSK3 (pGSK3) were examined in the murine cortex by Western Blot following a 6-h sleep deprivation (SD) or undisturbed baseline sleep. 2) Knockout (KO) of GSK3 was performed using the CRISPR/Cas9 system delivered by AAV viral vectors (one encoding Cas9 nuclease and one guide RNA targeting Gsk3 gene), in two cerebral cortex locations above which electrodes for electroencephalography (EEG) were implanted in adult male mice. Littermates were injected in parallel with a Cas9 coding AAV virus and a control AAV. EEG recordings were performed followed by vigilance state identification and spectral analysis to quantify vigilance state duration and quality. 3) The role of GSK3 in the EEG response to SD was simultaneously assessed in CRISPR/Cas9 KO and control animals. Results: 1) A 6-h SD increased levels of GSK3 and pGSK3 in the mouse cerebral cortex. Additionally, SD tended to decrease the pGSK3/GSK3 ratio suggesting increased GSK3 activity. 2) Preliminary EEG analysis suggests that KO of GSK3 increases the duration of wakefulness and decreases the duration of non-rapid eye movement sleep, in addition to increasing sleep intensity. 3) The effect of GSK3 KO on recovery following SD is being analyzed. Conclusion: These data suggest that GSK3 responds to wakefulness and sleep history, and participates in the regulation of sleep.



### P3

#### Working memory but not decision making deteriorates after cumulative sleep restriction

Santisteban, Jose Arturo<sup>1,2</sup>; Brown, Thomas<sup>1,3</sup>; Neibert, Mariana<sup>2</sup>; Gruber, Reut<sup>1,2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Eighteen percent of young adults are sleep deprived. Sleep deprivation leads to significant neurobehavioral impairments and compromises job and academic performance and driving safety. Data is scarce and contradictory regarding the impact of cumulative sleep deprivation on neurobehavioural functioning (NBF). The objective of this study was to assess the impact of cumulative sleep restriction on the NBF of young adults. Methods: Participants Sixty-five healthy participants (ages 18-34). Design A double-blind, placebo controlled, randomized trial. Participants were randomized into experimental and placebo conditions. Each participant completed a period of baseline protocol and an experimental period. The experimental period lasted 6 nights and had 2 conditions: 1) sleep restriction condition participants were asked to restrict their sleep by one hour per night 2) placebo condition- participants were asked to use a lamp which had no clinical effects for 30 minutes during day time. NBF was assessed at baseline (Day 1) and following sleep manipulation (Day 12). Measures Sleep duration was assessed using actigraphy, an accelerometer that measures sleep objectively based on movement. NBF was measured using the Cambridge Neuropsychological Test Automated Battery Spatial Span task and the Cambridge Gambling Task for working memory and decision-making, respectively. Results: Poorer performance on spatial span task was found in the experimental condition compared to the placebo condition, controlling for baseline spatial span length, sex, age, sleep efficiency during experimental week, baseline sleep duration, and chronotype, ( $F(1,49)=5.18$ ,  $p < 0.05$ ). No significant effects for sleep restriction were found on decision making measures when comparing the experimental condition to the placebo condition. Conclusion: Young adults performance on spatial working memory task deteriorated following cumulative sleep deprivation whereas their performance on decision making task was not affected. The present study indicates that sleep deprivation has a differential impact on the NBF of young adults.

## P4

### A dedicated brainstem circuit controls REM sleep

Fraigne, Jimmy <sup>1</sup>; Torontali, Zoltan <sup>1</sup>; Thomasian, Aren <sup>1</sup>; Li, Daniel <sup>1</sup>; Peever, John <sup>1</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** It remains unclear which neural circuit triggers REM sleep and REM sleep atonia, but glutamate neurons in the subcoeruleus (SubCGLUT) are hypothesized to control REM sleep as well as REM sleep atonia by activating GABA neurons in the ventral medulla (vMGABA). Here, we aimed to determine how optogenetic activation and inhibition of the SubCGLUT-vMGABA circuit impact REM sleep and REM sleep atonia. To control the neuronal activity of the glutamatergic SubC neurons, we bilaterally infused 200nL of an adeno-associated viral vector (AAV) containing either a light-sensitive excitatory opsin (AAV-EF1-DIO-ChETA-eYFP) or a light-sensitive inhibitory opsin (AAV-EF1-DIO-ARCH-eYFP) or an inert control protein (AAV-EF1-DIO-eYFP) into the SubC of 33 Vglut2-cre mice. Animals were instrumented for EEG and EMG recordings. SubCGLUT neurons were activated or silenced specifically during REM sleep. In another set of animals, the SubCGLUT-vMGABA circuit was inhibited continuously during REM sleep at the level of the vM. Only animals that had histological verification of eYFP expression in the SubC region and projection fibers in the vM were used for analysis. We used Vglut2 fluorescent in situ hybridization and/or Vglut2-tdTomato expressing mice to confirm the specificity of our virally-mediated opsin expression. We found that activation of SubCGLUT neurons increased the length of REM sleep episodes by 773% (n=5, p<0.01), and further decreased motor activity during REM sleep (n=5, p<0.01). In contrast, inhibition of SubC cells shortened the duration of REM sleep episodes (n=6, p<0.01), and increased overall motor activity by 26% (n=5, p<0.01). Importantly, silencing SubCGLUT transmission at the vM (SubCGLUT-vMGABA) increased overall motor activity during REM sleep (n=3, p<0.05) without affecting REM sleep amounts (n=3, p=0.639). These results support the hypothesis that neurons in the SubCGLUT-vMGABA circuit control both REM sleep and REM sleep atonia.

## P5

### Cataplexy produces muscle paralysis by recruiting the REM sleep circuit

Torontali, Zoltan <sup>1</sup>; Fraigne, Jimmy <sup>2</sup>; Peever, John <sup>3</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Cataplexy is the uncontrollable onset of skeletal muscle paralysis during wakefulness and is a debilitating symptom of the sleep disorder narcolepsy. Cataplexy is thought to result from the intrusion of REM sleep paralysis into wakefulness. The subcoeruleus nucleus (SubC) is hypothesized to be the core circuit that generates REM sleep paralysis. Here, we found that cataplexy is exacerbated by activating the SubC in narcoleptic mice and can produce cataplexy-like attacks in wild-type mice. We used chemogenetics to either activate or inactivate the SubC in both wildtype and narcoleptic mice with recording both encephalogram and electromyogram activity to define behavioural states. We found that SubC activation triggered cataplexy-like attacks in wild type mice and that SubC activation promoted cataplexy in narcoleptic mice, whereas its inhibition decreased these attacks. Our results support our working hypothesis that cataplexy is triggered by recruiting the brainstem circuitry that underlies REM sleep paralysis. Support: This research was funded by the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Ontario Graduate Scholarship (OGS).



## P6

### Spontaneous Activity Networks Present In Sleep

Houldin, Evan <sup>1</sup>; Ray, Laura <sup>1</sup>; Owen, Adrian <sup>1</sup>; Fogel, Stuart <sup>2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Although there is an extensive literature on spontaneous activity networks (SANs) present in the waking state, with select studies examining the impact of sleep on a subset of wake SANs (e.g. Horovitz, 2009, PNAS), no studies to date have fully characterized the repertoire of SANs present in sleep, with an aim to identify potentially new SANs. Although the function of SANs is currently undetermined, they are thought to support cognitive processing during wake (Smith, 2009, PNAS). Past studies have examined the impact of sedation (Boveroux, 2010, Anesthesiology) and disorders of consciousness on SANs (Boly, 2009, HBM), indicating the persistence of SANs such as the default mode network. Unlike these conditions however, sleep is a healthy alternate functional mode of the brain, one that may be supported by correspondingly unique SANs. This study examined whether sleep is accompanied by the presence of SANs different from the canonical waking set. Data from a combined EEG/fMRI sleep study was examined in each of wake, N2, N3 and REM states. 35 healthy subjects (20 female, mean age 23.7, without sleep disorders) were recruited for an evening study and asked to sleep naturally in the scanner for approximately 90 minutes, with no prior sleep deprivation. A separate wake resting state scan was also collected immediately prior to the sleep scan. Sleep scoring of the EEG data was used to classify the fMRI data according to each sleep stage. Independent component analysis was then performed on the datasets for each sleep stage and the resulting independent components were compared with spatial templates derived from a separate wake SAN study. No new SANs were discovered in any sleep stage, suggesting that the repertoire of SANs present in wake comprises the full set. Further, this suggests that sleep functions are subserved by unique interactions between the canonical SANs.

## P7

### Frequency analysis and modeling of Evoked Response Potentials for wake-like and sleep-like states in cultured neural networks

Xue, Mengran <sup>1</sup>; Taishi, Ping <sup>2</sup>; Roy, Sandip <sup>1</sup>; Krueger, James M. <sup>2,1</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Evoked response potentials (ERP) reflect the functional state of brain networks. In vivo, ERP frequency content during sleep as compared to waking, has an amplified low-frequency content. Preliminary data indicate that sleep regulatory substance interleukin-1 beta (IL1) induces a similar amplification of low-frequency content in vitro. We develop generative mathematical model for the in vitro ERP signal. Methods: Co-cultures of neurons/glia derived from 1-day old C57BL6 mice were grown on multi-electrode arrays as described by Jewett et al Eurp. J. Neurosci. 2015. Recordings were taken after the addition of 0.0 or 0.1 ng IL1 s on day 15. Electrical-induced ERPs were calculated by signaling averaging all responses greater than 2 standard deviations above baseline noise levels. Frequency content of the averaged ERP was calculated by Fast Fourier Transform (FFT). Models were fit to the averaged ERP data to minimize the integrated-squared error between the model prediction and the data. Results: The ERP with IL1 had ~20dB higher delta-wave amplitudes compared to samples without IL1 added. The accentuation of the low-frequency band reflects the more common occurrence of larger-amplitude biphasic evoked responses when IL1 is added. The frequency- and time- domain characteristics of the ERPs together suggest a third-order linear transfer model for the evoked response with and without IL1. The average ERPs with and without IL1 exhibited a common set of modes (time constants), but nevertheless reflect an altered input-output response. Specifically, a linear transfer function with three poles is employed to match the trajectory of one ERP signal. The best fit models are as follows, for the with and without IL1 cases, respectively:  $H(s)=(-700s-30)/(s^3+6s^2+12s+8) e^{(-0.1s)}$  and  $H(s)=(-50s+330)/(s^3+6s^2+12s+8) e^{(-0.3s)}$ . The poles of both transfer functions (the denominators) are the same while the zeros (the numerators) are distinct from each other. Support: NIH/NINDS NS025378.

## P8

### Evoked Response Potentials are attenuated in mice lacking the interleukin-1 receptor accessory protein.

Sahabandu, Dinuka <sup>1</sup>; Taishi, Ping <sup>2</sup>; Roy, Sandip <sup>1</sup>; Krueger, James M. <sup>1,2</sup>

<sup>1</sup>Washington State University- Pullman, <sup>2</sup>Washington State University- Spokane

**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Interleukin-1 (IL1) is a well characterized sleep regulatory substance. IL1 signals in part via a neuron-specific IL1 receptor accessory protein (AcPb). Mice lacking AcPb have attenuated sleep homeostasis after sleep deprivation. Sleep- and wake-like states occur in neuronal/glia co-cultures grown on multi-electrode arrays (Jewett et al Eurp. J. Neurosci. 2015). We now characterize evoked response potentials (ERPs) in cultured cells from wild type (WT) and AcPb knockout (KO) mice. In animals, sleep ERPs are larger than during waking. Methods: Co-cultures of neurons/glia derived from 1-day old AcPbKO and WT mice were grown on multi-electrode arrays as described by Jewett. Recordings were taken on culture days 5, 10 and 14 and after the addition of 0.0, 0.01 or 0.1 ng IL1 to culture wells on day 15. To elicit ERPs, electrical stimuli began at the time of IL1 treatment. ERPs for individual electrodes were calculated by signal averaging all responses greater than 2 standard deviations above baseline noise levels. Results: ERP peak to peak voltages and energy increase 200-500% in cells from WT mice on days 10 and 14 compared to day 5. ERP peak to peak voltages and energy increase 125-250% in cells derived from AcPbKO mice on days 10 and 14 compared to day 5. On day 14 absolute ERP values were greater in WT cells than cells from AcPbKO mice. With the addition of IL1, ERP values in WT cells increased in response to 0.1 ngIL1 whereas they decreased in AcPbKO cells. Conclusions: ERPs in mature WT cells are of larger magnitude and are more responsive to electrical stimulation with or without the presence of IL1 than are cells lacking AcPb. AcPb plays a role in the expression of ERPs that parallel the attenuated sleep homeostasis in AcPbKO mice. Support: NIH/NINDS (USA) grants NS025378 and NS096250

## P9

### Brain transmembrane TNF signals upon soluble TNF receptor stimulation to inhibit evoked response potential amplitudes

Chen, Liangyu <sup>1,2</sup>; Sahabandu, Dinuka <sup>3</sup>; Taishi, Ping <sup>2</sup>; Roy, Sandip <sup>3</sup>; Li, Shuyi <sup>1,2</sup>; Gibbons, Cody M. <sup>2</sup>; Krueger, James M. <sup>3,2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Tumor necrosis factor alpha (TNF) can induce whole organism sleep, local unilateral intense sleep, sleep-like states within cortical columns (Churchill et al Neurosci 2008), and a deep sleep like state in neuronal/glia co-cultures in vitro (Jewett et al 2015 Eurp. J. Neurosci.). In brain, the dominate form of TNF is the 26kD transmembrane TNF (tmTNF). In sympathetic axons, the soluble TNF receptor (sTNFR) reverse signals via tmTNF. We determined whether the sTNFR, and if the absence of TNFRs, affected electrically-induced evoked response potentials (ERP) in neuronal/glia co-cultures using cells from wild type (WT) and double TNFR knockout (KO) mice. During sleep in vivo cortical ERPs are of greater magnitude than during waking. In vivo and in vitro neuronal/glia co-cultures, ERPs are enhanced by the soluble 17kD form of TNF which signals via the transmembrane TNFRs. Methods: Neuronal/glia co-cultures of cells from WT and double TNFR KO mice were prepared per Jewett et al and ERPs were determined on development days 5, 10, and 14, and on day 14 with and without the addition of 2 different doses of the sTNFR. Results: ERP peak to peak amplitudes were about 20% lower in the TNFR KO mice than in WT mice on culture days 10 and 14; on day 5 values were similar in cells from both strains. After addition of sTNFR to the cultures on day 14, ERP amplitudes and ERP energy were less in the cells derived from the TNFR KO mice than in those derived from WT cells. Conclusion: We conclude; the sTNFR, either by its absence or by the addition of exogenous sTNFR, affects the emergent network property, ERPs. Support: NIH/NINDS (USA) NS096250 and NS025378.

## P10

### **Synchronization and delta power are emergent network properties tailored by interleukin-1 receptor accessory proteins**

Nguyen, Joseph T. <sup>1</sup>; Taishi, Ping <sup>1</sup>; Sahabandu, Dinuka <sup>2</sup>; Jewett, Kathryn A. <sup>3</sup>; Roy, Sandip <sup>2</sup>; Krueger, James M. <sup>3,2</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction:Co-cultures of neurons and glia display sleep- and wake-like properties including sleep homeostasis (Jewett et al Eur. J. Neurobiol. 2015). Synchronization (SYN) of neuronal firing and slow wave (SW) delta power are measures used to characterize sleep in vivo; they also emerge within cultures as connectivity develops. Interleukin-1 (IL1), a well-characterized sleep regulatory substance, has several roles in brain connectivity. Within brain a neuron-specific IL1 receptor accessory protein (AcPb) expression is enhanced by sleep deprivation while the alternatively spliced gene product, AcP, which is found in almost all cells, is not (Taishi et al J. Appl. Physiol. 2012). Mice lacking AcPb have attenuated sleep homeostasis after sleep deprivation (Davis et al Br. Behav. Immun. 2015). Methods:In the current study, co-cultures of neurons/glia derived from 1-day old AcPb knockout (KO), AcPKO, and wild type (WT) mice were grown on multi-electrode arrays as described by Jewett. Recordings were taken on culture days 5, 10, and 14 and action potentials/sec (AP/s), a burstiness index (BI), SYN and SW power were determined. Results:During the first 4 days of culture APs occurred although the other measures were near background. By day 10, WT and AcPKO cells began firing more while AcPbKO cells did not. The rate of emergence and maximum values of the BI, SYN, and SW power were greatest in cells from AcPKO mice, less in cells from WT mice and lowest in cells from AcPbKO mice. Conclusions:The emergence of these network properties, which are used to define sleep in vivo and in vitro, is dependent on AcPb and AcP. Because AcPb is neuron-specific, the current data provide strong evidence for brain IL1 and its signaling mechanisms in sleep regulation.

**Submission Group** General Submission

## P11

### **Interleukin-1 enhances the burstiness of neuronal/glia co-cultures only when both isoforms of the interleukin-1 accessory protein are present**

Gibbons, Cody M. <sup>1</sup>; Nguyen, Joseph T. <sup>1</sup>; Taishi, Ping <sup>1</sup>; Sahabandu, Dinuka <sup>2</sup>; Jewett, Kathryn A. <sup>1</sup>; Roy, Sandip <sup>2</sup>; Krueger, James M. <sup>2,1</sup>

<sup>1</sup>Washington State University, Spokane, <sup>2</sup>Washington State University, Pullman

**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: The synchronization of electroencephalogram (EEG) electrical potentials, action potential (AP) burst-pause patterns, and EEG slow wave power are used to characterize sleep in mammals. Comparable measures are used to define sleep-like states in co-cultures of cortical neurons and glia in vitro (Jewett et al Eur. J. Neurobiol. 2015). In culture, AP burstiness (BI; burstiness index) increases after long periods of electrical stimulation-induced wake-like states suggesting a homeostatic sleep rebound in vitro. Further, optogenetic stimulation of cultured cortical cells enhances interleukin-1 beta (IL1) expression. IL1 is a sleep regulatory substance. For IL1 to signal it requires the IL1 receptor (R) and a receptor accessory protein. There is a neuron-specific IL1R accessory protein (AcPb) and an alternatively spliced accessory protein (AcP) which is found on most cell types including neurons. We determined the effects of exogenous IL1 treatment on the number of APs/sec and the BI in cell cultures obtained from wild type (WT), AcPb knockout (KO), and AcPKO mice in vitro. Methods: Co-cultures of neurons/glia derived from 1-day old AcPbKO, AcPKO, and WT mice were grown on multi-electrode arrays as described by Jewett et al. After one hour of acclimation, cells were treated with 0.0 or 0.01 ng IL1. After the additions, cells were recorded for 1hr and APs/sec and BI were determined. Results: The 0.01 ng IL1 dose doubled the number of APs/sec for all cell types across the entire hour recording period compared to the control 0.0 ng IL1 dose. In contrast, IL1 enhanced the BI only in WT cells. Conclusion: IL1 increases the number of APs and can do so without AcP or AcPb. The BI, an emergent network property, requires the presence of both AcP and AcPb. Support: NIH/NINDS (USA) NS025378 and NS096259



## P12

### **Interleukin-1 enhances delta wave power in neuronal/glial co-cultures of wild type cells but not in cells lacking the neuron-specific IL1 receptor accessory protein**

Nguyen, Joseph T. <sup>1</sup>; Taishi, Ping <sup>2</sup>; Sahabandu, Dinuka <sup>3</sup>; Gibbons, Cody M. <sup>2</sup>; Jewett, Kathryn A. <sup>2</sup>; Roy, Sandip <sup>3</sup>; Krueger, James M. <sup>2,3</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Synchronization (SYN) of electrical potentials and high amplitude slow wave (SW, delta) waves are cardinal features of non-rapid eye movement sleep. SYN and SW power also characterize sleep-like states in neuronal/glial co-cultures (Jewett et al Eur. J. Neurobiol. 2015). Interleukin-1 beta (IL1) is well-characterized as a sleep regulatory substance; e.g. IL1 promotes sleep in vivo. A neuron-specific IL1 receptor accessory protein (AcPb) is required for full expression of sleep homeostasis in vivo and emergence of SYN and SW power in vitro. AcPb expression is enhanced by sleep deprivation while the alternatively spliced gene product, AcP, which is found in almost all cells, is not (Taishi et al J. Appl. Physiol. 2012). We determined whether exogenous IL1 treatment of cells from wild type (WT) and AcPb knockout (KO), and AcPKO mice alters SYN and delta power in vitro. Methods: Co-cultures of neurons/glia derived from 1-day old AcPbKO, AcPKO, and wild type (WT) mice were grown on multi-electrode arrays as described by Jewett et al. After one hour of acclimation, cells were treated with 0.0, 0.01 or 0.1 ng IL1. After the additions, action potentials, a burstiness index (BI), SYN, and SW power were recorded for 1 hr. Results: The 0.1 IL1 dose, but not the 0.01 dose, enhanced SYN and SW power across the hour recording in WT cells. In contrast, in AcPbKO cells were not responsive to IL1. AcPKO cells exhibited slightly enhanced SYN after both IL1 doses, but SW power was enhanced only after the 0.01 dose but not after the 0.1 IL1 dose compared to the 0.0 dose. Conclusions: IL1 promotes SYN of potentials and enhancement of delta power in neuronal/glial tissue cultures. Neuron-specific AcPb is required for these actions.

## P13

### Study of REM sleep coherence in cognitively healthy elderly

Lafreniere, Alexandre <sup>1,2</sup>; Brayet, Pauline <sup>3,2</sup>; Petit, Dominique <sup>2</sup>; Gagnon, Jean-Francois <sup>3,2</sup>; Gosselin, Nadia <sup>1,2</sup>; Lina, Jean-Marc <sup>2</sup>; Carrier, Julie <sup>1,2</sup>; Montplaisir, Jacques <sup>2,1</sup>

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Aging is associated with modifications in waking electroencephalographic (EEG) coherence, a measure of cerebral functional connectivity. EEG coherence in the alpha frequency band was reported to be lower in rapid eye movement (REM) sleep than during wakefulness in young individuals. The aim of this study was to compare EEG functional connectivity in REM sleep and in wakefulness in a group of elders with normal cognition. Methods: Thirty-two subjects without cognitive impairment (10 F; mean age 63.7 ± 6.6 years) underwent a neuropsychological evaluation, a night of polysomnography and a resting state EEG recording with 14 EEG electrodes. Imaginary coherence analyses were performed on manually selected artefact-free sections in both REM sleep and resting wakefulness. Four frequency bands (delta, theta, alpha and beta) were analysed. REM sleep and wakefulness (Fisher transform) were assessed with a Welch's t-stat. Non-parametric test on the max-stat and a permutation resampling allowed to account for multiple comparisons (between pairs of electrodes) in a false discovery rate like thresholding ( $p < 0.01$ ). Results: A global decrease of imaginary coherence was found for the alpha band in REM sleep compared to wakefulness. For delta and theta bands, imaginary interhemispheric coherence was lower in frontal areas (between F3-F4-F7-F8) but imaginary intrahemispheric coherence (between F3-C3-T5 and F4-C4-P4) was higher in REM sleep compared to wakefulness. Conclusion: REM sleep and wakefulness show robust differences in functional connectivity in elderly individuals with normal cognition. Future analyses will determine how these differences in coherence are associated to cognitive status in aging.

## P14

### Transcranial Alternating Current Stimulation (TACS) as a tool to entrain spindles during sleep in older individuals

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**TOPIC:** Basic Neuroscience

**Abstract Description** Objectives: NREM sleep markers like sleep spindles are crucial for brain plasticity and their density, amplitude and duration decrease in aging. Few studies were able to entrain NREM sleep oscillations using transcranial alternating stimulation (TACS) and to enhance sleep-dependent memory consolidation. This pilot study aimed to entrain sleep spindles using TACS in older individuals. Methods: Eighteen older (60-75yo; mean: 64yo) healthy participants came to the laboratory for polysomnographic recording of two counterbalanced naps with and without TACS (STIM and SHAM). Fourteen participants completed the study, as four participants were excluded because of insufficient sleep in one of the naps. In the STIM condition, one-sec bursts of TACS oscillating at 14Hz with a random delay between 4 and 10 sec., were applied bilaterally on central (C3, C4) locations for four-minute. Each stimulation periods were followed by two-minute without stimulation to allow the scoring of the EEG. Intensity of the stimulation was adjusted just below each individual sensation threshold (min.: 0,04mA; max.: 1mA). Parameters for the SHAM condition were exactly the same, except that TACS was turned on only one second at the beginning of the nap. The participants were blind to the conditions. After selecting EEG signals free of TACS artefacts, spindles were automatically detected on F3 and Cz. Differences in spindle characteristics between the two conditions (TACS, SHAM) were computed using paired T-tests. Results: In comparison with SHAM stimulation, TACS increased spindle density ( $p=0,053$ ) in Cz derivation only. No significant effect was found for spindle duration, frequency and amplitude in Cz. No significant effect was observed in Fz derivation. Conclusion: TACS was able to locally enhance spindle density during a nap in a small sample of older participants. Whether this enhancement in sleep spindle density is linked to improved sleep-depend consolidation still needs to be evaluated.

## P15

### **Arousal and Respiratory Control Circuit Responses to Hypercapnic Stress Require the Recruitment of the Locus Coeruleus to Expand the Dynamic Range of the Core Network**

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**TOPIC:** Basic Neuroscience

**Abstract Description** Changes in blood gases can elicit a coordinated response from the respiratory and arousal control networks, which may rely on connecting-hubs joining these networks that control the responses of both circuits to shared stressors. The CO<sub>2</sub>-responsive locus coeruleus (LC) implicated in respiratory and sleep-wake regulation may be such a connecting hub. We used unilateral microdialysis to pharmacologically inactivate the LC in freely-behaving rats (n=13) instrumented to record sleep-wake states and respiratory muscle activities. The GABA<sub>A</sub> agonist muscimol (50M) was microperfused into the LC under normocapnia and hypercapnia (7% inspired-CO<sub>2</sub>). Hypercapnia had a wake-sustaining effect (shifted the distribution of wake bout lengths from short to long) and a wake-inducing effect (shifted the distribution of non-rapid eye movement (NREM) bout lengths from long to short). LC inhibition did not affect time spent awake under normocapnic-conditions; however, muscimol microperfusion reduced the hypercapnia-induced increase in wake time by 48% by preferentially blocking the wake-sustaining effect of hypercapnia. The wake-inducing effect of hypercapnia was not significantly attenuated. Hypercapnia reduced EEG power in all frequency bands from 1-32Hz (indicative of arousal) with the exception of the  $\delta$ -band in NREM sleep and the  $\delta$ -band in wake. In wakefulness, reductions in EEG power were attenuated by LC inhibition in all frequency bands, whereas attenuation was specific to the  $\delta$ -band during NREM sleep. LC inhibition did not affect ventilation under normocapnia, whereas under hypercapnia, muscimol microperfusion attenuated hypercapnic ventilatory stimulation. In conclusion, the core arousal and respiratory networks are insufficient to mount a full response to hypercapnic-stress; recruitment of conditional components is required. The LC is not a core component of respiratory or sleep switching circuitry; however, we show that the logical topologies of these control circuits reconfigure under stress to include the LC, so as to expand the dynamic range of their responses under challenging conditions.

## P16

### Sleep during sickness: The RFamide receptor DMSR-1 regulates stress-induced sleep in *C. elegans*

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**TOPIC:** Basic Neuroscience

**Abstract Description** Acute illness and cellular stress lead to stress-induced sleep (SIS) in vertebrates and invertebrates. *Caenorhabditis elegans* undergo SIS following a variety of stressors including heat shock, UV irradiation, exposure to bacterial toxins, osmotic shock, and cold shock. It has been previously shown that the ALA interneuron releases FLP-13 neuropeptides to induce sleep. FLP-13 produces neuropeptides with an amidated arginine phenylalanine (RFamide) C terminus. The objective of this study was to identify downstream targets of FLP-13 neuropeptides. A forward genetic screen was performed to identify mutant worms with an impaired response to the sleep-promoting FLP-13 neuropeptides. From this screen, a G-protein coupled receptor gene, *dmsr-1*, was shown to be necessary for stress induced sleep in *C. elegans*. DMSR-1 is activated by FLP-13 neuropeptides in cell culture, is expressed in several wake-promoting neurons, and likely couples to a Gi/o heterotrimeric G-protein. Rescuing *dmsr-1* expression specifically in the paired AIY head neurons and paired PHA tail neurons was not sufficient to completely rescue the defect in stress induced sleep seen in animals lacking *dmsr-1*. In our current model, FLP-13 neuropeptides released by the sleep-promoting ALA neuron bind to the DMSR-1 receptor on the surface of wake promoting neurons to inhibit them, and thus promote sleep, following cellular stress. These results further our understanding of the stress induced sleep signaling pathway in *C. elegans* and provide a foundation upon which to build a better understanding of SIS in more complex animals.

## P17

### Association between the length of the white matter fiber bundles underlying the thalamo-cortical loop and sleep spindles - A preliminary study

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**TOPIC:** Basic Neuroscience

**Abstract Description** Sleep spindles are generated by the thalamo-cortical loop and implicated in sleep-dependent learning. Recently, sleep spindles were associated to voxel-based metrics of brain white matter. This study aimed at investigating whether sleep spindle amplitude and frequency are associated to length of the white fibers between the thalamus and the frontal cortex using a streamline-based and bundle specific approach. Twenty-five subjects (20-30yo) underwent a whole-night of polysomnographic recording and a 3T MRI acquisition including a diffusion sequence and a structural T1 weighted image. Spindles were automatically detected on artefact-free non-rapid eye movement (NREM) sleep on F3, F4, C3, and C4 (linked-ears). Mean spindle amplitude and frequency were averaged across the night. Streamlines were obtained using anatomically constrained particle filter tractography and were clustered based on their starting and ending regions. In addition to the thalamus, three cortical regions of interest were considered: superior frontal gyrus, middle frontal gyrus and anterior cingulate cortex. Linear regression analyses were performed between the median length of the streamlines connecting the thalamus to each cortical region and sleep spindle amplitude and frequency. Longer streamlines connecting the thalamus and the middle part of the left superior frontal gyrus significantly predicted lower sleep spindle amplitudes on all derivations ( $p < 0.05$ ) whereas longer streamlines connecting the thalamus to the anterior part of the left superior frontal gyrus predicted lower spindle amplitude only in the frontal derivations ( $p < 0.05$ ). Finally, streamlines connecting the thalamus to the anterior part of the superior frontal gyrus significantly predicted slower sleep spindles frequency on all derivations ( $p < 0.05$ ). Our metric being streamline bundle specific, we highlight that the length of white matter fiber bundles connecting the thalamus to the frontal gyri significantly predicted both sleep spindle amplitude and frequency. This promising approach may allow enhancing our understanding of sleep regulation mechanisms.



## P18

### Mesoscale imaging of cortical activity dynamics during REM-like sleep

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**TOPIC:** Basic Neuroscience

**Abstract Description** Background: Sleep is characterized by loss of consciousness and reduced responsiveness to sensory stimuli. It consists of two basic stages: rapid eye movement (REM) and non-rapid eye movement (NREM) sleep. NREM sleep can be distinguished by slow and high-amplitude cortical EEG signals while REM sleep is characterized by desynchronized low-amplitude fast cortical rhythms. While until recently it has been widely believed that cortical activity during REM sleep is homogeneously desynchronized, a recent study (Funk et al., 2016) showed that some cortical regions show slow waves during REM sleep. However, due to the sparse sampling of electrophysiological technique used in this study, general picture about most of the cortical regions cannot be provided, the question we tried to address. Methods/Result: Urethane anaesthesia was used as a model of sleep as it induces spontaneous alternation of brain state between REM- and NREM-like in rodents in which cortical and hippocampal activities resemble to the activity during natural sleep (Clemet et al., 2008). The combined wide-field VSD imaging from cortex and LFP recording from ipsilateral hippocampus were performed from unilateral preparation in anaesthetized mice. Generally, transition to REM-like state in hippocampus accompanied with the transition in VSD signal manifested by reduction in its amplitude. However, in a portion of REM-like events some cortical areas did not show desynchronization i.e. their VSD signal amplitude did not decrease. These cortical regions tended to locate more in anterior and lateral part of one cortical hemisphere and their patterns were changing from one REM-like event to another. Moreover, during short temporal windows in one REM-like event, spatial map of desynchronized areas could be dynamic. Conclusion: Our results suggest that brain state alternation under urethane anesthesia could change the cortical ensembles activity reported by VSD imaging and provide evidences for the locality of cortical desynchronization during REM-like state.

## P19

### Markovian Analysis of Phasic Measures of REM Sleep in Normal Subjects Undergoing Pharmacological Manipulation of the Serotonergic/Cholinergic Systems

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction: Rapid eye movement (REM) density (RD) is the best-known measure of phasic REM activity, with recent research suggesting that higher RD could be a biological marker for vulnerability to mood disorders. RD is quite variable, however, and its physiological substrate is not well known. We sought a more consistent measure based on eye movements' (EMs) state which might also suggest the underlying physiology and which may be sensitive to pharmacological manipulations mimicking the serotonergic/cholinergic imbalance of depression. Methods Twenty healthy females (18-30 years of age) underwent polysomnography under four pharmacological conditions (counter-balanced randomized double-blind design). An anti-acetylcholinesterase, a serotonergic (5-HT1a) agonist, both drugs together, or a placebo were given at bedtime. Using the time intervals between individual EMs, we calculated empirical probability distributions of EMs states: "burst" and "isolated." Then, a novel Markov chain model of sequential transitions between the states was calculated for each subject. Results Total time spent in REMS and latency to REMS were affected by the drug condition but RD was not. The slope of the burst distribution was not significantly altered by drug condition but the slope of the isolated EMs was found to be less negative in the 5-HT1a agonist condition and more strongly negative in the anti-acetylcholinesterase condition. No correlation was found between burst and isolated slopes. Individual burst/isolated state thresholds (mean 4.0 s, SD 1.3 s) were positively correlated with Markovian burst-burst probability ( $r = 0.455$ ,  $p < 0.001$ ). Conclusions The Markov analysis confirmed the existence of two independent populations of rapid eye movements, a numerous burst population and a small isolated population. The isolated population was increased by the anti-acetylcholinesterase and suppressed by the 5-HT1a agonist, while a non-significant trend in the data suggested that the burst population was also sensitive to suppression by the 5-HT1a agonist.

## P20

### Spatial Distribution of Hippocampo-Cortical Interaction during Sharp-Wave Ripples

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**TOPIC:** Basic Neuroscience

**Abstract Description** Introduction. The coordination of cortical up-states and hippocampal sharp-wave ripples (SWR) during slow wave sleep has been suggested to play an important role in the consolidation of recently acquired memories (Battaglia et al., 2004). It is based on studies in which investigators have recorded the cortical local field potential (LFP) and multi-unit activity (MUA) in a single cortical area. Therefore, the degree of correlation between multiple cortical regions and hippocampal ripples is not well known. Methods. fMRI studies in monkeys have identified regions in the so-called default mode network which show high co-activity with SWRs (Kaplan et al., 2016), but fMRI suffers from low temporal resolution which is necessary to capture temporally fine neuronal activity. Voltage-sensitive dyes and genetically encoded voltage indicators allowed us to capture brain activity with high spatiotemporal resolution. To probe the spatial distribution of hippocampo-cortical interaction, we imaged the cortical activity using wide-field optical imaging combined with LFP/MUA recording from pyramidal layer of dorsal hippocampus CA1 under urethane anesthesia or during quite wakefulness. Results. We found that the activities of areas adjacent to mid-line sinus, especially retrosplenial cortex (RSC), as well as secondary visual areas show stronger correlation with SWRs. We also grouped the hippocampal MUA around SWRs and found distinct cortical response corresponding to each of these groups. It can provide a support for the hippocampal memory indexing theory. Discussion. Our findings introduce a critical cortical region, RSC, involved in hippocampo-cortical interaction, for further investigations. Exploring how RSC and hippocampus communicate in different stages of memory processing, from encoding to consolidation, can shed light on mechanisms by which memories are formed and stored in the brain.

## Circadian Rhythms

### P21

#### Light interventions: a novel approach for sustaining sleep quality and quantity of elite swimmers under conditions of shifted circadian rhythm

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**TOPIC:** Circadian Rhythms

**Abstract Description** For the 2016 Olympics at Rio De Janeiro the Danish swimmers were facing a very important problem, how to maintain a good sleep quality, quantity and high performance potential [1,2], while being subject to large shift in circadian rhythm. In the present study we suggest an alternative approach for sustaining sleep quantity and quality, namely light interventions. A light program, comprising of alternating blue enhanced white light and blue suppressed white light, was designed to complement the activities of elite Danish swimmers after arriving to preparation/training camp; mimicking the conditions expected in the 2016 Summer Olympics in Rio (5-10 hours shift in circadian rhythm). The sleep patterns of the swimmers were monitored throughout two different phases: the baseline period, registered both before and after the intervention; and the preparation period (intervention). Sleep duration, efficiency, latency, percentages of light, deep or REM sleep were the variables under investigation. The sleep output was modeled (ANOVA) with subject as a random effect and phase as fixed effect. It was observed that the light program during the intervention phase significantly enabled the conservation of sleep quantity and quality of the swimmers, despite the shifted circadian rhythm. The hypothesis of no effect of phase of experiment on sleep duration, efficiency, latency, percentage of light, deep and REM sleep were all accepted with p. values 0.17, 0.53, 0.90, 0.38, 0.57 and 0.52, respectively. The swimmers commented only positively the light interventions and decided to use them at Olympics 2016. No side effects were observed. Light interventions could become an alternative simple tool for coaches and elite swimmers to improve sleep patterns in occasions of disturbed circadian rhythm conditions (different time zones, uncomfortable competition times). Contrary to other methods for improving sleep pattern (e.g. sleeping pills) light interventions carry minimal risk for severe side effects[3].

## P22

### Abnormal Dim Light Melatonin Onset in Mild Traumatic Brain Injury

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**TOPIC:** Circadian Rhythms

**Abstract Description** Introduction: The neuroprotective properties of melatonin have been investigated in traumatic brain injury (TBI) but the chronobiologic aspects of secretion have received minimal attention. One previous study has measured melatonin subsequent to mild TBI and showed that 36% of patients with insomnia symptoms had a circadian rhythm sleep-wake disorder (Ayalon et al., 2007). The study was limited by not every patient receiving a circadian assessment and the time of injury was not documented. The goal of the current study was to extend the previous research by assessing dim light melatonin onset (DLMO) and the presence of circadian sleep wake disorders in a consecutive sample of individuals presenting with insomnia symptoms within two years following mild TBI. Methods: Twenty-three individuals seeking treatment for possible insomnia disorder (based on a structured sleep interview) completed two weeks of wrist actigraphy, in parallel monitored their sleep using a consensus sleep diary, and participated in a DLMO test. Results: Forty percent of the sample had DLMO outside of the normal zone and 17 % of participants were diagnosed with a circadian phase sleep-wake disorder based on the DLMO and actigraphy results. Based on patients report, the abnormal circadian sleep-wake pattern developed after the brain injury or was amplified subsequent to the injury. Conclusion: There is a high rate of abnormal DLMO and circadian sleep disorders among patients presenting with insomnia symptoms following mild TBI. This finding has important implications for the assessment and treatment of post-concussion insomnia. Support: CIHR, Youthdale Foundation (Sleep Program)

## P23

### Mood Enhancement Following Adjunctive Phototherapy Correlates with Subjective Sleep Improvements

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**TOPIC:** Circadian Rhythms

**Abstract Description** Introduction: Sleep abnormalities are common in young individuals with depression and are thought to play a role in the onset and maintenance of mood disorders. Since bright light has a strong impact on sleep and circadian systems, phototherapy has the potential to restore sleep dysfunctions, which in turn may alleviate mood. This study evaluated associations between changes in sleep and depressive symptoms following adjunctive phototherapy. Methods: This study included 22 individuals with depression (21.3 ± 5.2 years old; 76% female). As an adjunctive treatment to standard clinical care, participants were guided to use phototherapy at home. They used green-blue light-emitting glasses for 60 minutes upon awakening. Prior to starting phototherapy (baseline) and after the two weeks of phototherapy (follow-up), participants completed the Beck Depression Inventory-II (BDI-II) and the Leeds Sleep Evaluation Questionnaire (LSEQ). Results: From baseline to follow-up, there was a marked reduction in the severity of depressive symptoms for 28% of participants, as defined by a shift to a lower depression severity category on the BDI-II. On average, across the entire group, there was a significant improvement in the Getting To Sleep index of the LSEQ from baseline to follow-up ( $t(20) = 2.192, p = .040$ ). Improvements on the Getting To Sleep ( $r = .665, p = .001$ ) and Quality Of Sleep ( $r = .548, p = .010$ ) indexes across the course of phototherapy were both positively correlated with improvements in depression severity. Conclusion: These preliminary findings indicate that sleep improvements are associated with the antidepressant effects of light therapy. The restoration of sleep may represent one of the mechanisms underlying the antidepressant effects of light. In order to have a better understanding of the role of sleep restoration for mood enhancement following phototherapy, larger placebo-controlled trials are required. Support: Centre for Integrated Research and Understanding of Sleep (CIRUS)



## P24

### Is insomnia in shift work different according to work schedule?

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**TOPIC:** Circadian Rhythms

**Abstract Description** Introduction: Insomnia is known to have its own negative impact on health of shift workers, but little is known on insomnia symptoms in the context of shift work disorder (SWD). In particular, it is not known if insomnia in shift work differs according to work schedules. The present study aims at characterizing insomnia in shift work according to two distinct work schedules. Methods: 80 night shift workers of which 43 met Shift Work Disorder (SWD) criteria were recruited. They worked 6 to 10 nights out of 14. Night shifts are either consecutive (CNS) or fragmented (FNS), for which nights are intervened with free days. Participants completed sleep diaries for two weeks. Those without SWD and satisfied with their sleep were good sleepers (GS). Four groups were created: (1)CNS-SWD; (2)CNS-GS; (3)FNS-SWD; and (4)FNS-GS. Total Sleep Time (TST), Total Wake Time (TWT), and Sleep Onset Latency (SOL) were computed for the main sleep episode (longest sleep episode after night shift) and for the 24-hour sleep period (includes all sleep episodes occurring in that period).Results: For main sleep episode, CNS-SWD have higher TWT and SOL and a lower TST than CNS-GS ( $p < .001, .05, .02, .003$ ), while FNS-SWD have higher TWT ( $p < .04$ ) than FNS-GS. There is no significant difference between CNS and FNS for main sleep episodes. For 24-hour sleep period, the same significant differences are observed for TWT and SOL. In addition, FNS-GS sleep less than CNS-GS( $p < .05$ ). Conclusion: Consecutive and fragmented night shift workers present similar insomnia symptoms during the main sleep episode, and on the 24-hours sleep period. However, good sleepers in the fragmented night shift group sleep less than their counterparts working on consecutive night shifts. Components other than the work schedule might be involved in shift work insomnia. Supported CIHR 191771 to first author

## P25

### Association between suppression of melatonin production before bedtime and circadian phase in individuals complaining of delayed sleep

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**TOPIC:** Circadian Rhythms

**Abstract Description** Introduction Evening light, especially blue light, delays circadian rhythms. Enhanced sensitivity to evening light could therefore contribute to a late circadian phase. This study measured the suppression of melatonin production at home before bedtime to evaluate light sensitivity in relation to circadian phase in individuals complaining of a late sleep schedule. Methods 14 young adults (19-28 y.; 8F/6M) complaining of delayed sleep (habitual bedtime, HB: 01:36 1:14h) were compared to 14 matched subjects with an adapted sleep schedule (HB: 23:15 0:14h). During two consecutive evenings, salivary melatonin was measured every 30 minutes from 3h before HB to HB. The first evening, saliva samples were collected at home in natural conditions and light exposure was measured by an ambulatory photometer (Actiwatch-Spectrum). The second evening, saliva samples were collected in dim light (< 5 lux) at the laboratory. Laboratory dim light melatonin onset (DLMO) was used to estimate circadian phase. Melatonin suppression was computed by comparing the area under the curve between the two conditions. Results DLMO was later in the delayed than in the adapted group (23:03 01:27h vs. 21:13 1:00h,  $p=0.001$ ). There was no group difference for melatonin suppression during the 3 hours before HB (delayed: 29.0 27.3%, adapted: 37.1 25.1%,  $p=0.42$ ). However, in the delayed group, a significant correlation was found between DLMO and melatonin suppression during the hour prior to HB ( $r=0.56$ ,  $p=0.04$ ). Blue light exposure did not correlate with melatonin suppression at that time ( $r=0.39$ ,  $r=0.17$ ). Conclusion Among delayed subjects, increased suppression of melatonin production in the hour prior to bedtime may contribute to the severity of the circadian phase delay. As blue light exposure alone was not associated with melatonin suppression, our results suggest that increased sensitivity to light may play a role in delaying circadian phase in individuals complaining of late sleep timing.

## Epidemiology/Health Services

### P26

#### Diagnostic Accuracy of Level IV Portable Sleep monitors Versus Polysomnography for Obstructive Sleep Apnea: A Systematic Review and Meta-Analysis

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**TOPIC:** Epidemiology/Health Services

**Abstract Description** Purpose: Obstructive sleep apnea (OSA) is an under-diagnosed disorder affecting 3-4% of women and 6-9% of men. In-laboratory, overnight Type I polysomnography (PSG) is the current gold standard for diagnosing OSA. Diagnostic sleep studies can be also conducted at home with Type IV portable monitors (PM) that use fewer channels but offer better comfort and lower costs. We aimed to systematically review the evidence on diagnostic ability of Type IV PMs compared to PSG in diagnosing patients with suspected OSA. Methods: Participants: patients 16 years old with symptoms suggestive of OSA. Intervention: type IV PM for diagnosing OSA. Comparator: in-laboratory PSG. Outcomes: diagnostic accuracy measures. Studies: cross-sectional, prospective observational/experimental/quasi-experimental studies. Information sources: MEDLINE and Cochrane library from January 1, 2010 to May 10, 2016. All review stages were conducted independently by two investigators. Result(s): We screened 6,054 abstracts and 115 full-text articles to select 24 full-text articles for final review. These 24 studies enrolled a total of 2,068 patients with suspected OSA, and evaluated 11 different PMs with 1-6 channels. Only 7(29%) studies tested PMs in home setting. The mean difference (bias) between PSG-measured and PM-measured apnea-hypopnea index (AHI) ranged from -6.5 to 13.5 events/hour. At AHI5 events/hour, the sensitivity of Type IV PMs varied from 67.5-100% and specificity from 25%-100%. Conclusion(s): Level IV PMs offer the potential to widen access to treatment for this underdiagnosed condition. Policy recommendations regarding PM use should consider the health and societal implications of false positive and false negative diagnoses and its cost-effectiveness.

## P27

### An environmental scan of quality-of-care measures used in Canadian sleep centres

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**TOPIC:** Epidemiology/Health Services

**Abstract Description** Introduction: Sleep-disordered breathing (SDB) has significant clinical, economic, and public health consequences. Timely initiation of effective treatment can reduce these consequences. There are many ways to diagnose and treat SDB, and a variety of health care providers can be involved. Consequently, individuals with SDB may experience significant variation in the quality of care they receive. Quality indicators (QIs) are used to gauge performance in health care and can be used to identify this variation. The extent to which QIs are used to measure quality of SDB care in Canada has not yet been determined. Objective: To characterize how quality of patient care for SDB is assessed at sleep centres across Canada. Methods: An online survey containing questions about sleep centre characteristics and QI use was distributed through the electronic mailing lists of the Canadian Sleep Society and Canadian Thoracic Society. Centres that indicated formally measuring quality of care in the initial survey were contacted for semi-structured phone interviews to determine which QIs were used and how they were measured. QIs used by the sleep centres were organized into the Institute of Medicine's six dimensions of healthcare quality (safe, effective, patient-centered, timely, efficient and equitable) and the Donabedian structure-process-outcome framework for assessing quality of care. Results: Responses were received from 34/122 (28%) Canadian level one sleep centres, of which 19 (56%) reported formally measuring quality of patient care. QIs related to patient-centeredness and effectiveness of care were used by 17/18 (94%) interviewed sleep centres. No sleep centres used QIs to assess equity, and just one (6%) used QIs to assess efficiency. Structure, process and outcome-related QIs were used by 9 (50%), 18 (100%) and 17 (94%) sleep centres, respectively. Conclusion: QIs are used in a minority of Canadian sleep centres, and only assess a limited number of dimensions of quality.

## P28

### Sleep and stress in Canadian young adults

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**TOPIC:** Epidemiology/Health Services

**Abstract Description** INTRODUCTION: Sleep problems are increasingly common in young adults, but few studies have focused specifically on sleep in this population. The purpose of the current study was to examine sleep and stress in Canadian men and women aged 20 to 39 years. METHODS: The study sample included 2,909 young adults aged 20 to 39 years from the 2012 Canadian Community Health Survey. We performed a series of chi-square tests to examine the influence of sex, age, and stress on trouble sleeping and sleep duration. Age was divided into the following categories: 20-24, 25-29, 30-34, and 35-39. Trouble sleeping was defined as having trouble falling asleep or staying asleep most or all of the time. Sleep duration was measured as the self-reported average hours of sleep per night. Low stress indicated that participants perceived their lives as not at all, not very, or a bit stressful, while high stress signified quite a bit or extremely stressful. RESULTS: Women had more trouble sleeping than men during ages 20 to 24 ( $\chi^2=17.63$ ,  $p<0.001$ ), 30 to 34 years ( $\chi^2=16.91$ ,  $p<0.001$ ), and 35 to 39 ( $\chi^2=34.47$ ,  $p<0.001$ ). Men slept for fewer hours than women between the ages of 25 and 29 ( $\chi^2=17.33$ ,  $p<0.001$ ) and 35 to 39 years ( $\chi^2=14.21$ ,  $p=0.003$ ). Women had more trouble sleeping than men regardless of stress level. Men slept less than women when stress was high ( $\chi^2=14.269$ ,  $p=0.003$ ), but there was no difference when stress was low. CONCLUSION: Women generally had poorer sleep than men; however, men had trouble sleeping and shorter sleep duration at certain ages. Further research is needed to investigate these potentially vulnerable periods. Long-term consequences of sleep problems include psychological issues, obesity, and cardiovascular disease, and it is therefore critical that we improve our understanding of sleep in young adults.

## Insomnia

### P29

#### Prevalence and Predictors of Poor Sleep in Individuals with Multiple Sclerosis

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**TOPIC:** Insomnia

**Abstract Description** AbstractIntroduction: Sleep disturbance in individuals with multiple sclerosis (MS) is approximately four times higher than in the general population. This is concerning given that poor sleep quality negatively affects one's mental and physical well-being. The objectives of this study are: 1) To document the prevalence of sleep problems in a Canadian sample of older individuals living with MS, 2) To identify demographic and clinical factors related to poor sleep, and 3) To investigate the potential impact of possible sleep promoting and sleep interfering medications. Methods: This study is a secondary analysis of sleep and related variables from the Canadian survey of health, lifestyle, and ageing with multiple sclerosis study. The survey consists of 743 Canadians, 55 years or older who have experienced MS symptoms for at least 20 years. We asked participants In the past 2 weeks, how much have you been bothered by problems sleeping?Results: Overall, 43% of patients with MS reported problems sleeping. The strongest predictors of poor sleep were number of comorbidities, clinically significant anxiety, and a greater perceived impact of physical symptoms of MS on functioning. Conclusion: Sleep problems are prevalent in individuals with MS. Individuals who had clinically significant levels of anxiety were roughly 2 times more likely to have trouble sleeping when compared to individuals without anxiety. Consideration of the risk factors for poor sleep is essential so that quality of life can be maintained, and should warrant investigation of sleep disturbances and implementation of treatment when necessary.



## P30

### Clinical Profile of Suvorexant, a Novel Orexin Receptor Antagonist, for Treating Elderly Patients With Insomnia

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**TOPIC:** Insomnia

**Abstract Description** Introduction: The elderly constitute a large proportion of those with insomnia and have particular problems with sleep-maintenance. Hypnotic medications are frequently prescribed but there are concerns that the elderly may be more sensitive to adverse drug effects (e.g., falls) and/or show differential efficacy compared with non-elderly patients. Suvorexant is a first-in-class orexin receptor antagonist for treating insomnia, currently approved in the US, Japan, and Australia at doses up to 20mg. We evaluated its clinical profile in elderly patients. Methods: Pre-specified pooled efficacy-analysis of elderly data from two similar phase-3, randomized, double-blind, placebo-controlled, 3-month trials in elderly (65y) and non-elderly (18-64y) primary insomnia patients. Elderly patients received suvorexant 30mg or 15mg. Efficacy was assessed by patient-reported-outcomes (PRO), and by objective polysomnographic (PSG) endpoints in a subgroup of ~75% of patients. The pooled safety-analysis also included 3-month elderly data from a 1-year safety trial of 30mg. Results: Sample sizes for PRO endpoints were 30mg=313, 15mg=198, placebo=307. In elderly patients, suvorexant 30mg improved PRO and PSG measures of sleep-maintenance and sleep-onset compared to placebo at the earliest timepoints (Week-1 for PRO and Night-1 for PSG measures) and Month-3 ( $p<0.05$ ). Results were similar for 15mg, except for the PRO and PSG onset measures at Month-3 ( $p=0.05$  and  $p=0.09$ , respectively). Sample sizes for the safety-analysis were 30mg=627, 15mg=202, placebo=469. Suvorexant was generally well-tolerated with few discontinuations due to adverse-events (30mg=6.4%, 15mg=3.5%, placebo=5.5%). The most frequent adverse-event, somnolence (30mg=8.8%, 15mg=5.4%, placebo=3.2%), was generally transient and mild-to-moderate in intensity. Conclusions: Suvorexant was effective and generally well-tolerated over 3-months in elderly insomnia patients. Support: Merck & Co. Inc., Kenilworth, NJ, USA

## P31

### Clinical Profile of Suvorexant for the Treatment of Insomnia over 3 Months in Men and Women: Gender Subgroup Analysis of Pooled Phase-3 Data

Herring, W. Joseph <sup>1</sup>; Snyder, Ellen <sup>2</sup>; Snavely, Duane <sup>2</sup>; Lines, Christopher <sup>2</sup>; Michelson, David <sup>2</sup>

<sup>1</sup>Merck & Co., Inc., <sup>2</sup>Merck & Co., Inc., Kenilworth, NJ USA

**TOPIC:** Insomnia

**Abstract Description** Introduction: Suvorexant is a first-in-class orexin receptor antagonist for treating insomnia, currently approved in the US, Japan, and Australia at doses up to 20mg. Previously-reported Phase-3 trial results showed that suvorexant was effective and generally well-tolerated in a combined-gender analysis. We evaluated its clinical profile in gender subgroups. Methods: Gender subgroup efficacy analyses were pre-specified and included pooled data from two similar randomized, double-blind, placebo-controlled, parallel-group, 3-month trials in elderly (65y) and non-elderly (18-64y) insomnia patients. Two age-adjusted (non-elderly/elderly) dose-regimes of 40/30mg and 20/15mg were evaluated. Fewer patients were assigned to 20/15mg than 40/30mg or placebo. Efficacy was assessed by patient-reported outcomes (PRO), and by objective polysomnography (PSG) endpoints in ~75% of patients. The pooled safety analyses by gender included data from the 3-month trials plus 3-month data from a safety trial for 40/30mg and placebo. Results: 1264 women and 707 men were included in the efficacy analysis of PRO endpoints. The gender subgroup analyses mirrored the improvements seen for suvorexant 40/30mg and 20/15mg over placebo on PRO and PSG sleep maintenance and onset endpoints in the primary analyses; 95% CIs excluded zero in favor of suvorexant for the majority of endpoints in both subgroups and similar efficacy was observed across genders (95% CIs overlapped). 1744 women and 1065 men were included in the safety analyses. Suvorexant was generally well-tolerated in women and men. The most frequent adverse event was somnolence for both 40/30mg (women: 11.1% vs. 2.3% for placebo; men: 10.1% vs. 4.2% for placebo) and 20/15 mg (women: 8.5% vs. 2.3% for placebo; men: 3.4% vs. 4.2% for placebo). Somnolence was generally transient and mild-to-moderate in intensity. Conclusion: Suvorexant was generally effective and well-tolerated by both women and men with insomnia. Support: Merck & Co. Inc., Kenilworth, NJ, USA

## P32

### Effects of Suvorexant on the Insomnia Severity Index in Patients with Insomnia: Analysis of Pooled Phase-3 Data

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**TOPIC:** Insomnia

**Abstract Description** Introduction: Suvorexant is a first-in-class orexin receptor antagonist for treating insomnia, currently approved in the US, Japan, and Australia at doses up to 20mg. Previously-reported Phase-3 results showed that suvorexant improves sleep maintenance and onset. We evaluated its effects on the Insomnia Severity Index (ISI) which assesses sleep problems and their impact on daytime function. Methods: The analysis included pooled-data from two similar randomized, double-blind, placebo-controlled, parallel-group, 3-month trials in elderly (65y) and non-elderly (18-64y) insomnia patients. Age-adjusted (non-elderly/elderly) dose-regimes of 40/30mg and 20/15mg were evaluated. Fewer patients were assigned to 20/15mg than 40/30mg or placebo. The ISI, a 7-item patient questionnaire, was administered as an exploratory assessment at Months 1 and 3. Results: 1824 patients were included in the analysis. Compared to placebo, suvorexant improved change-from-baseline in total score at both timepoints (Month 3: 20/15mg = -6.2, 40/30mg = -6.7, placebo = -4.9, p-values <0.001) and the percentage of responders (6-point improvement from baseline) at both timepoints (Month 3: 20/15mg = 55.5%, 40/30mg = 54.9%, placebo = 42.2%, p-values <0.001). Scores for individual items of the ISI showed numerical improvement for both suvorexant dose regimes versus placebo at both timepoints; the impact of insomnia component (last 3 items) which assesses the impact of insomnia on daytime function/quality-of-life was also improved by both dose regimes. Conclusion: Suvorexant improved sleep as assessed by the ISI in patients with insomnia. Improvement in sleep onset/maintenance as well as a reduction of the impact of sleep problems on daytime function contribute to the overall improvement observed in ISI total score. Support: Merck & Co. Inc., Kenilworth, NJ, USA

## P33

### Providing Cognitive Behavioural Therapy for Insomnia (CBT-I) in primary care: How well does it work?

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#### TOPIC: Insomnia

**Abstract Description** Introduction: Despite its demonstrated efficacy, CBT-I requires further study in real-life settings, especially in primary care - where patients are most likely to report sleep problems. The purpose was to examine sleep and mood outcomes of a CBT-I program in a Canadian primary care setting. Methods: The Kingston Family Health Team is an interdisciplinary primary care group serving 31,000 patients. The CBT-I program comprises six 2-hour group sessions that cover stimulus control therapy, sleep restriction, cognitive therapy, and relaxation training. We examined the outcomes of 81 consecutive adult patients with chronic insomnia who participated. Outcome measures included sleep diaries, sleep medication use, Insomnia Severity Index (ISI), the Hospital Anxiety and Depression Scale (HADS), and number of visits to the family physician. Initial and post-program data were compared using paired t-tests, ISI clinical categories, and effect sizes (Cohens d). Results: The patients were 70 women and 11 men (mean age = 57.0 years). 83% had medical comorbidity; 57% had psychological comorbidity. Post-program sleep onset latency, wake after sleep onset, early morning awakening, number of awakenings, sleep medication use, ISI and HADS decreased (all  $p < .001$ ); total sleep time, sleep efficiency, and ratings of sleep quality increased (all  $p < .001$ ). 61% of patients reported at least moderate sleep improvement (ISI score  $>7$  reduction). 88% no longer had clinically significant insomnia (post-program ISI score  $<14$ ). Effect sizes were medium to large. Wait list data for 42 patients showed minimal sleep and mood improvements with simply the passage of time. Visits to the family physician 6 months post-program declined, although not significantly ( $p = .108$ ). Available follow-up data suggest that sleep improvements were maintained over time. Conclusion: The results demonstrate the real-life effectiveness of CBT-I as integrated into primary care in Canada. Effect sizes are similar to, or larger than those found in research samples.

## P34

### Development and validation of an algorithm for the study of sleep using a biometric shirt in young healthy adults

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**TOPIC:** Insomnia

**Abstract Description** Introduction. Portable polysomnography systems are often too complex and encumbering for home sleep recordings. We assessed the feasibility of measuring sleep with a biometric shirt. Methods. Twenty healthy young adults (12 women, 8 men; 21.92.0 years) were recorded in a sleep laboratory for two consecutive nights using standard polysomnography and a biometric shirt, simultaneously. Polysomnographic recordings were scored using standard methods. The biometric shirt had embedded electrocardiogram sensors, two respiratory inductance plethysmography bands, a 3-axis accelerometer and a detachable microcontroller performing signal acquisition, data processing and communication protocols. The shirt size was individualized so that the signal was optimal. An algorithm was developed to classify the biometric shirt recordings into three vigilance states: wake, nonREM sleep and REM sleep. The algorithm was based on breathing rate and heart rate variability, body movement and included a correction for sleep onset and offset. The results from the two types of recordings were compared with percentages of agreement and kappa coefficients. Results. Five nights from four subjects were rejected due to recurrent signal artefacts caused by an ill-fitting or misplaced shirt. The overall mean percentage of agreement for 35 recording pairs was 77.55%. When NREM and REM sleep epochs were grouped together, the agreement was 90.7%. The overall kappa was 0.53. Removing breathing rate from the algorithm decreased kappa to 0.340.13, whereas removing heart rate did not significantly modify it (0.540.13). Five of the seven sleep variables were significantly correlated (sleep latency, total sleep time, %NREM and %REM sleep, the sleep period, wake time after sleep onset and sleep efficiency) while the minutes spent in NREM and of REM sleep did not. Conclusion. The findings of this pilot study indicate that a simple portable system using a biometric shirt can estimate reasonably well the general sleep pattern of young healthy adults.

## P35

### **SIESTA Home Sleep Study with BresDx Portable Monitor for the Diagnosis of Obstructive Sleep Apnea: A Pragmatic Randomized Controlled Trial**

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**TOPIC:** Insomnia

**Abstract Description** Objectives: The objectives of this RCT were to evaluate 1) the accuracy of the clinical diagnosis of obstructive sleep apnea (OSA) informed by the home sleep study with a portable monitor BresDx against the clinical diagnosis informed by the in-laboratory sleep study with polysomnography (PSG) as the reference standard; and 2) the agreement between the apnea-hypopnea index (AHI) measured using BresDx versus PSG. Methods: SIESTA was a pragmatic, multi-centre randomized single-blinded trial, which enrolled adult patients referred to three Ontario sleep clinics with suspected OSA. Patients were randomized into BresDx/PSG or PSG/ BresDx sequence arms. In each sleep clinic, two sleep specialists were randomized to conduct i) clinical assessment and diagnosis using BresDx/PSG results, or ii) clinical assessment with diagnosis and treatment prescription. Results: Two hundred forty three patients completed both sleep studies (n=126 in BresDx/PSG, n=117 in PSG/ BresDx arms). Two hundred thirteen patients completed both consultation visits (n=111 in BresDx/PSG arm, n=102 in PSG/ BresDx arm). Considering the uncertainty around undetermined diagnoses, the sensitivity of BresDx-informed clinical diagnosis against PSG was between 0.867 and 0.897, and the specificity was between 0.396 and 0.458. At the AHI cut-off of 5 events/hour and 15 events/hour, the sensitivity of BresDx was 0.85 (95%CI: 0.78, 0.90) and 0.60 (0.51, 0.69), the specificity was 0.47 (0.35, 0.60) and 0.95 (0.90, 0.98) with an area under the ROC curve equal to 0.79 (0.74, 0.85) and 0.86 (0.81, 0.90) respectively. Conclusion: The device was quite accurate for in home testing of routine referrals with suspected OSA. In a more refined triage population with a high pretest probability of moderate/severe OSA, a combined strategy of initial screening with the BresDx followed by PSG for patients with negative test results could be a reasonable option for OSA screening/diagnosing.

**Submission Group** General Submission

## P36

### The EMR Drives Process Improvements in the Sleep Laboratory

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**TOPIC:** Insomnia

**Abstract Description** Introduction: The Sleep Laboratory provides quality care to a steady stream of referrals. Implementation of an Electronic Medical Record (EMR) created opportunities and challenges. In 2014 the laboratory transitioned from a paper booking system to an electronic system of orders, scheduling and results reporting. Initial implementation caused concerns with increased workflow times with steep learning curves. Methods: A quality improvement initiative was created to provide a structured review for 2 main parameters: 1) Access - Wait time data was extracted from the EMR regarding appointment types and availability. 2) Budget - operational costs and fee reimbursement. A billing report from the EMR was created to increase accuracy and reduce process time. Measures were % Revenue Recovery and Process Time (Hours) for budget indicators. Results: 1) Access - Appointment data has driven practice changes. Physicians altered schedules to allow more intakes. 2) Budget - %Revenue Recovery is the actual amount received over what is expected. In FY15-16 this was 61.5%. % Revenue Recovery increased to 81% in Q1 of FY2016-2017 and 96% in Q2. Process Time - billing was previously compiled manually taking approximately 11 hours/month. Process Time has reduced to 30 min. /month. EMR data is an excellent way to drive efficiency. Time saved can be invested in additional process improvements such as booking and scheduling. Conclusions: Seeking opportunities to drive solutions through the EMR is a cultural shift that continues to show promise. The concept of the billing report and providing data to physicians has expanded to other areas within the hospital. The EMR billing report is an interim step. Awareness has prompted Finance and IT to develop a direct data link of billing information to the accounting software. This will automate the process further reducing time, enhancing recovery and limiting errors.

## P37

### **SLEep APnea Screening using Mobile Ambulatory Recorders after TIA/stroke (SLEAP SMART): A Randomized Controlled Trial**

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**TOPIC:** Insomnia

**Abstract Description** INTRODUCTION: Despite its high prevalence and unfavourable clinical consequences, obstructive sleep apnea (OSA) remains under-diagnosed after cerebrovascular events. Although in-laboratory polysomnography (PSG) is the gold standard for diagnosing OSA, its utility as a broadly-used diagnostic tool is hampered by limited access, lengthy wait times, and patient unwillingness to sleep in a laboratory setting. Home sleep apnea testing (HSAT) is an alternative to PSG for the detection of OSA, however, whether use of HSAT improves clinical outcomes after cerebrovascular events is unknown. OBJECTIVES: To determine whether the use of HSAT compared to PSG increases the proportion of patients diagnosed with OSA, enhances CPAP compliance, improves sleep-related and neurological outcomes, and decreases 24-hour ambulatory blood pressure at 6 months. We will also ascertain whether HSAT is cost-effective compared to PSG. METHODS: Patients with an imaging-confirmed stroke or stroke specialist-diagnosed transient ischemic attack (TIA) within the past six months will be randomized (1:1) to undergo objective sleep testing for OSA using either HSAT or PSG. Study assessments will take place at baseline and 6 months. RESULTS: For this on-going randomized controlled trial, we report on the baseline characteristics and progress of the first 150 study participants. To date, no notable differences have been detected between the two study arms. Recruitment is on target and expected to be completed by July 2017 with a total of approximately 240 participants. CONCLUSION: If our study demonstrates that HSAT improves outcomes compared to PSG, this would inform how patients with stroke/TIA are managed. Instead of undergoing in-laboratory polysomnography at the discretion of their treating physicians, stroke/TIA patients would routinely undergo screening for OSA using HSAT. This novel approach would have the potential to improve patient outcomes while reducing healthcare expenses. SUPPORT: ResMed; Innovation Fund of the Alternative Funding Plan from the Academic Health Sciences Centres of Ontario.



## P38

### Genetic risk factors of insomnia

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#### TOPIC: Insomnia

**Abstract Description** Insomnia is the most common sleep disorder affecting 4.5 million Canadians. Despite its high prevalence and the proof of its moderate heritability, little is known about contributing genetic factors. Insomnia is highly comorbid and has a bidirectional relationship to mental disorders, particularly depression and anxiety. Insomnia patients are 2.6 times at risk of developing depression and those with anxiety and depression are 50 to 70% more likely to suffer from insomnia. Consequently, similar pathophysiology between insomnia, depression and anxiety is suggested. This common biological basis is illustrated by the use of common pharmaceutical treatments targeting GABAergic and serotonergic pathways. Along with adenosine, these pathways are known to play major roles in sleep regulation. Previous studies that aimed to identify genetic risk factors of insomnia have two major limitations: the use of small samples and the variability in measuring insomnia. Hence our objective is to follow a candidate gene approach to identify the genetic factors of insomnia that have previously been associated with depression and anxiety disorders. Our candidate gene list accounts genes involved in GABA, serotonin and adenosine pathways. We hypothesize that severe cases of insomnia will be more strongly associated with genetic variation related to anxiety and depression compared to those who have mild insomnia. We dispose a large sample of 694 insomnia patients who consulted at CAMS, diagnosed with primary insomnia by a physician and advised pharmaceutical or psychotherapeutic treatments. The sample is stratified based on insomnia severity as reported by the insomnia severity index or by medical notes. DNA was isolated from whole blood using standard techniques and gene variants are determined with polymerase chain reaction (PCR) techniques. Preliminary results show that polymorphisms in the serotonergic and GABAergic pathways are associated with insomnia, suggesting that these pathways may play key role in the pathophysiology of the disease.

## P39

### Insomnia symptoms are associated with sleep architecture among kidney transplant recipients

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**TOPIC:** Insomnia

**Abstract Description** Introduction: Insomnia complaints are frequent among kidney transplant (kTx) recipients and are associated with fatigue, depression, lower quality of life and increased morbidity. However, it is not known if subjective insomnia symptoms are associated with objective markers of sleep quality. Thus, we analyze the association between insomnia symptoms versus sleep architecture and sleep EEG activity among kTx recipients. Methods: Participants (n1 = 100) were selected from prevalent adult transplant recipients (n0 = 1,214) followed at a single institution. Insomnia symptoms were assessed by the Athens Insomnia Scale (AIS) and standard overnight polysomnography was performed. In a subgroup of patients (n2 = 56) sleep microstructure was also analysed with power spectral analysis. Results: In univariable analysis AIS score was not associated with sleep macrostructure parameters. However, REM sigma activity was significantly associated with AIS score ( $r = 0.287$ ;  $p = 0.032$ ). In multivariable analysis after controlling for covariables AIS score was independently associated with the proportion of slow wave sleep ( $: 0.263$ ; CI: 0.026 - 0.500) and REM beta activity ( $: 0.323$ ; CI: 0.041-0.606) ( $p < 0.05$  for both associations). Association of REM sigma and AIS score ( $: 0.306$ , CI: -0.005 - 0.616;  $p = 0.054$ ) was nearly significant in the multivariable analysis. Conclusions: Among kTx recipients the severity of insomnia symptoms is independently associated with higher proportion of slow wave sleep and increased beta activity during REM sleep suggesting either a potential compensatory sleep protective mechanism and a sign of REM sleep instability among this population.

## P40

### Dream Content and Cortical Activity during REM sleep in Insomnia Individuals

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**TOPIC:** Insomnia

**Abstract Description** Current models of insomnia suggest that cortical hyperarousal is one of its core feature. Greater activation in beta and alpha frequencies during the night and greater negative dream content in insomnia sufferers (INS) than in good sleeper (GS) have been found. However, it remains unknown if there is a relationship between cortical activation and oneiric content. Thus, we aim at: 1) comparing negative, positive and active elements in INS and GS dreams, 2) measuring cortical activity in REM in both groups and 3) examining the link between cortical arousal and dream content across successive REM periods. PSG was recorded in 12 INS (mean age 37.5 years, SD=4.3) and 12 GS (mean age 37.3 years, SD=4.7) for five consecutive nights (N1 to N5). On N3 and N5, participants were awoken in REM sleep for dream collection. Generalized linear mixed regression model showed no significant effect for group, REM periods and interaction on negative and positive elements of dream content ( $p > 0.05$ ). However, a significant interaction of group and REM periods on activity elements of dreams ( $p = 0.04$ ) was found, GS presenting more activity elements at the end of the night than INS. No significant group effects on cortical activation were found ( $p > 0.05$ ). Nonetheless, a significant effect of REM period was observed, both beta and alpha activity decreasing throughout the night ( $p < 0.001$ ). Finally, no link between cortical activity and dream content was observed. The absence of beta and alpha increases in INS might suggest that spectral analysis is not optimal to study hyperarousal in INS during REM sleep. However, because cortical activation is already very high during REM, more activity in high frequencies can be linked to awakening. Because a greater number of elements of activity is observed in dreams of GS, it might suggest that INS are more focused on negative elements.

## P41

### Development and Implementation of a Polysomnography Laboratory Protocol for Neuromuscular patients

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**TOPIC:** Insomnia

**Abstract Description** Introduction: Polysomnography (PSG) is the gold standard tool for the diagnosis of nocturnal hypoventilation in patients with neuromuscular disorders. PSG can also provide important information during non-invasive ventilation (NIV) titration that might improve adherence to therapy and respiratory outcomes in neuromuscular patients. Methods: Two neuromuscular respiratory physicians, two sleep physicians, two polysomnography technologists and one respiratory therapist all with experience titrating NIV for patients with NMD, participated in an iterative process to build consensus for the new protocol at the Foothills Medical Sleep Centre laboratory. The goal was to standardize split-night polysomnography for diagnosis and treatment of nocturnal hypoventilation for neuromuscular patients with respiratory muscle weakness. Results: A flow diagram for split-night polysomnography for diagnosis and treatment of nocturnal hypoventilation in NMD will be presented in this poster along with case examples of important findings emerging from the protocolized titrations. Important observations were that (1) Patient selection is important. The protocol is directed towards patient with documented respiratory muscle weakness. (2) Transcutaneous CO<sub>2</sub> (tcCO<sub>2</sub>) is necessary. Comparing the tcCO<sub>2</sub> to baseline PaCO<sub>2</sub> and to the morning awake tcCO<sub>2</sub> provides reassurance of an accurate signal. (3) Titration to a goal tidal volume of at least 8 ml/kg IBW is essential. When V<sub>t</sub> is not achieved with pressure support then increasing the inspiratory cycle time is an effective strategy. However, excessive system leak renders this parameter useless. (4) A back up rate and titration to <20% patient triggered breaths was incorporated. (5) Patients with chest wall restriction in the absence of respiratory muscle weakness (eg scoliosis) benefit from a different polysomnography titration pathway, more similar to OSA/OHS. Conclusion: Polysomnography labs are increasingly utilized for complex sleep disordered breathing, including NIV titration of patients with neuromuscular disorders. A specific protocol for ventilation titration in NMD was developed and implemented using a multidisciplinary approach.

## P42

### Metabolism connects sleep deprivation and aging

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#### TOPIC: Insomnia

**Abstract Description** Decreased sleep is a hallmark of modern society, both due to environmental factors such as stress as well as biological factors such as aging. Sleep deprivation (SD) has been linked to life-threatening complications, for example learning and memory related neurodegenerative diseases and cardiometabolic disorders. The role of metabolic disruption in physiological effects SD is still unclear. Interaction of SD with aging phenotypes is also poorly understood, although emergent evidence points to a defined interaction. To better understand these phenotypes at a metabolic level, we used a mouse model of 5 h acute sleep deprivation in young and aged mice capture multi-organ metabolic shifts. Remarkably, numerous metabolites were perturbed post SD in young (24, 61, 53 metabolites corresponding to hippocampi, liver, and plasma, respectively) and aged animals (17, 42, 38 metabolites). Young animals demonstrate greater metabolic susceptibility in this acute SD model than aged animals as assessed by multivariate data analysis. Hepatic signatures of ketosis was common to both age groups, however, the effect was more prominent in the young animals. Altered hepatic NAD metabolism and urea cycle was also common signature of SD in the liver. Choline and acetylcholine pool in the young animals was specifically perturbed in hippocampus, potentially linking metabolism to SD induced alteration in memory consolidation. Comparison of SD and age also revealed specific SD metabolites in young animals (5, 19, 15 metabolites), that recapitulate a portion of the aging signature, in essence demonstrating how SD makes the young seem old. These results form a foundation for understanding the systemic metabolic effects of sleep deprivation and aging.

## P43

### Respiratory Muscle Electromyography during Polysomnography

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**TOPIC:** Insomnia

**Abstract Description** Introduction: Polysomnography records various biological signals in sleep. Electromyography (EMG) is the recording of muscle activity. Respiratory muscle EMG is suggested for titration of non-invasive ventilation (NIV) in neuromuscular patients . We evaluated quantitative and qualitative analysis of diaphragm and intercostals surface EMG in neuromuscular patients undergoing split-night polysomnography for the diagnosis and treatment of chronic stable hypoventilation. Methods: Patients with neuromuscular disorders who required polysomnography for diagnosis of nocturnal hypoventilation and titration of NIV were studied in the Foothills Medical Sleep Centre laboratory. Results: A total of 13 studies were reviewed and samples of the recordings will be presented. Polysomnography was performed using standard channels according to AASM recommendations . In addition, surface EMG of the diaphragm and intercostals muscles was recorded using Meditrace 530 stickers, Generics snap electrodes, recorded with Sandman Elite v10.1. Maximal respiratory muscle activity was recorded during biocalibrations with patients taking a deep breath in while awake. Subsequent EMG activity was compared to baseline during the remainder of the recording period. Diaphragm EMG was more often successfully recorded. There was a decrease in respiratory EMG during hypopneas, particularly in REM sleep. With NIV application, respiratory EMG was further suppressed. Conclusion: The current AASM Manual for Scoring of Sleep and Associated events recommends the use of nasal pressure transducer signal (or device flow signal during PAP therapy) to identify hypopneas. The Manual also includes guidelines on distinguishing obstructive from central hypopneas. Respiratory effort can be evaluated using esophageal manometry (which is invasive and not routinely used) or dual thoracoabdominal respiratory impedance plethysmography (RIP). In this study we compared the surface EMG of diaphragm to dual thoracoabdominal RIP in neuromuscular hypoventilation. Diaphragm EMG is sensitive, and useful in detecting suppression of respiratory muscle work in NIV titration.

## P44

### The Relationship Between Sleep Misperception and Spindle Architecture in Primary Insomnia

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**TOPIC:** Insomnia

**Abstract Description** Sleep misperception, the discrepancy between self-reported and objectively-recorded sleep duration, is often observed in insomnia, and may result from dysfunction in underlying neural mechanisms as indexed by electroencephalogram during sleep. Recently, evidence has suggested that sleep protection mechanisms, indexed by sleep spindle architecture may be associated with sleep misperception. However, the specific relationship between spindle architecture and sleep misperception index (MI) is not known. In the current study, 22 individuals (17 females, 5 males, mean age = 42.0, SD = 15.3) diagnosed with primary insomnia completed an overnight polysomnographic (PSG) recording in the sleep laboratory, and spindle density, duration, frequency, and amplitude were calculated using automatic detection during stage N2 sleep. MI was calculated as the degree of discrepancy between total sleep time as measured by PSG compared to self-reported sleep time from 1-week sleep diaries. A significant positive correlation (.364,  $p = .048$ ) was observed between MI and spindle density per 30 second epoch, as well as MI and spindle amplitude (.378,  $p = .042$ ), where greater sleep misperception was associated with higher spindle density and larger spindle amplitude. Interestingly, the strongest correlation was observed between MI and REM duration (.477,  $p = .012$ ). No significant correlation was observed between MI and N1, N2, or N3 duration, spindle duration, spindle frequency, or spindle power (a trend, .352,  $p = .054$  was observed for spindle power). These results support a subgrouping approach to insomnia, whereas individuals with objective psychophysiological insomnia exhibit spindle dysfunction, and differ from individuals with a high MI where spindles remain intact. These results further suggest that REM may contribute less to an individuals' perception of time spent asleep compared to slow wave sleep.

## Instrumentation and Methodology

### P45

#### **A pilot study to determine the consistency of sleep actigraphy measurements comparing all four limbs of patients with Parkinsons disease**

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**TOPIC:** Instrumentation and Methodology

**Abstract Description** Introduction: Actigraphy has been widely used in pharmacological and non-pharmacological intervention research involving a range of medical and neurobehavioral conditions. Compared to overnight polysomnography study, actigraphy offers several advantages including feasibility and economy for use over extended periods of time (i.e. days to weeks), hence allowing collection of data about day to day variability in sleep patterns. Actigraphy also provides information about sleep and wake patterns in the patients natural sleep environment. Literature indicates that 50% to 70 % of persons with Parkinson disease have sleep problems and the need for outcome research is significant. However, reliable actigraphy is potentially challenged by disease symptoms such as tremor and decreased mobility. There is limited research as to if, and to what extent, actigraphy readings are effected by limb placement in Parkinson patients. Objective: To examine consistency of actigraphy findings in Parkinson patients when the monitors are simultaneous worn on all four limbs. Methods: Participants will complete a baseline profile assessment (dominance, motor function, tremor) and then wear a sleep actigraph overnight on each limb for one week. Findings of the four devices will be compared to determine degree of consistency of sleep efficiency components (latency, duration, frequency and length of awakenings). Results: Testing the protocol with healthy volunteers showed that although variables (eg sleep efficiency and wake after sleep onset) were collected simultaneously, they varied between limbs by as great as 30 %. Readings from left and right upper limb placement were more consistent and recorded more night-time awakenings. We are now data collecting with Parkinsons patients. Conclusion: From initial data, we anticipate that the placement site of actigraphs are crucial and further study is much needed. This pilot data will allow us to refine the study protocol for a larger study of excessive daytime sleepiness in persons with Parkinson disease.



## P46

### Reduced slow-wave density in aging: lower amplitude or inability to generate slow-wave?

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**TOPIC:** Instrumentation and Methodology

**Abstract Description** INTRODUCTION. Based on standard criteria in detection of slow waves (SW; 4Hz, peak-to-peak amplitude Ap75V, negative amplitude An40V), aging is associated with a reduction in SW density (number of SW/minute of NREM sleep) and amplitude. Considering those amplitude criteria to detect SW (SW-75V), age-related decrease in SW density could be due to a reduction in SW amplitude and not to a decline in the capacity to generate SW. We developed a data-driven approach to compute amplitude criteria specific for older individuals. This approach is based on a similar signal-to-noise ratio (SNR) of a permissive detection of SW in both groups. METHOD. Young (N=31; 22.8 y.o.) and middle-aged (N=33; 59.55 y.o.) healthy subjects slept for one night of polysomnography recording. SW were detected in frontal derivations using SW-75V. To determine SNR criteria for both Ap and An, SW were also detected using very low criteria (Ap>9V and An>5V). A SNR between "signal" (SW with Ap75V and An40V) and "noise" (spurious SW with Ap75V or An40V) was computed from the young subjects. Detection criteria for the middle-aged subjects were then obtained such that the detection produced a SNR similar to the young subjects. The obtained criteria defined the SNR detection threshold for the middle-aged group. RESULTS. Based on SW-75V, SNR detection threshold was found for the older group, with Ap67V and An36V criteria. Significant differences in SW density, amplitude and slope were obtained whether comparisons were made using SW-75V for both groups, or if SNR detection threshold was used for older subjects and SW-75V for young subjects. CONCLUSION. Even though SW amplitude criteria were lowered, age differences remain. Our results support the hypothesis that age differences in SW density, amplitude and slope are due to declining SW generation capacity, and not due to the amplitude criteria.

## P47

### Review of a Multisensor, Low Cost, and Unobtrusive Approach to Detect Movements in SIT and Sleep

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#### TOPIC: Instrumentation and Methodology

**Abstract Description** Introduction: Movement measurements in the Suggested Immobilization Test (SIT) and sleep recordings are typically measured by polysomnography (PSG) with electromyography (EMG). We investigated the viability of an alternate home-based recording system, SleepSmart, which combines sensing technologies integrated in a bed-sheet and video to detect movements. Methods Pilot study: 19 participants were administered the SIT in the Biomechanics Lab; the subject lay on an angled bed for 30 minutes and slept for up to 30 minutes. We used a combination of the Kinect videography system enabling conventional 2D and novel 3D-technology, a portable EMG device, and a mattress topper sheet fitted with flexible sensors. EMG data was recorded for both tibialis anterior muscles. The goal was to perform pilot testing on the integrated system to fine tune the procedure and equipment. Results Main findings: The 3-D video recordings enabled the study of movement developments, a novel feature not captured by 2-D video-recordings and/or EMG. Pitfalls in the EMG setup, overall protocol design, and data synchronization were encountered. Several requirements were identified to optimize the test-setup: (1) A millisecond-level time stamping system was needed to sync data between multiple modalities; this mechanism will support identification of movement characteristics (development and peak) for Periodic Limb Movements (PLM). (2) Reflective or light-absorbing artifacts should be removed to maintain video data integrity. (3) With the demonstrated effectiveness of the video-data characterization feature, the mattress-sensor framework should implement machine learning algorithms to automatically identify movement events. Conclusion Based on findings, the mattress sensors are being replaced with newer sensors to improve performance. The switch from force-sensing resistors (FSRs) to accelerometers incorporates detection of physiological signals (heartbeat and breathing rate). More pilot testing will be conducted to validate changes. Support Kids Brain Health Network; AIT Austrian Institute of Technology; BC Children's Hospital Foundation.

## Other Topics

**P48**

### **Sleep and Trauma Exposed Workers**

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**TOPIC:** Other

**Abstract Description** Authors: Anna Aishford PhD Student, Shu-Ping Chen PhD, Cary A Brown PhD. Department of Occupational Therapy, Faculty of Rehabilitation Medicine, University of Alberta.

**Introduction:** Studies indicate that workers in high-stress jobs who are exposed to repetitive traumatic events (such as law enforcement officers, emergency ambulance personnel, rescue and military personnel), experience a high risk of developing clinical or sub-clinical sleep problems. Of concern, these trauma-exposed workers experience decreased vitality in everyday tasks, increased risk taking, decreased physical activity, increased difficulty regulating emotions, and increased risk for numerous physical and mental health concerns. **Objectives:** This poster presents a review of the current evidence-base related to sleep in trauma-exposed workers. The review focuses strongly on the under-addressed relationship between environmental factors and trauma-exposed workers sleep deficiency. The review serves the following primary objectives: (1) to raise awareness about the significant risk of sleep deficiency in this often neglected population and area of practice, (2) to contextualize sleep deficiency and its impact on functionality within trauma exposed-workers. **Methods:** A literature review to identify the evidence-base specific to trauma-exposed workers was completed using key words through multiple databases. Data from the primary research publications and grey literature searches is currently being synthesized. **Results:** Preliminary findings indicate sleep deficiency is particularly prominent in the sub-group of trauma-exposed workers who are experiencing Post Traumatic Stress Disorder (PTSD). The literature suggests there is an apparent bi-directional relationship between PTSD and sleep deficiency. The preliminary findings also identify that the range of non-pharmacological sleep interventions with demonstrated effectiveness is limited. The synthesized findings will be presented and challenges to treatment implementation for this unique population will be discussed. **Conclusions:** Understanding the unique aspects of sleep deficiency in trauma-exposed workers is an important first step for risk reduction, promoting functionality, health and well-being through both research and clinical perspectives.

## P49

### Dream experience in the absence of vision

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**TOPIC:** Other

**Abstract Description** As vision is the predominant sensory modality in the dreams of normally sighted people, it is reasonable to ask do blind individuals have visual dreams? Blindness, particularly when it occurs early in life, is associated with reduced visual imagery and an increased incidence of sleep disturbances including more frequent nightmares. However, the sensory and emotional dream qualities of individuals with differing blindness etiologies remain poorly studied. The goal of the present study was to further assess the dream experiences of individuals with different times of blindness onset. We examined dream reports collected from 11 blind individuals who reported no light perception, and 11 age- and sex-matched normal-sighted controls. Of the blind individuals, 5 were born blind (congenital blind) and 6 had acquired blindness some time after birth (late blind). Dream content and themes were examined using daily dream questionnaires collected over a period of 30 days, as well as with the Inventory of Dreams: Experiences and Attitudes (IDEA) questionnaire and the Typical Dreams Questionnaire (TDQ). As expected, the incidence of visual dream elements was much lower in both groups of blind individuals, while other sensory modalities were more present. Further, congenitally blind individuals, but not late blind individuals, reported more nightmares. Although dream themes were generally similar between blind and normal-sighted individuals, as well as between the congenital and late blind groups, we noted some contents that were characteristic of the blind. Particularly, they reported a greater intensity of positive emotions in their dreams, as well as a more positive attitude towards the dreaming experience. Blindness not only results in the reduction of visual elements in dream content, but may alter their emotional quality, including a heightened frequency of nightmares among congenitally blind individuals.

## P50

The contribution of short sleep duration to ethnic differences in cardiovascular disease - the helius study

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**TOPIC:** Other

**Abstract Description** Introduction: Cardiovascular disease (CVD) prevalence is higher in ethnic minority groups compared to host populations in high-income countries. Conventional risk factors for CVD do not fully explain ethnic differences in the prevalence of CVD, hence the need to identify novel modifiable risk factors. We analysed the association between short sleep duration and prevalence of CVD in a multi-ethnic population living in Amsterdam, the Netherlands. In addition, we analysed the contribution of short sleep to the observed ethnic differences in the prevalence of CVD, independent of CVD risk factors. Methods: 20730 participants (aged 18-71 years) of the HELIUS study of Dutch, Ghanaian, Turkish, Moroccan and Surinamese origin were investigated. Self-reported sleep duration was classified as: short (<7 hours/night), and healthy (7-9 hours/night). The prevalence of CVD was assessed using the Rose questionnaire on angina pectoris, intermittent claudication and possible myocardial infarction. The association of short sleep duration with prevalent CVD, and the contribution of short sleep to the observed ethnic differences in the prevalence of CVD were analysed using adjusted prevalence ratio(s) (PR) with 95% confidence interval (CI). Results: Short sleep was associated with CVD among all ethnic groups with PRs ranging from 1.41 (95%CI 1.21-1.65) in Moroccans to 1.62 (1.20-2.18) in Dutch after adjustment for age, sex and conventional CVD risk factors. The independent contributions of short sleep (in percentage) to ethnic differences in CVD compared to Dutch were 10%, 15%, 15%, 5%, and 5% in South-Asian Surinamese, African Surinamese, Ghanaian, Turkish and Moroccan respectively. Conclusion: Our study showed that short sleep contributed substantially to ethnic differences in CVD independent of well-known CVD risk factors particularly in Surinamese and Ghanaian groups. Reducing sleep deprivation may be an important step for reducing increased CVD risks among the various ethnic minority groups.

Presentation Type: Oral Presentation with Poster Presentation

## P51

### The Relationship of Positive and Negative Impactful Dreams with Pre-Sleep and Post-Sleep Mood

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**TOPIC:** Other

**Abstract Description** Introduction: While impactful dreams are known to influence at least morning psychological state, little is known about the relationship between pre-sleep, dream, and morning mood in the case of negative and positive impactful dreams. Methods: Thirty-two participants (21 females) reported one dream self-rated as either very or extremely emotionally impactful and one dream self-rated as not at all emotionally impactful (mundane dream), totalling 64 dreams. They completed a pre-sleep, dream, and post-sleep mood checklist as well as a dream diary. Using the Hall & Van de Castle method, dreams containing more positive emotions were classified as positive and those containing more negative emotions as negative. Results: A 2 x 3 analysis of variance revealed a significant difference between mundane dreams and both positive and negative impactful dreams. Compared to mundane dreams, negative impactful dreams showed higher negative mood before sleep, during dreams, and after sleep. Conversely, for positive impactful dreams, there were more positive emotions experienced during the dream and at post-sleep, but not at pre-sleep, compared to mundane dreams. Correlational analyses demonstrated that for negative impactful dreams, negative dream mood strongly correlated with negative post-sleep mood. Similarly, for positive impactful dreams, positive dream mood strongly correlated with positive post-sleep mood. However, pre-sleep and dream mood (positive or negative) were not correlated. Additionally, there was a significant correlation between pre-sleep and post-sleep positive mood in mundane and positive impactful dreams. Conclusion: These results suggest that dream mood has a lasting emotional relationship with morning mood. However, the absence of a relationship between pre-sleep mood and dream mood undermines the continuity theory of dream formation. The approach used in this study could be useful for testing of dream function theories. Supported by the Social Sciences and Humanities Research Council of Canada

## P52

### Relative success of digital, media, and traditional recruitment methods for Better Nights, Better Days.

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**TOPIC:** Other

**Abstract Description** Introduction Approximately 80% of Canadians have internet access, making internet service delivery (eHealth) a powerful tool to overcome barriers to treatment. To this end, we developed Better Nights, Better Days (BNBD), an innovative, bilingual (English and French language) eHealth program for primary caregivers across Canada, aiming to provide accessible and evidence-based care for insomnia in typically developing children aged 1-10 years. Study recruitment can be challenging, however recent eHealth interventions have suggested that incorporating online recruitment strategies can be both practical and effective. Here we report on the response rate of various recruitment strategies for the English-speaking segment of the randomized controlled trial (RCT), targeting 400 participants. Methods A comprehensive recruitment campaign was developed including a combination of digital (social media platforms, search engines, online news articles), media (e.g., radio and television interviews), and traditional (e.g., poster advertisements, health care professional referrals) recruitment strategies. As part of the online screening questionnaire, individuals were asked to indicate how they heard about the study. The response rates to four recruitment strategies were computed: Digital, Media, Traditional, and Other. Results The BNBD RCT launched September 2016. Over 2,000 individuals responded within the first three months, and the target number of 400 English speaking primary caregivers had consented, with their study participation currently ongoing. Results from the online screening questionnaire indicated 41% heard about BNBD through digital strategies, 27% through media sources, 5% through traditional strategies, and 27% from other unspecified sources (principally referrals from family or friends). Conclusion The high rate of recruitment likely speaks to both the need for intervention, and the effectiveness of our multi-modal recruitment campaign. Given Canadians have increasing access to the internet, creating a dynamic online presence can help to increase study visibility and be effective in recruiting for eHealth interventions.

## P53

### Assessing the Effects of Acute, Partial Sleep Restriction on Attentional Processes

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**TOPIC:** Other

**Abstract Description** Most adults require 7-8 h of sleep nightly to function optimally, but many do not get this amount, resulting in negative effects on cognition, daytime functioning and performance, including difficulties with attention. A widely accepted current model of attention posits three separate but interacting attentional networks in the brain, each of which is responsible for a different component of attentional abilities: vigilance/alerting, orienting/selection and executive control. The extent to which each of these attentional networks is differentially affected by sleep loss has not been established. We used the Dalhousie Computerized Attention Battery (DalCAB), which is based on this attentional model, to assess the impact of sleep loss on the component systems underlying attentional performance. Healthy participants (women aged 19-25 years) completed the DalCAB twice; once after a 9 h overnight sleep opportunity (OSO), and again after either another 9 h OSO (control condition; n=19) or after a 3 h OSO (sleep restriction condition, n=20). Self-ratings of sleepiness and mood were completed in the morning after each of these sleep conditions. Changes in DalCAB performance, mood and sleepiness were compared between groups and between days. Stanford Sleepiness Scale scores showed increased subjective sleepiness in the restricted but not the control group after the second night. Most significant group by session interactions were found for processing speed on tasks related to vigilance (e.g., simple and choice reaction time), although sleep restriction also increased reaction time on tests of executive control (e.g., go/no-go, flanker task) and working memory (delayed target probe task). Moderate, acute sleep loss may have specific effects on vigilance and executive control components of attention, with relatively less impact on orienting/selection. These findings highlight the potential independence of the functioning of the attention networks, and the need to consider specific components in models of how sleep loss affects cognition.



## P54

### Spectral EEG Correlates of Emotional Valence during REM Sleep Mentation

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**TOPIC:** Other

**Abstract Description** Introduction: Electrophysiological correlates of REM sleep mentation have been largely researched, yet few studies have focused on the EEG correlates of dream emotional tone. Although we recently reported promising evidence of increased frontal theta activity during emotionally charged dream segments, this evidence was primarily based on EOG electrodes derived EEG spectral analyses. Here we attempted to replicate our previous work with a more complete EEG montage taking into account the chronology of the emotional valence within the dream experience. Method: Six participants spent two consecutive nights of polysomnography recordings, using fifteen EEG channels including Fp1, Fp2, F3, F4, F7, and F8, in addition to the previously used C3, C4, O1, O2, and EOG channels. Participants were awakened during REM sleep and had to report their dream in a chronological scenario. In the morning, the dreams were divided into segments and each segment was scored through a 4-points scale for emotional valence. Ocular correction (ICA) and spectral analysis was conducted on chronologically corresponding segment and the frequency bands averages were extracted (Brain Analyzer) and submitted to analyses of variance of emotional valence in comparison to spectral activity. Results: Results show that dream segments with higher emotional intensity were associated with an increased prefrontal and frontal theta activation ( $p < 0.01$ ), particularly in the right anterior frontal area ( $p < 0.01$ ). Therefore, an increase in emotional intensity during dreams was accompanied by a higher theta activity, more specifically at 5.5 Hz. Conclusion: This study validates the use of this approach to further explore EEG correlates of REM dream content. Larger-scale research combining neuroimaging and electrophysiology could further support these results by investigating hippocampus and amygdala activation in negatively charged dream segments and their implication in the fear extinction theory.

**Presentation Type:** Oral Presentation with Poster Presentation

## Pediatrics

### P55

#### Providing the Best Bedroom Sleep Environment for Children with Cerebral Palsy

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Between 23-46% of children with cerebral palsy (CP) have sleep problems. Often these sleep problems go undiagnosed and undertreated. Interventions, if offered, are most often pharmacological. However, medication side effects are a significant concern and there is a clear need to build the evidence-base for non-pharmacological sleep interventions for these children. A recent review of the evidence-base for environmental modifications to promote sleep showed promising results warranting further study. The study aims were to determine 1) if providing parents with manualized sleep education and problem solving strategies focused on the environment increased parental knowledge, and 2) if increased knowledge translated to parental actions to decrease sleep negative features in the bedroom. Methods: This pilot study recruited child/parent participants through community agencies. Baseline and 6 week follow-up data collection included the Parental Sleep Environment Knowledge Questionnaire (PSEKQ), Parental Interactive Bedtime Behavior Scale, Child Sleep Habit Questionnaire, Parent Knowledge of Healthy Sleep and sleep actigraphy. Parents received the Childrens Best Bedroom for Sleep (CBBES) manual (including sleep science information, self-assessment tool and environmental modification recommendation) as the intervention. Results: There were 6 parent/child participants. The PSEKQ improved slightly (66.66% at baseline to 78.33% at follow-up). Comparing baseline and post-intervention BEAC results demonstrated that parents ability to assess their childs bedroom and act to modify environmental problems that interfered with sleep had improved. Actigraphy data was inconclusive and, because the intervention focused on the environment, as expected, there was no change in behavioural measures. Conclusion: Results support providing parents with a sleep environment psycho-education manual to build knowledge and skills for addressing environmental components of their childs sleep problems. This research is ongoing and future studies will test the CBBES with parents of children with a range of health conditions. Support: The Canadian Centre for Disability Studies

## P56

### Treatment for Children with Residual Insomnia Symptoms after Obstructive Sleep Apnea Treatment: A Usability Study

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<sup>1</sup>Dalhousie University, <sup>2</sup>University de Montreal, <sup>3</sup>PEAK Medical Group

**TOPIC:** Pediatrics

**Abstract Description** INTRODUCTION:1-3% of children are affected by obstructive sleep apnea (OSA), a disorder marked by blocked breathing during sleep. OSA is associated with harmful cognitive, emotional, and physical consequences. Over 50% of children with OSA exhibit insomnia symptoms. Of the children with both insomnia and OSA, 20-25% still have insomnia after OSA treatment. Access to treatment for residual insomnia symptoms after OSA treatment is limited, as there are few programs available and few trained practitioners to deliver these programs; however, the internet can be an effective means of increasing treatment access. Better Nights Better Days Obstructive Sleep Apnea (BNBD-OSA), is a proposed online intervention for treating pediatric insomnia following OSA treatment in children. The intervention includes the original five sessions of BNBD (an eHealth intervention designed to treat insomnia in 1-to-10-year-old children) along with one additional session focused on OSA.METHODS:The proposed project will be a usability study in which parents and health professionals will be asked to evaluate the usefulness, value, and credibility of BNBD-OSA for children. The anticipated sample includes 20 parents and 20 healthcare practitioners. Each participant will engage in online interviews and complete questionnaires about their experience with the program. Participants responses will be qualitatively analyzed with a thematic analysis. Emerging themes will result in modifications to BNBD-OSA. RESULTS:The original intervention for pediatric insomnia, BNBD, has been found to be effective thus far. It is therefore believed that BNBD-OSA will be found to be similarly effective. BNBD-OSA is anticipated to successfully treat pediatric insomnia in the context of OSA and enhance adherence to OSA treatment.CONCLUSION:If found effective, BNBD-OSA can have significant implications for e-health interventions. The program will allow effective distance treatment for pediatric insomnia in the context of OSA, significantly reducing the personal and economic costs of childhood sleep disorders.

## P57

### Family Adversity and Kindergarten Childrens Externalizing Behavior Problems: The Moderating Role of Sleep

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Evidence suggests family adversity increases children's emotional-behavioral problems (Essex et al., 2003; Sameroff, 2006). Moreover, studies have supported the moderating role of sleep in environmentally risky environments (Bordeleau et al., 2012). Our study aimed to examine: (1) the direct effects of family adversity and sleep latency and duration on children's prospective externalizing behavior problems based on mothers, fathers, and teachers report; and (2) whether sleep duration and latency moderated those relationships. Methods: We used data from the Quebec Longitudinal Study of Child Development (1998-2005) when children were aged 5 (Time 1). Sample children had mothers, fathers, and teachers reports on their externalizing problems at age 6 (Time 2, N=613), after excluding children with disabilities or chronic illness. At T1, fathers and mothers reported on family adversity measures (depression symptoms, harsh and restrictive parenting, daily stress, and conflictual marital relationships); mothers reported on childrens sleep (night-time sleep duration and sleep latency). At T2, fathers, mothers, and teachers reported on childrens externalizing behavior problems, using hyperactivity, physical aggression, and opposition subscales from the Social Behavior Questionnaire (Tremblay et al., 1991). Analyses were conducted separately for mothers, fathers, and teachers reported outcomes, controlling for childrens gender. We used the PROCESS custom dialog box for SPSS to undertake moderated regression analyses (Hayes, 2013). Results: For significant main effects, fathers linked family adversity ( $\beta=1.38$ ,  $p<0.001$ ), sleep latency ( $\beta=0.38$ ,  $p<0.001$ ), and sleep duration ( $\beta=0.18$ ,  $p<0.05$ ) to childrens externalizing behaviors. Mothers reported family adversity ( $\beta=1.25$ ,  $p<0.001$ ) affected childrens externalizing behaviors but that effect was moderated by sleep latency ( $\beta=1.12$ ,  $p=0.01$ ). Teachers reported a significant main effect of family adversity ( $\beta=0.59$ ,  $p=0.02$ ) and sleep latency ( $\beta=0.30$ ,  $p=0.03$ ) on childrens externalizing behaviors. Conclusion: Sleep latency is an important but often overlooked indicator of sleep problems. In vulnerable families, extended sleep latency is related to childrens externalizing behaviors.

## P58

### The Moderating Role of Insomnia In The Interplay Between Mood, Cognition And Internalizing Symptoms In Adolescents

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<sup>1</sup>McGill Univesrity, <sup>2</sup>Riverside School Board

**TOPIC:** Pediatrics

**Abstract Description** Cognitive models view internalizing problems as resulting from an interaction between erroneous beliefs or patterns of thought that predispose individuals to a higher likelihood of psychopathology, and negative mood. In adolescents, lower subjective sleep quality and quantity are cross-sectionally associated with negative mood, and longitudinally with increased risk of mood problems. In addition, experimentally restricting sleep in adolescents worsened mood and emotional regulation. However, few studies have explored the interplay between negative mood, cognitive bias, and insomnia as they relate to internalizing symptoms in adolescents. The objective of this study was to examine the hypothesis that insomnia moderates the associations between affective and cognitive mechanisms that underlie internalizing problems. **Methods.** Thirty five adolescents (mean age 14.9 + 1.5 years) participated in the study. Negative mood and cognitive errors were assessed using self-report measures validated for youth. Insomnia was assessed using the Pittsburgh Sleep Quality Index Scale. Internalizing problems were assessed using the Child Behavior Checklist (CBCL). **Results.** Regression analysis was used to examine the moderating role of insomnia status on the associations between negative mood and Cognitive errors. CBCL internalizing score served as the independent variable; effects of gender and chronotype were controlled for, as these variables are known to impact internalizing problems. Analyses revealed an interaction effect of insomnia status by negative mood such that, for youth with insomnia but not for youth without insomnia, negative mood was associated with higher internalizing scores. No interaction effect was found for cognitive errors. **Conclusion:** Negative affect was associated with high levels of internalizing symptoms in adolescents with insomnia but not in adolescents without insomnia. This supports the hypothesis that disrupted sleep moderates the association between mood and internalizing problems in adolescents.

## P59

### Protective and Risk Factors for Adolescent Sleep: Findings from Canada and Australia

Bartel, Kate <sup>1</sup>; Cassoff, Jamie <sup>2</sup>; Williamson, Paul <sup>3</sup>; Knuper, Brbel <sup>2</sup>; Gruber, Reut <sup>2</sup>; Gradisar, Michael <sup>3</sup>

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**TOPIC:** Pediatrics

**Abstract Description** Introduction Sleep is vital for healthy development and functioning in adolescents. A global phenomenon exists whereby adolescents do not obtain adequate sleep, especially during the school week, due to late bedtimes and early rise times. Many behavioural protective and risk factors may contribute to adolescent sleep across the school week, yet their relative degree of influence is unknown. Moreover, research is needed into whether these associations are similar within different countries. Methods The current study used a single time point, online questionnaire, to collect data across Canada and in Adelaide, Australia, to determine which behavioural factors are of largest influence for Canadian and Australian adolescents bedtime, sleep latency and sleep duration, when multiple potentially influential factors are analysed simultaneously. 193 Canadian (15.90+1.60yo, 15%*m*) and 325 Australian (15.85+1.34yo, 42%*m*) adolescents contributed data. Multiple hierarchical regression analysis demonstrated the effects of behavioural factors after controlling for age and gender (biological influences). Results Behavioural factors explained up to 50% of variance in sleep parameters for both countries. Later internet stop times were related to later bedtimes and less sleep for both Canadian and Australian adolescents. Conversely, good cognitive emotional sleep hygiene was related to shorter sleep latencies and longer sleep. Effects of other influential risk and protective factors (e.g., parent-set bedtime, after school sports) varied between countries, although some factors showed no significant association in either country (e.g., evening caffeine consumption). Conclusion Later internet stop times may be detrimental for adolescent sleep, whereas good cognitive emotional sleep hygiene should be considered helpful. This highlights that some behaviours have similar associations with adolescent sleep parameters, for both Canadian and Australian adolescents, yet, some protective and risk factors vary between countries. Thus, research and clinical work regarding adolescent sleep may need to take country of residence into account, however, overall, many similarities between countries exist.

## P60

### A scoping review of long-term non-invasive ventilation in children

Castro Codesal, Maria <sup>1</sup>; Dehaan, Kristie <sup>2</sup>; Featherstone, Robin <sup>2,3</sup>; Bedi, Prabhjot <sup>2</sup>; MacLean, Joanna <sup>4</sup>

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**TOPIC:** Pediatrics

**Abstract Description** **INTRODUCTION** Long-term non-invasive ventilation (NIV) is a common modality of breathing support used for a range of sleep and respiratory disorders. The aim of this scoping review was to provide a summary of the literature relevant to long-term NIV use in children. **METHODS** We used systematic methodology to identify 11581 studies with final inclusion of 289. The search was run in nine databases with additional grey literature sources. The search was limited to human studies published between 1990-2016. Inclusion criteria were: children 0-18; and NIV use greater than 3 months outside acute care. Study design or outcomes assessed were not limited. **RESULTS** We identified 76 terms referring to NIV. Study design characteristics were most often single center (84%), observational (63%), and retrospective (54%). NIV use was reported for 73 medical conditions with obstructive sleep apnea (29%) and spinal muscular atrophy (8%) as the most common conditions. There were significant differences in medical conditions across ages (Pearson Chi-square 112.4,  $p < 0.05$ ). Continuous positive airway pressure (CPAP) was used in 25% of studies, versus 19% bilevel positive airway pressure, 2% auto-PAP, and 42% combination of CPAP and bilevel. Outcomes from sleep studies were reported in 27% of studies followed by outcomes on respiratory morbidity such as improvement of respiratory symptoms, tracheostomy avoidance or decannulation, or reduction in post-operative complications in 15%. Reduction in other symptoms including sleep, neurocognition, mood, behavior and quality of life were reported in 5% of studies. Mortality was an outcome of interest in 6% of studies. Outcomes assessed differed by disease category (Pearson Chi-square 19.6,  $p < 0.05$ ). Adverse events and adherence were reported in 20% and 26% of articles respectively. **CONCLUSIONS** Long-term use of NIV has been documented in a large variety of pediatric patient groups with studies of lower methodological quality. Data was unevenly available across medical conditions.

## P61

### Evaluating the Effects of General Anesthesia on Sleep in Children Undergoing Elective Surgery

Selvadurai, Sarah <sup>1,2</sup>; Maynes, Jason <sup>1,2</sup>; McDonnell, Conor <sup>1,2</sup>; Cushing, Sharon <sup>1,2</sup>; Propst, Evan <sup>1,2</sup>; Lorenzo, Armando <sup>1,2</sup>; Lim, Andrew <sup>3,2</sup>; Meltzer, Lisa <sup>4</sup>; Horner, Richard <sup>2</sup>; Narang, Indra <sup>1,2</sup>

<sup>1</sup>The Hospital for Sick Children, <sup>2</sup>University of Toronto, <sup>3</sup>Sunnybrook Health Sciences Centre, <sup>4</sup>National Jewish Health, Denver

**TOPIC:** Pediatrics

**Abstract Description** Introduction Sleep disturbance during early childhood can lead to cognitive impairment, behavioural disorders and emotional dysregulation. There is increasing interest on the factors that may contribute to impaired sleep following surgery. The impact of general anesthesia on sleep has become of emerging interest. The objective of this study is to identify potential effects of a general anesthetic on sleep. Methods This is a prospective, observational study with children, aged 18 months to 8 years, undergoing general anesthesia for elective surgery. Subjects underwent actigraphy sleep monitoring for 14 days: 7 consecutive days prior to and following the surgery. Data regarding baseline behaviour patterns were collected using standardized behavioural assessments. One and three months after surgery, the actigraph was worn again for 7 days with completion of behavioural assessments. Results Eighteen patients (mean age 4.7 years, 78% male) underwent surgery. All patients received sevoflurane as the inhaled anesthetic agent. The median anesthetic duration was 111 minutes. Between baseline and 7-day postoperative period, actigraphy measures were not significantly different (sleep efficiency:  $p=0.67$ , total sleep time:  $p=0.99$ , wake after sleep onset:  $p=0.16$ , sleep onset latency:  $p=0.29$ ). Among the 18 patients, 7 patients completed both the 1- and 3-month follow-up, where no significant differences were found in actigraphy measures across all time points. Additionally, no significant differences in mean scores were found for overall internalizing behaviour, ( $F(1.24, 7.43)=0.28$ ,  $p=0.66$ ), externalizing behaviour ( $F(1.23, 7.35)=0.28$ ,  $p=0.67$ ) and executive functioning ( $F(1.02, 4.08)=0.28$ ,  $p=0.83$ ). Conclusion In this study, general anesthesia did not cause sleep disturbance or negative behaviour changes in children. These findings are reassuring to both physicians and parents.



## P62

### Family help-seeking for behavioural insomnia of childhood: What motivates parents to seek help?

Newton, Adam <sup>1</sup>; Reid, Graham <sup>1</sup>; Corkum, Penny <sup>2</sup>; Blunden, Sarah <sup>3</sup>

<sup>1</sup>Western University, <sup>2</sup>Dalhousie University, <sup>3</sup>CQ University

**TOPIC:** Pediatrics

**Abstract Description** Objectives: Behavioural Insomnia of Childhood (BIC) involves difficulties with bedtime resistance, sleep onset and quality, and affects 25% of children. Next-to-nothing is known about help-seeking processes for BIC. This study investigates the main motivator that would lead, or led, families to seek help. Method: Parents with children age 2-10 years (N = 138) reported on whether they had sought help, or considered seeking help, for BIC in the past 6 months. Motivators were assessed by asking parents the main negative impact of BIC on their childrens (e.g., behavioural problems) and on their own functioning (e.g., parents sleep), and impact on the family, that led (help-seeking parents) or would lead (non-help-seeking parents) to professional help-seeking. Results: Parents were categorized as (1) help-seeking (10%); (2) help wanted, not sought (12%); the remainder of parent did not want or seek help (78%) but were still asked about motivators. These groups reported distinct motivators for help-seeking. Concerning child factors, help-seeking parents most commonly endorsed irritability (41.7%) and social impairments (25%). The help wanted, not sought and help not wanted or sought parents reported significantly ( $p = .015$ ) different reasons - behavioural problems (~ 41%) and fatigue (~18%). Parent motivators differed, but not significantly ( $p=.07$ ), across groups. The help-seeking and help not wanted or sought most commonly endorsed the impact on their own daytime functioning (54% and 46%, respectively); help wanted, not sought parents most commonly endorsed the impact on the rest of the family (47.1%) and impact on their own daytime functioning (24%). Conclusion: There are clear differences between what parents believe will motivate their help-seeking and which impacts lead to actual help-seeking. These differences fit within models of mental health help-seeking (e.g. Revised Network Episode Model). Funding: This project is funded by the Department of Psychiatry Research Fund at Dalhousie University.

## P63

### A systematic review of adherence to long-term non-invasive ventilation in children

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**TOPIC:** Pediatrics

**Abstract Description** Background: Adherence to non-invasive ventilation (NIV) has been shown to optimize both day and nighttime gas exchange in children with documented physiological advantages. Minimal hours of treatment required for optimal effect have not been established. Variability in adherence to NIV in children also requires further examination. In this systematic review we summarized the available data on adherence and factors that influence adherence in children using NIV. Method: This extension of a scoping review on long-term NIV therapies in children identified all publications examining NIV adherence in children; 289 included publications were reviewed to identify those reporting on adherence. Grey literature sources and articles reporting only adherence rates were excluded. Data extraction on study design, sample size, intervention type, adherence measurements, barriers to adherence, and determinants of adherence will be completed. Results: Seventy five manuscripts mentioning adherence were identified from the scoping review of which 27 studies (1138 subjects) were included for data extraction. Objective measures of adherence were available in 21 (78%) of the studies. Preliminary analysis showed both patient and technology influences contributing to the variable rates of childrens adherence (e.g. patient age, interface type). Six studies reported on adherence measures, most commonly (70%) defined as an average of 4 or more hours of NIV use per night at least 5 nights a week. Only one study related adherence to outcome. This study reported longer duration of CPAP use correlated inversely with Epworth Sleepiness Scale scores. Conclusions: This systematic review revealed gaps in the evidence on objective measures used to assess adherence in long term NIV use in children. The relationship between these measures and clinical outcomes in children was also limited. Identification of factors influencing NIV use in children requires further study in order to understand how to better support children to use long term NIV.

## P64

### Maternal depression and sleep quality in early postpartum: Do maternal sleep-related cognitions and nighttime behaviours mediate the relationship?

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: While postpartum depression has been linked to poorer maternal sleep quality, the pathways underlining this relationship are not well known. This study aimed to investigate the links between maternal postpartum depression, cognitions regarding infant sleep, nighttime behaviours and reported sleep quality. We propose a model linking postpartum depression and maternal sleep quality through maternal cognitions and ensuing maternal behaviours. Methods: Using a prospective cohort study design, nulliparous women with a singleton pregnancy completed questionnaires at 18, 28, 36 weeks gestation and 5 weeks postpartum. A sample of 452 women participated in this study. Measures included the Edinburgh Postnatal Depression Scale, three subscales from the Maternal Cognitions about Infant Sleep Questionnaire (Anger, Limits and Doubt) and the Pittsburgh Sleep Quality Index. Maternal nighttime behaviours, including infant settling methods, checking, and sleep location, were assessed by a questionnaire. Path analysis was undertaken using Mplus version 7 and mediators were tested using the Indirect approach. Model fit was assessed using a variety of standard fit indices. Results: Depression is associated with maternal cognitions (Limits  $b=.20$ ;  $p=.001$ ; Anger  $b=.40$ ,  $p<.001$ ; Doubt  $b=.40$ ;  $p<.001$ ) and poorer sleep quality ( $b=.34$ ;  $p<.001$ ). Anger and doubt are associated with infant checking. Doubt is associated with sleep location (bed sharing coefficient  $=.03$ ;  $p=.007$ ; separate room coefficient  $= -.05$ ;  $p<.001$ ) and was found to mediate the relationship between depression and problematic nighttime behaviours. Both doubt and checking were found to mediate the relationship between depression and sleep quality (indirect effect  $= 0.01$ ;  $p=.031$ ). Conclusion: Some evidence substantiating the proposed maternal sleep model was found, especially pathways linking depression and sleep quality through doubt and checking behaviours. Further investigation of this model is warranted, especially in the context of developing interventions to improve maternal sleep quality during the postpartum period. Support (If Any): Funding from CIHR

## P65

### Exploring Experiences and Perceptions of Sleep Disturbance among Family Caregivers of Children who depend on Medical Technology

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Family caregivers of children with complex care needs that depend on medical technology provide skillful, vigilant homecare 24-hours/day. This responsibility has been linked to chronic sleep disturbance, placing them at risk of negative health outcomes. Informing development of a sleep promoting intervention, the following questions guided this research: What factors influence sleep among family caregivers? How do they appraise utility of sleep-promoting interventions? To what degree do they perceive sleep and related outcomes as problematic? Methods: A cross-sectional observational design using mixed data sources is underway. Participants include family caregivers with a child dependent on medical technology at night, > 3 months homecare experience and no diagnosed sleep disorders. Interviews have been completed for qualitative content analysis. Quantitative measures have been administered: Q- sort using images/text depicting sleep-promoting interventions; Scale of the Problem to measure participants appraisal of their sleep/health (unipolar Likert scale ranging 0-4). Results: Nine participants have completed study procedures. Emerging qualitative themes include: caregiver (vigilance/worries, mood/emotions, sleep habits, parenting preferences), child (age/development, equipment use, sleep quality, care needs), family (financial/household stressors, other child-care, employment demands), environment (lights/noises, personal technologies, housing, sleep location); and homecare (presence of night nursing, provider competence, family-centred service, resource constraints). To date, participants rank mindfulness/yoga (7/9), brief daily-exercise (6/9) and enhanced use of respite (6/9) their top choices among evidence-based interventions. Moreover, family caregivers appraise their sleep quality (3.2/4), daily stress (3.2/4), sleep quantity (3.0/4) and fatigue (3.0/4) to be problematic. Conclusion: Emergent qualitative findings suggest multiple factors contribute to poor quality and inadequate quantity of sleep among family caregivers when a child is medically complex. Family caregivers assign value to addressing sleep problems and support testing of evidence-based sleep interventions with demonstrated effectiveness in other caregiver (older-adult) populations. Support: Generously funded by SickKids Foundation and Holland Bloorview Research Institute.

## P66

### A Systematic Review of Sleep Quantity, Sleep Quality, Sleepiness, and Fatigue Outcomes for Parents of Children with Neurodevelopmental Disabilities

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Sleep problems are common in children with Neurodevelopmental Disabilities (NDDs), with estimates ranging from 25% to 86% (Wiggs, 2001). Short sleep duration, frequent nighttime wakes, and bedtime resistance interfere with parental sleep and aspects of daytime functioning. No previous comprehensive systematic reviews examining sleep outcomes in caregivers of children with NDDs have been published. Methods: A systematic search of five databases (Cochrane Library, Medline, EBSCOhost CINAHL, PsychINFO, EMBASE) was conducted between June and July 2016. Eligibility criteria included: English, peer-reviewed, full-text journal reports; any study design, except case reports; sample including parent caregivers of a child with a NDD; sleep quantity, sleep quality, sleepiness, and/or fatigue outcomes reported. Studies were appraised using NHLBI Quality Assessment tools. Results: Of 7534 citations retrieved, 7444 were removed after screening titles and abstracts for duplicates and exclusion criteria. Screening the 90 remaining full texts left 33 meeting eligibility criteria. Most (n=27) were cross-sectional, included a range of NDDs and were of poor (n=14) or fair (n=17) quality. One of two good quality studies found parents of children with NDDs slept significantly fewer minutes at night than parents with typically developing children (TD). Parents of children with NDDs consistently reported (n=10 studies) significantly poorer subjective sleep quality using the Pittsburgh Sleep Quality Index. No studies compared sleepiness across samples, and fatigue was not measured consistently across studies. Although maternal (n=16) and parental/caregiver (n=17) sleep were frequently examined, no studies exclusively reported on paternal sleep. Conclusions: Parents of children with NDDs report significantly poorer sleep quality compared to parents of TD children. There is a paucity of good quality comparative studies, using well-validated measures, that examine sleep duration, daytime sleepiness, and/or fatigue. Future research should aim to fill this gap, providing greater insight to parents experiences and identifying targets for intervention design and evaluation.

## P67

### The Relationship between Sleep Problems and Fluid and Crystallized Cognition in Children with Mild Traumatic Brain Injury and Orthopedic Injury at 3 Months Post-Injury

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: The relationship of injury type and sleep problems to fluid and crystallized cognition at 3 months post-injury was examined in children with mild traumatic brain injury (mTBI) or orthopedic injury (OI). Methods: 58 children with mTBI and 34 children with OI aged 8 to 15 years of age were recruited from the Emergency Department of two Ohio children's hospitals at the time of their injury. At 3 months post-injury, parents rated their children's post-injury sleep problems (Sleep Disorders Inventory for Students). Children completed a battery of cognitive measures to assess fluid and crystallized cognition (NIH toolbox). Multiple linear regression was used to test whether, after controlling for age, sleep problems and injury type significantly predicted fluid and crystallized cognition at 3 months post-injury. Results: Together age, sleep problems, and injury type explained a significant amount of variance in fluid ( $R^2 = .095$ ,  $p = .035$ ), but not crystallized cognition ( $R^2 = .019$ ,  $p = .644$ ) at 3 months post-injury. After controlling for age, sleep problems ( $\beta = -2.25$ ,  $p = .027$ ), but not injury type ( $\beta = -1.85$ ,  $p = .077$ ) significantly predicted fluid cognition at 3 months post-injury. The interaction of sleep problems and injury type did not account for significant additional variance in either fluid ( $R^2$  change = .000,  $p = .979$ ) or crystallized cognition ( $R^2$  change = .038,  $p = .065$ ) at 3 months post-injury. Conclusion: Children with mTBI or OI who have greater parent-reported sleep problems at 3 months post-injury perform poorer on measures of fluid cognition than children with mTBI or OI who have fewer parent-reported sleep problems at 3 months post-injury. Consistent with previous literature, poorer sleep was related to poorer outcome following injury in children and youth and is an important target for intervention, regardless of injury type. Support: The research was funded by a grant from the United States National Institutes of Health to Keith Yeates (1R01HD076885).

## P68

### **Barriers and Facilitators to Accessing and Providing Treatment for Insomnia in Children with Neurodevelopmental Disorders: Parent and Health Care Professional Perspectives**

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Insomnia is highly prevalent in children with neurodevelopmental disorders (NDD) including Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (ADHD), Fetal Alcohol Spectrum Disorder (FASD), and Cerebral Palsy (CP), ranging from 50-95%. Although treating insomnia is critical to reduce negative effects on child functioning, little research exists on insomnia treatment access and provision for this population. Our objectives were to identify barriers and facilitators experienced by parents of children with NDD and the Health Care Providers (HCPs) who work with them, related to access, uptake, and implementation or provision of insomnia treatment. Methods: Parents of 4- to 12-year-olds diagnosed with ASD, ADHD, FASD, and/or CP, and HCPs who worked with this population, were recruited to participate in separate online audio/video synchronous focus groups and interviews. Data collection will be complete in Jan. 2017. Current [anticipated] ns: HCPs, 42 [45] and Parents, 39 [45]. Focus group/interview transcripts were qualitatively analyzed using conventional content analysis (coding for key themes, grouped into barriers and facilitators). Results: Key themes emerged from parents/HCPs across all NDDs: 1) Insomnia treatment is challenging compared to treatment for other problems due to high impact on family, complex causes, need for individualization, and sleep being one of many challenges competing for these parents attention; 2) Limited awareness of and knowledge about insomnia, and how to access help for both parents and HCPs; 3) Consistency with routines and perseverance are helpful; 4) Sleep-related beliefs and attitudes influence parents seeking treatment for, and HCPs willingness to treat insomnia. Conclusions: Both parents and HCPs reported high perceived need for individualized treatment, yet described using similar behavioural strategies across NDD diagnoses. Results will inform the modification of Better Nights, Better Days, an online parent-mediated insomnia intervention for typically-developing children, into a version for children with NDD. Support: SSRHC; NSHRF; Kids Brain Health Network (NeuroDevNet)

## P69

### Poor sleep has negative implications for children with and without ADHD, but in different ways

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: Sleep problems are commonly reported in attention deficit/hyperactivity disorder (ADHD), but are also a familiar feature of typical development (TD). In this study we sought to elucidate the relationship between sleep, ADHD-trait behaviours and cognitive inattention, and how it manifests between ADHD and TD child populations. Methods: Eighteen children diagnosed with ADHD and 20 age-matched TD controls aged 5-11-year-old participated in the study. Sleep profiles were assessed using Childrens Sleep Habits Questionnaire and actigraphy measures. Behavioural functioning was examined using Conners Parent Report Scale and attention using the computerised Conners Continuous Performance Task. Results: We found evidence of 1) poorer sleep quality in the ADHD group, despite no difference in actual sleep time; 2) poor sleep quality in TD children predicted increased ADHD-trait behaviours, despite no association with cognitive inattention; 3) a consistent trend for poor sleep quality predicted reduced attentional control in ADHD children, despite no association with behaviour. Conclusions: Poor sleep quality affects developmental sub-groups in different ways. For ADHD children poor sleep worsens their predisposed attentional deficit, whilst for TD children it mimics ADHD behaviours. These findings have important implications for the debate on over-diagnosis of childhood ADHD, and the use of sleep-based interventions. Above all, they highlight the importance of promoting good sleep hygiene in all children especially in this era of high sugar and caffeine diets, and readily accessible night-time distractors.



## P70

### A systematic review of health outcomes for children with neuromuscular disorders using long term non-invasive ventilation.

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**TOPIC:** Pediatrics

**Abstract Description** Introduction: The use of long-term non-invasive ventilation (NIV) for the treatment of sleep disordered breathing and chronic respiratory insufficiency is well established for children with neuromuscular disease. Despite this, the benefits of this therapy on health outcomes are unclear. The aim of this systematic review is to synthesize the published data relevant to health outcomes in children with neuromuscular disease using NIV. Method: A scoping review was performed to identify all publication on children using long-term NIV since 1990, and 289 publications were included. These articles were screened by 2 reviewers to identify studies with discrete data on children with identified neuromuscular disease reporting on at least one of our outcome of interest: survival, hospitalization, lung function, sleep quality, quality of life, and healthcare costs. Results: A total of 34 publications were identified for inclusion; 797 children with 30 different neuromuscular conditions were included across these studies. The most common neuromuscular conditions were spinal muscular atrophy (52%) and Duchenne muscular dystrophy (31%). The most commonly studied outcomes of interest were survival (50%), lung function (41%), hospitalization (35%) and sleep (29%) with a minority of publications on quality of life or healthcare costs (5% each). All measures of sleep pertained to respiratory function during sleep. Preliminary analysis shows benefits of NIV for survival, lung function, hospitalization and respiratory function during sleep though the magnitude of these benefits are small. Conclusion: The majority of the literature relevant to the use of NIV in children with neuromuscular disease is focused on spinal muscular atrophy and Duchenne muscular dystrophy. Despite an emphasis on starting NIV early in clinical care to preserve function, the bulk of the evidence for its use related to later stage of disease with limited data to support NIV as a means of improving sleep quality or quality of life.

## Respiratory Physiology

### P71

#### Occurrence and Effect of Abdominal Muscle Recruitment During Sleep in Neonatal and Juvenile Rats

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**TOPIC:** Respiratory Physiology

**Abstract Description** Breathing and sleeping are two processes regulated by homeostasis that are necessary for survival. During sleep, specifically rapid eye movement sleep, breathing is more frequently prone to irregularities in both humans and rodents, especially in preterm and full term newborns. Previous work in our laboratory has demonstrated the occurrence of frequent recruitment of abdominal muscle activity in adult rats during REM sleep, despite REM induced postural muscle atonia. This recruitment was also associated with an increase in tidal volume and respiratory stability. Little is known about occurrence of expiratory activity in perinatal rats, specifically across sleep states, and how this recruitment contributes to ventilation. In this study our objective is to investigate the occurrence and the significance of expiratory modulated abdominal muscle recruitment across sleep wake cycles in the postnatal period (postnatal day, P0 to P14) of rats. We hypothesize that in the postnatal period, expiratory muscle activity is also recruited across sleep states and its recruitment contributes to stabilize ventilation, specifically during irregular breathing. We instrumented newborn and juvenile rats with EMG electrodes in neck, intercostal and abdominal muscles and recorded breathing parameters and overt behavior inside a whole body plethysmograph. Our results suggest that neonatal rats experience frequent abdominal muscle recruitment events, which occur in both active and quiet sleep. Our results further indicate that respiratory rate is less variable with onset of abdominal muscle recruitment in active sleep. We conclude that occurrence of expiratory activity is associated with stabilization and potentiation of ventilation during sleep in the postnatal period.

## Sleep and Behaviour

### P72

#### The effects of excessive smartphone and other mobile ICTs use by millennials on their sleep and rest quality: Implications for public health

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Canadians are among the worlds leading users of mobile information and communication technologies (ICTs) such as smartphones, and over half report using their devices in the bedroom. Currently, little is known about the negative health effects associated with ICTs, which are associated with maintaining optimal mental and physical health. Methods: A cross-sectional design study employing non-random purposive sampling involving 245 females and 175 males (N= 420 total) of undergraduate students aged 18 to 35 years who are high-end users of ICTs, was undertaken in Oshawa, Ontario. Data collection consisted of the 85 item Mobile Technology Use and Health Outcomes Questionnaire (MTUHOQ).Results: The mean age of females was 20.6 +/- 3.3 S.D. and the mean age of males was 21.3 +/- 3.4 S.D. The mean numbers of hours slept per night for females was 6.9 +/- 1.4 and 6.8 +/- 1.2 for males. During the school week, males rated their hours of sleep as 5.7 +/- 1.06 and females rated theirs as 5.9 +/- 1.06. During the weekend, males rate their hours slept as 8.03 +/- 1.37 and females rated their hours of sleep as 8.61 +/- 1.54. 81% of females and 87% of males reported using their smartphones in the bedroom, and 88.6% of males and 86.9% of females reported sleeping with their smartphone next to their bed. Using a Likert-type scale where 0=very poor and 5=excellent, females rated their current sleep and rest quality as 1.3 +/- 0.9, and males reported it as 1.1 +/- 0.9, respectively. Conclusion: This study provides preliminary evidence that the presence and use of ICTs in the bedroom may result in negative health outcomes associated with sleep disturbance, which causes adverse health effects in university students.

## P73

### Identifying current practices and opportunities for strength-based interventions to improve university students sleep habits and outcomes: A campus wide survey

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Concerningly sleep deficiency is a routinely accepted part of university even though it exerts a significant toll on physical and emotional health, and decreases capacity for critical academic skills including learning, memory and problem-solving. The relationship between sleep deficiency in university students and risk-taking behaviours such as drink driving, mental health conditions including suicidality, depression and anxiety, decreased self-efficacy, substance misuse, binge drinking and excessive caffeine consumption, smoking and high rates of social media use is clear. Students bring poor sleep habits and pre-existing sleep disorders into their pursuit of higher education. Compounding these pre-existing factors are new social and financial pressures, increased anxiety, and sleep-disruptive living environments. Students sacrifice sleep in pursuit of higher grades and academic achievement regardless of evidence that self-reported sleep quality and frequency significantly predict grades. **Method:** We carry out a campus-wide anonymous internet survey determining students self-reported sleep patterns, sources of advice for sleep problems, current sleep promoting practices, and preferred mechanisms to receive new information assisting with sleep problems. **Results:** 1,294 students (78.0% undergraduates; 87.5% living off-campus, 77.5% female) from the University of Alberta, Canada participated. 30.5% reported sleeping less than 6.5 hours a night; 66.5% stated they had insufficient sleep; 80.6% reported they had not sought help. Those that did seek help turned to family/friends and physicians for the most part. The three most frequent behaviours students used to aid sleep were reading a book, listening to music, and adjusting the heat. Participants preferences for receiving more information were predominately short-online video clips with an option to contact someone for one-to-one more personalized advice. **Conclusion:** Although widely reported, students seldom sought help for sleep problems. Students already practice several sleep strategies (reading books for example) that, employing a strengths-based behavioural change intervention, could potentially be modified providing evidence-based sleep promoting strategies.

## P74

### Left anterior insula activity and functional connectivity are modulated by sleep quality in an emotional empathy task

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**TOPIC:** Sleep and Behaviour

**Abstract Description** A recent study has shown that sleep quality is predictive of the emotional empathic responses of the individuals, particularly in negative contexts. Here, we investigated the neural mechanism underlying such a relationship. We assessed subjective sleep quality (PSQI, ISI, questions from the CSD-E) in 107 healthy young volunteers, and asked participants to complete a computerized emotional empathy task evaluating their emotional empathic responses towards negative, neutral, scrambled, and sleep related images. Sixteen out of the 107 participants completed the emotional empathy task while undergoing functional Magnetic Resonance Imaging (fMRI). We conducted a Region of Interest (ROI) analysis using the Atlas of intrinsic connectivity of homotopic areas (Aicha) and selected ROIs based on a meta-analysis defining the core network for emotional empathy. We looked at Blood Oxygen Level Dependent (BOLD) signal change while participants performed the emotional empathy task, and measured how the BOLD signal detected in the ROIs was temporally correlated during the task (i.e. task-based functional connectivity). The behavioral data in the large sample (N=107) confirmed previous findings showing that subjective sleep quality accounts for variability in empathy scores while processing negative images. The neuroimaging data, revealed increased BOLD signal change in a selective region within the left anterior insula (parcellation 153 of the Aicha atlas) for individuals with better subjective sleep quality; further analyses revealed that sleep quality modulates the functional connectivity between the parcellation 153 and the other subcomponents of the anterior insula, with better sleep quality related to decreased functional connectivity between those areas, suggesting a functional specialization of different areas within the the anterior insula as modulated by sleep quality. These findings provide evidence that sleep quality affects emotional empathic responses in negative situations through a modulation of the activity and functional connectivity of Aicha area 153 and all other areas of the anterior insula.

**Presentation Type:** Oral Presentation with Poster Presentation

## P75

### Effectiveness of Hand Self-Shiatsu for Post Sport-related Concussion Sleep Disturbance in Young Athletes

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Sport-related concussion (SRC) is a prevalent injury with significant health consequences, especially in youth. One important, but under-addressed area, is sleep. Lack of sleep is considered a risk factor for many health issues. Sleep deficiency also affects learning ability, memory and can lead to suboptimal academic performance, which is significant for youth. Furthermore, not only does a SRC increase the risk of sleep problems, in turn, sleep problems affect recovery from SRC and increase the risk of recurrence. Hand self-Shiatsu (HSS) is a form of Complementary and Alternative Medicine (CAM). The mechanism of HSS may relate to bio-physiological effects and/or have a psychological basis in the reduction of negative rumination triggering stress response before sleep. Promising outcomes of HSS were found with chronic pain patients in a pilot study and the literature suggests that HSS is an approach worth studying further in larger studies of various patient populations. There are social and economic considerations making athletes an important population for investigation. This study tests HSS as a CAM approach to improve sleep onset and maintenance in young concussed athletes. Methods: Using consecutive case series study design, we recruited 18-25 year olds with self-reported sport-related concussion and a comparison group with no-concussion. After 7-day sleep diary and baseline actigraphy data collection, participants were taught to apply the standardized HSS technique and instructed to use it every night before bed and during awakenings. Follow-up data collection occurred at 4 and 8 weeks. Additional standardized sleep and CAMs questionnaires were included at baseline and follow-up collecting data about self-reported sleep quality, daytime fatigue and the attitudes toward HSS. Results and Conclusion: Follow-up and data analysis is underway. Preliminary data indicate some differences between groups. Final analysis will be completed early 2017.

## P76

### Neural Correlates of human cognitive abilities during sleep

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction Spindles are one of the only known electrophysiological oscillations identified as a biological marker of cognitive abilities typically assessed by intelligence tests. Spindles are highly correlated to trait-like Reasoning, but not Verbal abilities. This relationship is independent of sleep quality and circadian-related factors (e.g., chronotype). Simultaneous electroencephalography and functional magnetic resonance imaging (EEG-fMRI) have revealed brain activations which occur during spindles, including thalami, paralimbic, striatal and motor cortical areas. Interestingly, these regions are known to support Reasoning abilities. However, the neural correlates of the relationship between spindles and cognitive abilities are unknown. Using simultaneous EEG-fMRI during sleep, we seek to identify, for the first time, the neural activation patterns time-locked to spindles that are related to cognitive abilities. This will provide insight into the neural basis of the functional significance of spindles. Methods A total of 29 healthy adults (17 females; age=243.9) completed the Cambridge Brain Sciences (CBS) Trials online prior to the experimental session (21h00-23h00) where simultaneous EEG-fMRI was recorded while subjects slept in the MRI scanner. CBS Trials yields Reasoning, Verbal and Short Term Memory (STM) subscales. Results 1) Similar to previous studies, spindles detected at Cz (11-16Hz) in non-rapid eye movement sleep were related to Reasoning but not Verbal or STM abilities, and, 2) activations time-locked to spindles were observed in the thalamus, bilateral striatum, middle cingulate cortex, and cerebellum. 3) Importantly, Reasoning abilities were correlated with spindle-related activation in a subset of these regions including the thalamus, bilateral striatum, medial frontal gyrus, middle cingulate cortex, and precuneus. No spindle-related activations were correlated to Verbal abilities or STM. Conclusion Our results show for the first time, that brain areas known to support Reasoning abilities were activated time-locked to spindles, and were specifically related to interindividual differences in Reasoning but not Verbal, or STM abilities.

## P77

### A review of music as a non-pharmacological sleep intervention for post-secondary students

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Sleep deficiency (SD) is a prevalent problem among post-secondary student (PSS) populations and has serious negative consequences for physical, cognitive, and psychological well-being. In a survey of 1294 Canadian PSSs, 31.3% reported listening to music four or more times a week as a non-pharmacological sleep intervention (NPSI) (1). We are currently developing a study using sleep-promoting music as an evidence-based NPSI to help reduce SD in PSS populations. Influencing sleep behavioral change is not a straightforward process; consequently we will also test the use of social marketing theory principles as a study recruitment and intervention delivery vehicle. Objectives: To identify and synthesize the evidence for 1) sleep-promoting music, and 2) the effectiveness of social marketing principles to deliver a NPSI within the PSS population. Methods: A key-word search of the literature was carried out on the electronic data bases Scopus, Web of Science, Embase, and PubMed. A medical librarian was consulted and citations of the retrieved literature were manually scanned for any relevant studies. Results: The search yielded 28 studies examining the effects of music on sleep, and 10 studies, relevant to PSS populations, testing social marketing approaches. The retrieved evidence is being synthesized and findings will be discussed. Preliminary evidence suggests there is a base of support for sleep-promoting music and social marketing may offer an evidence-based approach to foster beneficial sleep behavior change. Conclusion: This review will guide development of a study testing a campus-wide music-based sleep intervention strategy. The review findings will also be relevant to other researchers and clinicians interested in the use of music as a NPSI and social marketing approaches to delivering sleep interventions.(1) Brown, C. A., Qin, P., & Esmail, S. (2016). Sleep? Maybe laterA cross-campus survey of university students and sleep practices. (Manuscript in review, contact cary.brown@ualberta.ca for more detail)



## P78

### Increase in Homer 1a with wakefulness occurs in the claustrum, a highly interconnected structure

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Homer proteins are a component of the postsynaptic density of neurons that are necessary for the maintenance and consolidation of behavioral state. The dominant negative protein Homer 1a is rapidly increased by neuronal activity and sleep loss. Homer1a knockout mice with globally absent Homer1a have reduced ability to sustain wakefulness during the active period. Homer1 is expressed widely in the central nervous system as well as peripheral tissue. It is not known whether Homer1a is required globally or in very specific brain regions/neurons for its role in maintaining wake. We used in situ hybridization (ISH) to identify the brain regions and neurons in which Homer 1a expression increased with sleep loss. Methods: Male C57BL/6 mice (n=8/group) were kept awake using gentle handling for 1 and 3 hours respectively and the brains were harvested for ISH studies. Undisturbed mice (n=8) sacrificed at the same diurnal time point were used as controls. Brains from mice (n=3) allowed recovery sleep for 3 hours were also used. ISH using sense and antisense cRNA probes generated from mouse Homer plasmid were used. Results: Homer1a mRNA is upregulated within 1 hour of enforced waking in the claustrum, piriform and motor cortices. Homer1a expression in these regions as well as the cingulate cortex is further increased with 3 hours of sleep loss with the largest increase observed in the claustrum. There was no increase in expression in neuronal groups known to regulate sleep and wake. Conclusion: Homer1a is upregulated early primarily in the claustrum. The claustrum which is a subcortical gray matter structure located beneath the insular cortex and above the striatum is the most connected structure in the human brain per unit volume with connections to all regions of the cortex. The role of the claustrum in regulation of behavioral state remains to be determined.

## P79

### Dynamic Functional Connectivity Analysis Reveals Temporal Features that Vary Between Wake and Stage 2 Sleep

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**TOPIC:** Sleep and Behaviour

**Abstract Description** The transition from wakefulness to sleep is marked by profound changes in neurophysiology, suggesting changes in awareness might be accompanied by changes in functional network organization. Evidence in support of this association however is mixed, with many studies reporting few differences in inter- or intra-network connectivity across wakefulness and sleep. One possibility is that standard methods that assume a static connectivity architecture obscure dynamic connectivity differences that are observable on shorter timescales. To investigate this possibility, brain activity of 38 healthy adult participants (16 males, mean age, 21.7 years) was measured via simultaneous fMRI/EEG in a Siemens Prisma 3T scanner and BrainVision EEG cap as participants transitioned from being fully awake to deeply asleep. EEG data were used to classify sleep stages. In all, 21, 7, 21, and 10 participants had sufficient data to measure static and dynamic functional connectivity (FC) across wake, Stage-1, Stage-2, and Stage-3 sleep respectively. Preprocessed fMRI volumes acquired during these time periods were ICA-decomposed using GIFT software, yielding 42-independent neurophysiologically plausible sources. Resulting time courses were used to estimate static (or mean) FC (via Pearson correlation) and dynamic FC (via sliding window method; window-size = 15TRs, time-step = 1TR, 7-state k-means solution) during these time periods. Consistent with previous findings, mean FC in Wake and Stage-2 sleep were highly comparable, and were marked by strong intra-network connectivity and weaker inter-network connectivity. By contrast, dynamic analysis revealed marked differences in the frequency of expression of 4/7 connectivity states when comparing wake with Stage-2 sleep (N = 21). Interestingly, a connectivity state marked by a disconnection between subcortical and cortical networks was more frequently expressed in Stage-2 sleep than in Wake. The current analysis suggests traditional FC analyses that assume a static connectivity architecture may obscure differences in FC that are observable on a finer temporal scale.

**Presentation Type:** Oral Presentation with Poster Presentation

## P80

### Activation of glutamate cells in the subcoeruleus nucleus triggers cataplexy-like attacks in wild-type mice.

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**TOPIC:** Sleep and Behaviour

**Abstract Description** INTRODUCTION: Cataplexy is characterized by the sudden uncontrollable loss in skeletal muscle tone during wakefulness and is hypothesized to be triggered by the same brainstem circuits that generate REM sleep. Recently, we determined that glutamate neurons in the subcoeruleus nucleus (SubC) are an important neural substrate for controlling REM sleep. Here, we aimed to determine if optogenetic activation of glutamate neurons in the SubC could produce cataplexy in wild-type mice. METHODS: To manipulate glutamate neurons of the SubC we bilaterally infused 200nL of an adeno-associated viral vector (AAV) containing a stabilized step-function opsin (AAV-EF1a-DIO-hChR2(C128S/D156A)-mCherry) into the SubC of mice expressing cre-recombinase in glutamate cells (vglut-cre). Animals were instrumented with EEG and EMG electrodes in order to monitor sleep-wake behaviors. SubC neurons were stimulated with brief pulses of blue light (50ms) applied every 10s for one hour, after which a single pulse of green light (50ms) was applied to terminate neuronal activation. Only animals with opsin expression and optic fibres targeted to the SubC were used for analysis. RESULTS: Under baseline conditions mice exhibited typical amounts of wake, non-REM and REM sleep and showed no evidence of cataplexy. However, activation of glutamate cells in the SubC triggered repeated behavioural arrests that strongly resembled cataplexy attacks in narcoleptic mice. During the 1-hour stimulation period mice experienced 42 ± 4 (n=2) cataplexy-like attacks that were 65 ± 5s in length. However, cataplexy-like attacks disappeared, and normal sleep-wake behaviours resumed, after SubC stimulation was optically terminated. CONCLUSION: Our results suggest that glutamate cells in the SubC are a potential neural substrate for triggering muscle paralysis during cataplexy.

**Presentation Type:** Oral Presentation with Poster Presentation

## P81

### Effects of Prolonged Wakefulness on Risk Taking in a Driving Simulator.

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: There is a considerable amount of evidence that sleepiness impairs driving performance. The effect of sleepiness on risk taking is more equivocal but there is some evidence that risk taking increases in sleep deprived individuals and that risk taking increases in men but not women. The present study investigated the hypothesis that prolonged wakefulness would increase risky driving. Methods: Participants (17F; 19M; Mean age = 20.5y) completed four simulated 30-minute driving sessions in the York Driving Simulator at 2400, 0200, 0400 and 0600. Stanford Sleepiness 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 difference 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. Results: As risk levels increased drivers allowed more cars to pass before turning ( $F(1,34)=4.91, p=0.033$ ). While prolonged wakefulness did not affect risk taking in women, men waited for significantly fewer cars to pass ( $F(3,102)=4.26, p=0.024$ ) as wakefulness was prolonged. There were no significant effects of these factors on response time. Conclusion: The hypothesis was supported for men but not women. The findings are consistent with other findings suggesting a gender difference in the impact of sleepiness on risk taking. Support: A grant from Queens University to A.W. MacLean. We are grateful to Martin York for support of the York Driving Simulator.

## P82

### Keeping it together: Inter-trial coherence of event-related potentials after sleep deprivation.

Balakumar, Sahithya <sup>1</sup>; Murphy, Tim <sup>1</sup>; Campopiano, Allan <sup>1</sup>; Kubishyn, Natalia <sup>2</sup>; Sherk, Lacey <sup>1</sup>; Segalowitz, Sidney <sup>1</sup>

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**TOPIC:** Sleep and Behaviour

**Abstract Description** INTRODUCTION: Sleep deprivation is well known to impair brain function and lead to increased variability in tasks requiring a timed response. Jackson et al. (2008) showed that 18 hours of sleep deprivation had no effect on the P100 amplitude but diminishes P300 amplitude, concluding that the effects of sleep deprivation occurred later in the cognitive processing of their task. Instead of examining averaged ERP amplitudes, we examined stability in two ERP components, the Error-Related Negativity (ERN) and the P100, by examining the inter-trial coherence (ITC), which is a measure of phase angle alignment between trials. The ERN is response locked and produced after subjective recognition of an error, and the P100 is stimulus locked and elicited during early stages of visual processing. OBJECTIVE: To investigate whether there is a higher degree of ITC when subjects are alert during a flanker task compared to sleep deprived. METHODS: 12 participants (mean age=20, SD=1.8, 4 males) were tested after 2 hours and 20 hours of wakefulness (counterbalanced). A flanker task (480 trials, 360 incongruent) was presented during each session (response keys were counterbalanced across participants). EEG data were recorded from a 128-channel EGI HydroCel Geodesic Sensory system. Trials were bootstrapped 1000 times with 20% trimmed means to produce the ITC results. ERN analyses were conducted at frontocentral sites and P100 analyses were conducted at occipital sites. RESULTS: The ITC values for the P100 showed significant differences between alert and sleepy conditions while there were no differences for the ERN. CONCLUSIONS: These results indicate that the effects of sleep deprivation may occur very early in the information processing stream during simple tasks and further research involving analysis of the stability of early visual processes is warranted.

## P83

### Waking EEG Connectivity Changes Differently in Young and Elderly Adults After a Total Night of Sleep Loss

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**TOPIC:** Sleep and Behaviour

**Abstract Description** **OBJECTIVE:** Research report robust change in functional connectivity (FC) during waking resting state after sleep loss in young adults. However, age-related effects of sleep loss on FC have not yet been reported. The present study therefore compared waking EEG connectivity before and after sleep deprivation in young and elderly adults. **METHODS:** Thirteen young (9W;20-28y.o., mean=24.32.7 and 12 elderly (6W;60-70 y.o., mean=64.13.4) healthy subjects were sleep deprived for 26 hours. Two waking EEGs were recorded: after 10 minutes and after 24 hours of wakefulness. In both age groups, imaginary coherence (IC; Fisher transformed) differences between the two experimental conditions were assessed with a standardized Z-stat. A non-parametric test on the max-stat and a permutation resampling allowed to account for multiple comparisons (between pairs of electrodes) in a FDR like thresholding ( $p < 0.05$ ) for significance. These analyses were performed in the anterior-posterior axis (Frontal, Central, Parietal, Occipital) for delta, theta, alpha, and beta bands. **RESULTS:** In the elderly, sleep loss induced an increased IC as compared to wakefulness in delta between central and parietal derivations, in alpha and theta between frontal, parietal and occipital derivations, and in beta between most derivations. In the young, sleep loss induced an increased IC in delta between parietal and occipital and in beta between frontal and parietal derivations. When comparing the two age groups, young subjects showed significantly stronger increase in IC after sleep loss in delta (P3-O1, P4-O1). However, older individuals showed stronger increase in coherence in theta (F3-F4, F3-P3) and beta (F4-O2). **CONCLUSION:** Overall, sleep loss increased EEG FC. Stronger impact of sleep loss in delta in the young subjects support the idea that they are more sensitive to the accumulation of wakefulness than older individuals. Interestingly, older subjects show stronger effects of the deprivation in theta and beta. This may reflect an adaptive mechanism to sustain performance level. Supported by NSERC, FRQNT, CIHR & FRQ-S.

**Presentation Type:** Oral Presentation with Poster Presentation

## P84

### **NREM and REM Sleep Induced by Orexin Receptor Antagonists Relative to GABA Receptor Modulators Across Preclinical Species**

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<sup>1</sup>Merck Research Laboratories, West Point, PA, USA, <sup>2</sup>Merck Research Laboratories

**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Pharmacological blockade of orexin receptors (OX1R, OX2R) attenuates the arousal promoting activity of orexin to promote sleep, and represents an alternative therapeutic approach to treat insomnia relative to GABA-A receptor modulators. The contribution of OX1R and OX2R in the regulation of arousal and vigilance states important for the sleep-promoting mechanism of dual orexin receptor antagonists (DORAs) and OX2R-specific antagonists (2-SORAs), however, remains unclear. Methods: Preclinical species (mice, rats, dogs and non-human primates) were implanted with radio-telemetry recording devices (Data Sciences International) and sleep parameters were collected across 3-5 days of drug administration. Utilizing Somnologica (Medcare) automated software modules, ECoG, EMG, EOG (dog, NHP) was recorded to quantify sleep stages. Changes in sleep stage magnitude over 2 hours following dosing was correlated with hOX2R receptor occupancy at C<sub>max</sub> in transgenic rats. A randomized, double-blind, 4-period cross over phase I study was conducted to measure polysomnographic responses to single doses of MK-1064 in 20 healthy males. Results: In rats, DORA treatment induced sleep architecture, including REM sleep statistically similar to that seen during normal resting phase sleep after vehicle treatment, while GABA-A receptor modulators reduced REM sleep in rodents, and intriguing induced wakefulness in dogs. Although OX2R blockade appears sufficient to induce sleep as demonstrated with 2-SORAs and genetic mouse models, OX1R appears to reduce the threshold for sleep stage transitions. In rats, sleep promoting effects of DORAs occurred at lower OX2R occupancies relative to 2-SORAs. Induction of both NREM and REM sleep was observed in response to the 2-SORA, MK-1064, across all species, including humans. Conclusion: DORAs appear to promote sleep by decreasing arousal and reducing the threshold for sleep stage transitions. Unlike GABA-A receptor modulators, orexin receptor antagonists (DORAs and 2-SORAs) promote both NREM and REM sleep across mammalian species. This research was funded by Merck & Co., Inc.

## P85

### Treatment for sleep apnea lowers work-related burnout by reducing daytime sleepiness

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction Sleep apnea (OSA) is one of the most common sleep disorders in the adult population and has detrimental impacts on daily functioning. Receiving treatment for OSA is known to have positive effects on sleep-related outcomes and daytime functioning, however less is known about the effects of treatment on work-related outcomes. The work-related outcome of interest in the current study was burnout. Burnout is a relatively common and costly outcome for organizations. We hypothesized that receiving treatment for OSA would positively affect daytime sleepiness and that the positive change in daytime sleepiness with treatment for OSA would lead to improvements in burnout across time.

**Methods** 131 adults referred to a mid-sized hospital's sleep laboratory with possible OSA agreed to participate in this study. All participants completed questionnaires before their overnight sleep study, and again one month and three months thereafter. 89 participants received treatment for OSA (either positional therapy or continuous positive airway pressure) and 42 participants did not receive treatment. The apnea-hypopnea index of the treatment and non-treatment groups was  $M = 31.3$  ( $SD = 32.1$ ) and  $M = 4.78$  ( $SD = 2.9$ ) respectively. The average age of the participants was 45.2 ( $SD = 10.2$ ) and 57% were men, with an average of 42.8 work hours per week. To test the hypothesis a cross domain latent growth curve model was used, where the slope of daytime sleepiness was used to predict the slope of burnout.

**Results** Individuals who received treatment for OSA had improvements in daytime sleepiness over time ( $\beta = -1.295$ ,  $SE = 0.52$ ,  $p < .05$ ). The change in daytime sleepiness predicted improvements in work-related burnout over time for the treatment group only ( $\beta = 0.83$ ,  $SE = 0.40$ ,  $p < .05$ ).

**Conclusion** Receiving treatment for OSA improved daytime sleepiness and improvements in daytime sleepiness led to improvements in burnout.



## P86

### Sleep Problems in Children with Down Syndrome

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Individuals with Down syndrome commonly experience sleep problems, including sleep disordered breathing (SDB), parasomnias, and insomnia. We investigated sleep problems in individuals residing in British Columbia (BC), Alberta (AB) and Ontario (ON). Methods: An anonymous online REDCap survey for parents/caregivers of individuals with DS was conducted in 2015. The survey was comprised of 80 questions in 5 parts: (i) demographics, (ii) diagnoses, medications and supplements, (iii) development, (iv) sleep/wake-behaviours, and (v) feedback/testimonials. We analyzed the sleep/wake-behaviour results with focus on the associated categorical diagnoses provided by professionals versus descriptive symptoms reported by caregivers. Results: 346 responses from BC, AB, and ON were received; 311/346 responded to the sleep sections specifically and 22% reporting sleep problems (BC: 19%; AB: 36%; ON: 21%). Percentages of categorical diagnoses and descriptive symptoms (2+,3+,4+) for SDB: BC 16/(66,43,21); AB 31/(71,51,22); ON 17/(56,41,11); parasomnias: BC 4/(17,5,0), AB 2/(11,2,2), ON 3/(7,4,0); and insomnia (1+,2): BC 15/(53,18); AB 22/(56,13); ON 7/(41,4). Conclusion: Across the three provinces, the number of reported symptoms was significantly higher than the frequency of diagnosed sleep disorders among individuals with DS. While SDB requires a formal sleep study for diagnosis, the diagnosis of insomnia and parasomnias is based on capturing descriptive symptoms. These results underline the necessity to bridge information gaps regarding sleep problems in the healthcare system in order to overcome under-diagnosis. We suggest bridging the gaps by enabling parents to share observation-based symptoms in a structured way with involved professionals using a Down syndrome medical care app.

## P87

### Comorbidities and Access to Health Care in a Canadian Cohort of Individuals with Down Syndrome

Beyzaei, Nadia <sup>1</sup>; Stockler, Sylvia <sup>2</sup>; McKenna, Dawn <sup>3</sup>; Hanbury, Patricia <sup>3</sup>; Chan, Melvin <sup>1</sup>; Tse, Emmanuel <sup>1</sup>; Berger, Mai <sup>1</sup>; Ipsiroglu, Osman S. <sup>4</sup>

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Down syndrome (DS) is the most common congenital condition in Canada; however, an overview of access to healthcare is lacking. We conducted a survey to investigate access to healthcare and comorbidities in a Canadian population of individuals with DS to understand the main met/unmet needs. Methods: An anonymous online REDCap survey for parents/caregivers of individuals with DS was conducted in 2015. The survey comprised 80 questions in 5 parts: (i) demographics, (ii) diagnoses, medications and supplements, (iii) development, (iv) sleep/wake-behaviours, and (v) feedback/testimonials. Results: 349 responses were received. General practitioners and paediatricians were identified as the primary physician for 97% of individuals with DS. The most frequent comorbidities included: ophthalmic (141/46%); ENT & respiratory (124/40%); cardiovascular (109/35%); dermatological conditions (104/34%); endocrine (80/26%); gastrointestinal (64/21%); orthopaedic (67/18%); mental health conditions (40/13%); haematological (19/6%); and, immunological (17/6%). 311/346 responded to the sleep sections specifically and 22% reporting sleep problems; however, there was a 3-4 times fold discrepancy between categorical diagnosis versus descriptive symptoms for sleep disordered breathing and even insomnia and parasomnias. Conclusion: Individuals with DS have multiple comorbidities that require specialized care. General practitioners and paediatricians were identified as the primary health care provider by the majority of study respondents; this suggests that these physicians are integral. As these physicians are continuously confronted with changing guidelines, a standardized approach is needed for knowledge dissemination. We are developing a Down syndrome medical care app for parents to enable them (i) the gathering of core descriptive symptoms and (ii) to optimize clinical care management by standardizing recommended healthcare investigations and connect professionals across sub-specialties and multiprofessional teams.

## P88

### Smartphone use, sleep quality and quantity, and mental health outcomes in a university population.

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: The use of mobile information and communication technologies (ICTs) such as smartphones has increased rapidly in recent years. Smartphones are popular devices and include many features however a number of negative health outcomes associated with high end users have been identified including addiction, poor mental health, and sleep disturbances. The purpose of this study was to examine smartphone use, sleep quality and quantity, and mental health outcomes in university students. Method: A cross-sectional design study using non-random purposive sampling was used. Participants meeting eligibility criteria were recruited from the university campus using recruitment e-mails and were asked to complete the Mobile Technology Use and Health Outcomes Questionnaire (MTUHOQ). The MTUHOQ consists of six sections related to mobile ICTs and use; mobile ICT use and health risk profile; pain and discomfort and vision status; internet addiction questionnaire, and nomophobia questionnaire. Both sleep quality and quantity was assessed based on self-report. Results: A total of 420 university students completed the questionnaire, of which 58% (n=245) were females. The majority (67%) rated their sleep quality as poor or very poor, with significantly more females (91.2%) reporting poor and very poor sleep quality compared to males (35%). Males averaged 5.7 hours (Standard Deviation [SD] 1.06) of sleep during the school week while females averaged 5.9 hours (SD 1.06). The majority of the sample (88%) reported sleeping with their smartphones next to them in bed. Mental health was rated as poor or very poor by 56% of females compared to 78% of males. Conclusion: The results of this study suggest that high end smartphone users rated their sleep quality as poor or very poor and were severely sleep restricted. Furthermore, excess use of smartphones resulted in poorer physical and mental health outcomes.

## P89

### Naps Containing REM Sleep Increase Stimulus-Preceding Negativity in Anticipation of Threat Judgements

MacDonald, Kevin <sup>1</sup>; Turpin, Victoria <sup>1</sup>; Cote, Kimberly <sup>1</sup>

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Introduction: Sleep, particularly REM sleep, has been proposed to play a role in regulating reactivity to threatening stimuli [1, 2]. The stimulus-preceding negativity (SPN) is an event-related potential produced in anticipation of affective or motivationally-relevant stimuli [3]. The current research examined the effect of a daytime nap on quickly-paced judgments of threat and the SPN produced in anticipation of threat judgments. Method: In a repeated-measures design, 40 participants (21 men, M age = 20.1) performed a threat-judgement task following either a 90-minute nap opportunity or continued wakefulness. Participants were presented with a mixture of 40 threatening and 20 non-threatening scenes. Participants were asked to imagine they were in the scenes with a gun, and, for each scene, they were to quickly give either a shoot or don't shoot response. The frequency of shoot responses and mean reaction time for each condition were recorded. SPN was measured 500-1500ms following the appearance of a crosshair indicating a scene would be presented in 2000-2500ms. Results: Following a nap, shoot responses to threatening scenes were slower,  $F(1, 36) = 6.46$ ,  $p = .015$ , but there was no difference in SPN. After dividing the sample into those who obtained at least 5 minutes of REM sleep and those who did not, it was found that naps containing REM sleep resulted in faster dismissals of non-threatening scenes,  $t(18) = 2.37$ ,  $p = .029$ , and a larger SPN over frontal sites,  $t(18) = 2.68$ ,  $p = .015$ . Conclusion: These results add further support to the proposal that REM sleep has a role in regulating reactivity to threat and suggest that changes to anticipatory processes may be involved. References: [1] Walker. (2009). *Ann. N.Y. Acad. Sci.*, 1156, 168197. [2] Rosales-Lagarde et al. (2012). *Front. Behav. Neurosci.*, 6. [3]. van Boxtel & Bcker. (2004). *Psychophysiology*, 18(2/3), 61-76. Support: NSERC

**Presentation Type:** Oral Presentation with Poster Presentation

## P90

### Changes in several frequency bands time-locked to sleep spindles associated to increase in motor sequence consolidation

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**TOPIC:** Sleep and Behaviour

**Abstract Description** Numerous studies have demonstrated the involvement of sleep spindles in motor memory consolidation. More specifically, spindles of posterior origin were found to be associated with offline gains in motor sequence performance. However, there is much to be understood on the interactions between spindles and other sleep oscillations implicated in the transfer of novel mnemonic traces to long-term. In the present research, by reactivating a motor memory trace with a conditioned stimulus, we sought to identify local changes in signal power and connectivity changes between regions occurring around or during NREM2 parietal sleep spindles. Using a targeted memory reactivation design we compared the effect of cuing (Cond group) participants, or not (NoCond group), during NREM2 with an olfactory stimulus previously associated to an explicit finger tapping task. Behavioral results showed that although both groups showed offline gains, cuing increased significantly performance at retest compared to the NoCond group. Time-frequency decomposition analyses showed that cuing induced significant differential and localized changes in delta (0.25-4 Hz) and theta (4-8 Hz) before, during and after the event, and changes in high-beta (20-30 Hz) during the spindle. Moreover, it helped identify a second spindle component in high-beta overlapping the main sigma component. Finally, coherence analyses identified significant changes in connectivity between regions during sleep spindles in theta and sigma (11-16 Hz) bands in the cued group. Together, these results confirm that sleep spindles implication in motor memory consolidation involves multiple cortical structures communicating through a wide range of oscillations. They also suggest that the time-locked interactions between lower (delta/theta) and higher (high-beta) frequencies around sleep spindles (sigma) are crucial for memory consolidation.

## Sleep Disorders, Non-Respiratory

### P91

#### Sleep Quality in Rheumatoid Arthritis: A Systematic Review and Meta-Analysis of Data from Validated Sleep Questionnaires

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**TOPIC:** Sleep Disorders, Non-respiratory

**Abstract Description** BACKGROUND: Sleep dysfunction has been evaluated in rheumatoid arthritis (RA) patients using various outcome measures, including multiple different sleep questionnaires. However, no comprehensive systematic review and meta-analysis of sleep outcome data to conclusively show sleep dysfunction in RA patients has been performed. METHODS: A systematic search of MEDLINE, Embase, PsycINFO, and the Cochrane Library was conducted from inception to December 1st, 2016. Studies reporting original data from validated sleep quality and daytime sleepiness questionnaires in human adult RA patients were included. Studies were screened first by title and abstract, then by full-text review by 2 independent reviewers. We extracted the mean and standard deviation of the scores for each scale. A random-effects meta-analysis was performed for questionnaires used in 5 or more separate studies. Statistical analysis was performed using the R statistical computing software package. RESULTS: Our search revealed 1140 articles for review with 53 studies of various designs meeting our pre-set inclusion criteria, encompassing 53626 individual patient questionnaire scores. The majority of patients were female and over the age of 45. Sleep quality in patient cohorts was assessed using the Pittsburgh Sleep Quality Index (PSQI) (n=32), Medical Outcomes Study sleep scale (MOS) (n=25), and 10 cm Visual Analogue Scale (VAS) (n=14). Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS) (n=11). The random effects estimated mean scores were 7.47 (CI 6.97-7.97, normal 5.00), 42.39 (CI 40.44-44.35, normal 24.50), 3.29 (CI 2.77-3.82, normal 2.09), and 7.45 (CI 5.91-9.00, normal 10.00), respectively. CONCLUSION: RA patients consistently exhibit poor sleep quality across multiple validated patient-reported measures of sleep but do not demonstrate abnormal daytime sleepiness.

## P92

### Narcolepsy and Mental Health: A Systematic Review

Parmar, Arpita <sup>1,2</sup>; McLaren, Anya <sup>1,2</sup>; Amin, Reshma <sup>1,3</sup>; Al-Saleh, Suhail <sup>1,3</sup>; Weiss, Shelly <sup>1,3</sup>; Murray, Brian <sup>4,2</sup>; Narang, Indra <sup>5</sup>

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**TOPIC:** Sleep Disorders, Non-respiratory

**Abstract Description** Background: Narcolepsy is a devastating, chronic sleep disorder with no cure, characterized by excessive daytime sleepiness, cataplexy, sleep paralysis, hallucinations and disturbed nocturnal sleep. The constellation of symptoms in Narcolepsy adversely impacts daily functioning, quality of life (QOL) and mental health. A systematic review was conducted to evaluate the relationship between mental health, specifically depression and anxiety and Narcolepsy, in both adults and children. Specific Aims: a) Evaluate the prevalence of depression and anxiety in patients with Narcolepsy and b) Identify predictors of depression and anxiety in patients with Narcolepsy. Methods: A literature search was conducted through PubMed, Web of Science, OVID, and Google Scholar for all studies matching the eligibility criteria between January 2006 and December 2016. Titles and abstracts were screened independently by two authors and consensus for included studies was achieved through discussion. Results were synthesized by narrative review. Results: Fifteen (1 longitudinal, 14 cross-sectional) studies were reviewed. Depression and anxiety were prevalent in both adults and children with Narcolepsy, with depression being more commonly assessed. Depression rates ranged from 20.0-41.6% in pediatric cohorts, and 7.0-60.8% in adult cohorts. Poor mental health outcomes among patients with Narcolepsy are more common than the normative population, and comparable among the two types of Narcolepsy (with or without cataplexy). Poor mental health outcomes are significantly correlated with poor QOL. Conclusions: There is a paucity of studies assessing mental health outcomes in children with Narcolepsy. Predictors of poor mental health outcomes in both adults and children with Narcolepsy, remain unclear. Future research is needed to quantify mental health outcomes and to identify the predictors contributing to poor mental health in childhood. This information will allow physicians to prioritize targeted therapeutic interventions in the paediatric population to optimize mental health downstream.

## P93

### Effects of transcranial alternating current stimulation (tACS) on the nap dreams of frequent lucid dreamers, frequent nightmare sufferers and controls

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**TOPIC:** Sleep Disorders, Non-respiratory

**Abstract Description** Introduction Frontal transcranial alternating current stimulation (tACS) administered during REM sleep can trigger an increase in lucid dreaming and in self-awareness among lucid dream nave subjects (Voss et al., 2014). Our objective was to validate tACS for inducing signal-verified lucid dreams in both frequent lucid dreamers (LD) and nightmare sufferers (NM). We expected that tACS during REM sleep would trigger signal-verified lucid dreaming in LD and NM groups but not among control subjects (CTL). We also expected that tACS would lead to an increase in self-awareness and control in dreams reported by the three groups. Methods We recruited 43 subjects in 3 groups: 17 LD, 13 NM and 13 CTL. Each took 2 morning naps: one with tACS (STIM) and one without (SHAM). They were instructed to signal occurrences of dream lucidity with pre-arranged eye movement sequences. During STIM, we applied frontal 40Hz tACS during REM sleep for 2.5 min. Subjects were awakened 3 min after stimulation offset for a dream report. Analyses were performed only on subjects who recalled a dream. Results There were no differences among groups in the presence/absence of signal-verified lucid dreams. However, a 32, group (LD, NM, CTL) x condition (STIM, SHAM) ANOVA revealed a condition main effect for control over the dream plot ( $F_{1,27}=8.41$ ,  $P=0.01$ ) by which control was greater for STIM than for SHAM dreams. This effect was due to the NM group ( $F_{1,27}=7.20$ ,  $P=0.01$ ). A 32 ANOVA for dream distress after waking up revealed a group x condition interaction ( $F_{2,27}=3.52$ ,  $P=0.04$ ) showing lower distress for STIM than for SHAM dreams only among the NM group. Conclusion Results suggest that NM subjects are more susceptible to tACS and respond in a more therapeutic fashion (greater control, lower distress). This may allow tACS to be used as a front-line treatment for recurrent distressing nightmares.

**Presentation Type:** Oral Presentation with Poster Presentation



## Sleep Disorders, Respiratory

### Oral Presentation – No Poster

#### Effect of head position on the apnea-hypopnea index in patients with obstructive sleep apnea

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Objective: Supine body orientation plays an important role in precipitating upper airway collapse in a significant proportion of obstructive sleep apnea (OSA) patients known to have supine-predominant OSA (OSA<sub>sup</sub>). Traditionally, trunk position is used to assess OSA<sub>sup</sub>, but the role of the head position has not been established. We hypothesized that head position influences OSA independently of trunk position. Methods: Head and trunk positions were determined from subjects undergoing overnight polysomnography. The apnea-hypopnea index (AHI) of all trunk and head positions (lateral and supine) were calculated and compared against the complete supine position, i.e. head and trunk supine. Results: In 28 subjects included, lateral rotation of the head while the body was supine resulted in a significantly lower AHI compared to the complete supine position (25.816.6 vs 36.022.5 events/hr,  $p=0.008$ ), and abolished OSA in 25% of patients. The proportion of rapid eye movement (REM) to non-REM sleep didn't differ between positions. Conclusion: Lateral rotation of the head resulted in almost 30% reduction in AHI. These results point to the effect of head position on OSA severity independent from trunk position and REM sleep, and possibly the additive effect of head and body positions on upper airway patency.

**Presentation Type:** Oral Presentation with no Poster Presentation

## P94

### Long-term gray matter changes in mild-moderate obstructive sleep apnea

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: Obstructive sleep apnea (OSA) causes intermittent hypoxemia and sleep fragmentation. The apnea-hypopnea index (AHI) is used to define OSA severity. An AHI between 5 and 15 represents mild OSA, while an AHI between 15 and 30 indicates moderate OSA. Gray matter changes were reported in patients with OSA. However, the evolution of these gray matter changes among patients with mild-moderate OSA without treatment is unknown. Our objective was to investigate the evolution of the gray matter changes in middle-aged and older individuals with mild-moderate OSA quantified by voxel-based morphometry (VBM) in magnetic resonance imaging. Methods: Twelve control subjects, 14 mild OSA subjects and 4 moderate OSA subjects were evaluated twice using a magnetic resonance imaging with an 18-month delay between visits. Subjects without OSA (AHI<5) formed the control group, while subjects with mild-moderate OSA formed the OSA group. The VBM method with paired t-tests was used to compare gray matter volumes between visits in each group ( $p<0.05$  FWE cluster level). Results: The OSA group showed a volume decrease in the caudate nuclei and in the right putamen and globus pallidus after 18 months. On the other hand, the control group showed a volume decrease in the right cerebellum and inferior temporal gyrus after 18 months. Conclusion: Decreased volume overtime in the basal ganglia specific to the OSA group could be explained by the chronic exposure to various pathophysiological processes specific to OSA, such as hypoxia, excitotoxicity and changes in regional cerebral blood flow. Our results suggest that even mild or moderate OSA causes gray matter damage different from normal aging in time. These changes are clinically important knowing that about 50% of OSA patients refuse to use any form of treatment.

## P95

### Short and Long-Term Use of Adaptive Servo-Ventilation (ASV) in Heart Failure Patients with Obstructive and Central Sleep Apnea in the ADVENT-HF trial

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Rationale: Adaptive servo ventilation (ASV) is a positive airway pressure (PAP) device for sleep disordered breathing (SDB) in heart failure (HF) patients. Although increased usage is associated with greater improvements in symptoms, PAP compliance can be problematic. Poor adherence in recent multi-centre trials testing PAP in SDB, might have contributed to their negative results. The purpose of this study was to evaluate ASV compliance between central (CSA) and obstructive sleep apnea (OSA) in the Effect of Adaptive Servo Ventilation on Survival and Cardiovascular Hospital Admissions in Patients with Heart Failure and Sleep Apnea (ADVENT-HF) trial to determine short and long-term predictors of ASV adherence. Methods: Subjects in ADVENT-HF randomized to ASV before July 1, 2016 were analyzed. ASV compliance (average hours of use per night) was calculated at 1 and 12 months and was compared between OSA and CSA patients. Results: Among 387 patients enrolled in the ADVENT-HF trial 194 were randomized to ASV, of these 42 with CSA and 75 with OSA completed the 12 month follow up. ASV adherence at 1 and 12 months was 4.622.07 and 3.912.5 hrs/night ( $p < 0.01$ ) among all patients, 4.962.19 and 4.722.36 hrs/night among the CSA patients ( $p = 0.43$ ), and 4.431.97 and 3.462.48 hrs/night among the OSA subjects ( $p < 0.01$ ). Among all patients, the predictor of short-term ASV compliance was the degree of increase in sleep efficiency from baseline (Odds ratio 1.11,  $p = 0.02$ , per 5% increase). Hours of ASV usage at 1 month was the best predictor of ASV adherence at 12 months (Odds ratio 2.1,  $p < 0.01$ ). Conclusions: HF patients compliance to ASV remained substantial after 12 months. OSA patients tended to decrease their long-term usage, while ASV compliance among CSA did not change over time. Short adherence to ASV is related to the improvement of the disease and can itself predict long-term ASV usage.

## P96

### Headaches in Patients with Obstructive Sleep Apnea

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: The purpose of this study to describe headache characteristics in patients with OSA. Methods: This is a prospective study of adult subjects with polysomnographically proven OSA, with an apnea+hypopnea index of > 20 per hour of sleep. A headache questionnaire was developed and administered by one of the authors (MK). The questionnaire included headache frequency, character, location, associated features, severity, chronicity, and response to treatment of OSA. Subjects have high clinical suspicion of OSA, or during the follow-up visit after polysomnography. Subjects with other specific headache diagnoses (eg, migraine, cluster, tension) were excluded. Two subject groups were defined, those with headaches (Group A) and those without headaches (Group B). Group B subjects had infrequent headaches (< 4 headaches per month) or headaches that were not related to sleep quality or duration. The polysomnographic variables analyzed in details. Data were analyzed using a one-tailed student's t test. Results: Thirty two subjects (26 men and 6 women) with a mean age of 51 years (range 31 to 74 years) have been enrolled to date. There are 10 subjects (4 women) in Group A and 20 subjects (no women) in Group B. Of the Group B subjects, 18 of 20 denied any sleep-related headaches and two had headaches < 1/week. There is no significant difference between the groups for age. However, Group A subjects had a higher BMI (42.6 kg/m<sup>2</sup> vs 36.3 kg/m<sup>2</sup>, p < 0.05). The headache frequency in Group A subjects was 2-5 per week (mean 4 headaches per week). The majority of these subjects (90%) had headaches upon awakening. Analysis of the polysomnographic variables showed a higher trend for REM AHI (55.4 vs 42.9, p = 0.08) and a higher spontaneous arousal index, (0.34 vs 0.12, p = 0.08) in subjects with headaches. Conclusions: OSA patients are at increased risk for associated headaches have a higher BMI.

## P97

### Electrical Stimulation of the Calf Muscle Reduces Seated Leg Fluid Accumulation over a Long Sedentary Period

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: People living sedentary lifestyles are susceptible to accumulation of fluid in the legs. Excessive leg fluid is associated with a greater shift of fluid from the legs to the upper body upon lying down which can lead to increased sleep apnea severity. Furthermore, removal of leg fluid through walking or compression stockings has been demonstrated to reduce sleep apnea severity. Calf muscle electrical stimulation (ES) is a device-based approach for preventing leg fluid accumulation to treat sleep apnea. The following study investigates the use of calf muscle ES in reducing leg fluid while sedentary. Method: In a randomized, double crossover study design; participants sat for 150 minutes receiving either the active or sham ES (control). The active ES condition induced calf muscle contractions in both legs every two seconds out of sync at the maximally tolerated amplitude. In the sham ES condition, electrical stimulation was applied to the calf muscle, but at low amplitude such that contractions were not elicited. Fluid volume in the lower leg was measured continuously using bioelectrical impedance analysis. Fluid volumes at the beginning and end of sitting were measured and repeated-measures ANOVA tested if the change in leg fluid over the seated period were different between the study conditions. Results: In fourteen men (age: 48.36.2 years, BMI: 27.26.4), leg fluid at baseline did not differ statistically between the active and sham conditions (843.3 117.1 ml vs. 803.8131.2 ml,  $P>0.1$ ). During the seated period, leg fluid accumulation was significantly reduced when using active ES, compared to sham ES (27.623.3 ml vs. 64.726.6 ml,  $P<0.001$ ). Conclusion: Calf muscle ES is an effective means of reducing leg fluid accumulation during a long period sedentary. Such a device has potential for development as a wearable treatment platform to prevent sleep apnea caused by fluid shift.

## P98

### Spatial and Declarative Learning and Memory in Children Evaluated for Sleep Disorders

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction Research describing the impact of sleep on memory processing in children has received greater attention in recent years, although findings are still scarce. In this study we examined learning (prior to sleep) and retention (following sleep) in children undergoing a diagnostic sleep study. Polysomnographic measures of sleep disturbance (apnea indices and electrophysiological arousals) were analyzed to assess their impact on learning and overnight retention of the spatial and declarative aspects of a popular children's memory game (Concentration). Methods 26 of 32 children (6-12yo) have completed a diagnostic sleep study in an accredited sleep laboratory. Each patient, with parental assistance, completed forms regarding sleepiness/alertness, sleep habits, and demographic information. Patients then performed a 3-minute PVT and trained on the Concentration game (15 picture pairs (5X6 array)), prior to the sleep study. In the morning, patients completed a free recall test of the Concentration items (declarative memory), followed by a cued recall test (locating a match in the 5X6 grid), a measure of spatial memory. Results Preliminary analyses (26/32 children) do not reveal a relationship between obstructive sleep apnea/hypopnea severity (mean AHI = 6.36.2 (SD) and declarative/spatial aspects of the Concentration task. Further analysis of objective (PVT) and subjective sleepiness, and nocturnal arousals will be required to confirm this relationship. Sleep stage composition analyses, however, reveal a possible relationship between amount of stage 2 sleep and free recall of Concentration items ( $p=.06$ ), but not recall of spatial information in the game ( $p>.70$ ). Conclusion This study should add substantially to findings characterizing the impact of sleep on declarative memory processing in children. Our results, thus far, suggest that obstructive sleep apnea severity (AHI range: 1.9-29.0 events/hr) is not associated with memory processing in our sample, and that amount of stage 2 sleep may predict better declarative, but not spatial, memory retention.

**Presentation Type:** Oral Presentation with Poster Presentation

## P99

### Prediction of Oral Appliance Therapy Outcome for Obstructive Sleep Apnea using a Feedback Controlled Mandibular Positioner (FCMP)

Remmers, John <sup>1,2</sup>; Charkhandeh, Shouresh <sup>2</sup>; Zareian Jahromi, Seyed Abdolali <sup>1,2</sup>; Topor, Zbigniew <sup>1,2</sup>; Grosse, Joshua <sup>2</sup>; Vranjes, Nikola <sup>3</sup>; Bruehlmann, Sabina <sup>2</sup>

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction Oral appliance therapy (OAT) resolves sleep apnea in only 50-70% of cases, pointing to the need to prospectively identify therapeutic responders. We sought to assess the accuracy of a feedback controlled mandibular positioner (FCMP) with machine learning to predict therapeutic outcome and an efficacious mandibular position. Methods Individuals with obstructive sleep apnea (OSA) participated in a blinded bi-phase investigation: phase 1 (n=149) to develop a predictive method and phase 2 (n=53) to prospectively evaluate its accuracy. Each participant underwent two full-night studies in the home while using a FCMP that moved the mandible in response to respiratory events. A machine learning classification system was trained on phase 1 study data and applied to phase 2 data to predict therapeutic outcome; efficacious target protrusive position was also predicted from the FCMP test. All study participants were treated with a custom oral appliance that was used during additional home sleep tests to assess therapeutic outcome and predictive accuracy. Results Using oxygen desaturation index (ODI) of <10 hr<sup>-1</sup> at outcome as the criterion for therapeutic success, predictive accuracy for phase 2 was as follows: sensitivity: 85%; specificity: 93%; positive predictive value (PPV): 97%; negative predictive value (NPV): 72%; and accuracy: 88%. Using ODI of <10 hr<sup>-1</sup> and a 50% reduction from baseline ODI as the criterion for therapeutic success, predictive accuracy for phase 2 was as follows: sensitivity: 81%; specificity: 94%; PPV: 96%; NPV: 71%. Of participants correctly predicted to respond to OAT, the predicted mandibular position proved to be efficacious in 86% of cases. Conclusions Data from an in-home sleep study with a FCMP, analyzed by a machine learning method, accurately identifies OSA patients who will respond to OAT. The study also provides a therapeutic target protrusive position that is efficacious in the majority of OAT responders.

## P100

### Correlation between pharyngeal airway dimensions and outcome of oral appliance therapy for OSA

Zareian Jahromi, Seyed Abdolali <sup>1,2</sup>; Charkhandeh, Shouresh <sup>2</sup>; Remmers, John <sup>1,2</sup>

<sup>1</sup>University of Calgary, <sup>2</sup>Zephyr Sleep Technologies

**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction Oral appliance therapy (OAT) has higher compliance and is preferred over continuous positive airway pressure (CPAP) therapy by most patients with obstructive sleep apnea (OSA). However, OAT resolves OSA in only 50-70% of patients, highlighting the need to prospectively identify therapeutic responders. Imaging provides a great tool to study the changes in the pharyngeal airway induced by mandibular protrusion in OAT. The objective of this research is to assess the relation between protrusion-induced changes in airway geometry while awake and the response to OAT. Methods Participants (n=28) with OSA were treated with a custom-made oral appliance (Micro2) adjusted to a final protrusive position. Baseline and therapeutic oxyhemoglobin desaturation index (ODI) were measured as the mean value determined from two nights of home monitoring (SnoreSat). OAT outcome was calculated as the fractional reduction in ODI comparing baseline and therapeutic values. While awake, seated, and relaxed, each individual underwent a cone beam computed tomography (CBCT) of the upper airway under each of two conditions: centric occlusion (CO) with nothing in place, and mandibular advancement (MA) with a temporary oral appliance (MATRx, Zephyr Sleep Technologies) set at 90% of full protrusion. Five geometric measurements each were obtained from velopharynx and oropharynx segments, namely: volume (V), minimum cross-sectional area (MCA), anterior-posterior (A-P) and lateral-lateral (L-L) distances at MCA, and mid-sagittal area (MSA). The relative protrusion-induced change in each geometric variable was correlated with OAT outcome. Results Mandibular protrusion significantly increased V and L-L of the velopharynx and oropharynx. A linear regression analysis comparing OAT outcome with each of the variables revealed no significant correlation. A multi-variable regression illustrated a significant correlation between all features and OAT outcome ( $r=0.51$ ;  $p=0.006$ ). Conclusions We demonstrate in patients with OSA a significant, but weak, correlation between the protrusion-induced increase in pharyngeal dimensions while awake and OAT outcome.



## P101

### The impact of air pollution on obstructive sleep apnea and systemic inflammation

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: Obstructive sleep apnea (OSA) is associated with inflammatory biomarkers which may predispose to premature cardiovascular disease. Air pollution is also associated with systemic inflammation, and may therefore also be associated with worsening OSA. Our objective was to assess whether traffic-related pollution (TRAP) is associated with OSA severity or systemic inflammation. Methods: 1858 consenting patients who underwent polysomnography (PSG) for suspected OSA were recruited between 2007 and 2013 into a research database. Information from a detailed questionnaire, BMI, and PSG were included. In a subset (n=494), serum was collected the morning after PSG, and levels of inflammatory biomarkers (e-selectin, intracellular adhesion molecule, vascular cell adhesion molecule, interleukin 6, interleukin 8) were measured using Luminex. For each patient, residential 6-digit postal code was used to estimate each subjects TRAP exposure (nitrogen oxides, black carbon and fine particulate matter) using land-use regression, with mean nitrogen dioxide concentration of 16.2 5.6 ppb (Vancouver, BC). SAS 9.4 was used for analysis. Results: 1339 participants (69.6% male, mean and SD age: 57.6 12.2 years, AHI: 22.5 22.1/hr) had a postal code within the air pollution model domain. 255 patients had no OSA (AHI 30/hr). Pollution measures were not significantly correlated with AHI (Pearson correlation coefficients -0.005 to -0.061, p>0.1 for all variables) or with OSA severity using categorical variables. The inflammatory biomarkers were not associated with pollution levels. Conclusion: In our cohort, we did not find an association between air pollution exposure and either OSA severity or inflammatory biomarkers.

**Presentation Type:** Oral Presentation with Poster Presentation

## P102

### Evaluation of an ambulatory algorithm for the diagnosis and treatment of suspected obstructive sleep apnea (OSA)

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: The use of portable monitoring (PM) for out-of-sleep-laboratory diagnosis of OSA and home-based automatically adjusting CPAP devices (APAP) with comparable treatment acceptance and adherence has transformed the practice of sleep medicine. Questionnaires alone are insufficient for the diagnosis and exclusion of OSA, and objective physiological measurement, at least using a Level III PM, is critical. We extend this research to a prospective, randomized parallel group study of in-laboratory versus home-based management of OSA. Methods: 128 patients from our sleep clinic completed three validated questionnaires for screening of OSA and two nights wearing a portable monitor (MediByte, Braebon Inc., Ontario). Based on a high probability of OSA from 2 or 3 of three questionnaires (i) Berlin, (ii) Sleep Apnea Clinical Score, (iii) Stop-Bang, and a respiratory disturbance index (RDI)  $\geq 10$  derived from PM, 51 participants were randomized to treatment group and followed-up at 3 months. All participants had a diagnostic in-laboratory sleep study (PSG) and all titrations were via APAP. Results: In-laboratory versus at-home treatment was completed by 27 (21 males) and 21 (14 males) of similar age 50.11; 53.12 years, BMI 35.6; 33.7 kg/m<sup>2</sup>, sleepiness (ESS) 10.5; 11.4 and RDI 38.26; 29.13 /hr respectively. PSG-derived AHI was skewed for in-laboratory 51.32 versus home-based 37.16 groups although the difference was not significant. The effective CPAP pressure was different (Lab: 8.52.6; Home: 9.81.7 cmH<sub>2</sub>O). Both groups showed significant improvement with treatment in Calgary Sleep Apnea Quality of Life Instrument (SAQLI) but no between-group difference (Lab: 4.21.4 to 5.31.5; Home: 4.51.3 to 5.41.2) and comparable CPAP adherence based on percentage nights used 4 hours or more (Lab: 82.19; Home: 84.19%). Conclusion: CPAP adherence and clinical outcome (SAQLI) was similar at 3 months in patients with a high probability of OSA based on questionnaires and PM set-up via APAP in-laboratory or at-home.

## P103

### Accuracy of a Novel Automated Respiratory Event Detection in the MATRx plus Home Sleep Recorder

Topor, Zbigniew <sup>1,2</sup>; Grosse, Joshua <sup>2</sup>; Zareian Jahromi, Seyed Abdolali <sup>1,2</sup>; Remmers, John <sup>1,2</sup>

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** IntroductionMATRx plus is a novel sleep recorder that performs both a therapeutic type study to select candidates suitable for oral appliance therapy, and a level III sleep study for diagnosis or evaluation of clinical outcome. The level III recorder automatically detects apneas and hypopneas with novel approaches for baseline and breath detection, allowing a more reliable implementation of the latest version of the AASM scoring rules. The objective of this study is to evaluate the accuracy of the novel automated event detection. MethodsFive overnight studies were performed on participants suspected of having OSA using the MATRx plus sleep recorder. Respiratory events were manually scored by two experienced sleep technologists from two different sleep clinics in Calgary and were compared with the automated detection for total respiratory events, AHI and event matching. Inter-scorer differences, differences between the automatic and each manual scorer independently as well as the mean (true value) were calculated. ResultsSmall differences in the number of events between automated and manual scorers (mean difference in number of events = 6.8, 8.1) resulted in clinically identical values of AHI (AHI = 0.8-2.0; 1.3-1.0). Mean inter-scorer differences were 7.0-4.7 compared with the mean difference between the automated detection and the assumed true value of 9.3-7.1. The sensitivity of the automated detection to identify individually matched events from the true value was 81.6-5.7%. ConclusionsThe automated event detection of the new MATRx plus sleep recorder was as accurate as the variability between manual scorers and sensitivity was high, with possible improvements with the introduction of an expert scorer and additional studies. The automated event detection of the MATRx plus device allows its reliable use in a complete workflow from diagnosis, therapy selection to clinical outcome study.

## P104

### The utility of a simple questionnaire to identify obstructive sleep apnea in arrhythmia patients

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Introduction: Obstructive sleep apnea (OSA) is associated with different cardiovascular disorders including arrhythmia. The STOP-BANG is an 8-item self-report questionnaire to screen patients for OSA, and was validated in preoperative surgical patients. The STOP items are snoring, daytime tiredness, observed apnea, and high blood Pressure. The BANG items are BMI >35 kg/m<sup>2</sup>, age >50, neck circumference >40 cm, and male gender. We aim to determine the screening properties of the STOP-BANG questionnaire in arrhythmia population. Methods: Consecutive patients were recruited from arrhythmia clinics. Patients with previously diagnosed and/or treated OSA were excluded. The STOP-BANG questionnaire was administered to all patients. All patients had two consecutive nights of home sleep recording. OSA was defined as AHI >5/hour of sleep. The receiver operating characteristic (ROC) curve analysis was assessed. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the STOP-BANG questionnaire were calculated. Results: We recruited 75 participants (72% Males) with atrial fibrillation. Mean age was 64 years (range 23-89). Mean BMI was 28 kg/m<sup>2</sup> (range 17.5-47). Twenty-seven percent had BMI >30, and seven percent had BMI >35. From total patients, eighty-four percent had score ≥3 on the STOP-BANG. Eighty-five percent were found to have OSA on home sleep studies. The ROC curve showed an area under the curve= 0.685, p= 0.051, 95% CI: 0.536- 0.835. The sensitivity of STOP-BANG score ≥3 for detection of OSA was 86%, specificity 27%, PPV 87%, and NPV 25%. Conclusion: The STOP-BANG questionnaire is 86% sensitive for detection of OSA. However, the specificity is low with a high false positive rate. The high PPV and low NPV are influenced by the high prevalence of OSA in patients with atrial fibrillation. Therefore, sleep studies are necessary to confirm the presence of OSA regardless of the use of the screening test.

## P105

### Investigating the Relationship between Pharyngeal Tissue Mass and Acoustic Features of Snoring Sounds

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Rationale: One of the main contributing factors in generation of snoring sounds is the vibration of pharyngeal tissue due to the upper airway (UA) narrowing. Since we place the microphone over suprasternal notch to record snoring, vibrations of pharyngeal tissue can contribute to snoring spectral features. Based on a spring-mass model, there is an inverse relationship between the natural frequency of a system and its mass. Rostral fluid shift and the consequent increases in neck fluid volume (NFV) and neck circumference (NC) could increase pharyngeal tissue mass. We hypothesized that increases in pharyngeal tissue mass during sleep, assessed by increases in NFV and NC, will be inversely associated with the natural frequency of snoring. Methods: We analyzed data from a previous study where twenty non-obese men (age: 43.8±12.7 years, AHI: 27.9±24.8) participated in a daytime polysomnography. NC and NFV were measured before and after sleep using tape and bioelectrical impedance respectively. Snoring sounds were recorded with a microphone placed over the neck. The snoring spectral-centroid frequency was estimated to represent the natural frequency of snoring. Changes from the beginning to end of sleep were assessed with paired t-test, while correlations between variables were assessed with Pearson correlation. Results: An average of 342223 inspiratory snores was manually extracted. Snoring centroid frequency was inversely correlated with increases in NFV ( $r = -0.50$ ,  $p = 0.026$ ) and NC ( $r = -0.53$ ,  $p = 0.016$ ) during sleep. Furthermore, snoring centroid frequency decreased from beginning to end of sleep ( $= -9.214.14$ ,  $p = 0.01$ ). Moreover, there was a borderline correlation between decreases in centroid frequency and increases in NC ( $r = -0.44$ ,  $p = 0.053$ ). Conclusion: Our results show that the snoring centroid frequency is inversely correlated with increases in the pharyngeal tissue mass. These results can be used to develop an assessment system of pharyngeal tissue mass and its effect on UA narrowing based on snoring sound features.

## P106

### Sleep quality in a healthy, late-term pregnant Sherpa during ascent from 3440m to 5160m using actigraphy

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Pregnancy is a profound physiological stressor, eliciting significant cardiorespiratory adaptations in response to the mechanical and metabolic demands of supporting the developing fetus. Exposure to hypobaric hypoxia at high altitude also elicits cardiorespiratory adaptations. Both stressors can elicit sleep apnea, where pregnancy can cause obstructive sleep apnea (OSA), and ascent to altitude causes central sleep apnea (CSA). How high altitude natives respond to the simultaneous stressors of pregnancy and high altitude is unknown. We present a case study of a non-obese, high altitude native Sherpa (28yrs, BMI=26.6 kg/m<sup>2</sup>) as she ascended from 3440m to 5160m over seven nights in the Nepal Himalaya during her third trimester of pregnancy (G1P0; ~30weeks gestation). We used wrist-worn actigraphy to compare sleep characteristics in this pregnant Sherpa (PS) and 10 healthy, non-pregnant, low-lander native women (LL; 25.68yrs; BMI=21.62kg/m<sup>2</sup>). Resting blood oxygen saturation measured with pulse oximetry every morning during ascent was similar in both groups, with a nadir of 83% in the PS and 81.41.7% in LL at 5160m. Mean arterial blood pressure was consistently lower in the PS than the LL mean during ascent, with the PS at 86 mmHg and LL at 95.42.1mmHg at 5160m. Using actigraphy, total sleep time and sleep efficiency were similar during ascent. However, both fragmentation index (FI) and sleep fragmentation index (SFI) were consistently higher in PS than LL. In all participants, there were no changes in FI (P=0.68) or SFI (P=0.2) with ascent, suggesting that (a) participants did not develop CSA, or (b) actigraphy is not well-suited to detecting CSA during sleep at altitude. This is the first report of sleep assessment using actigraphy in a pregnant Sherpa at altitude. Our data suggests the presence of OSA in a pregnant Sherpa at altitude, which was not worsened during ascent. Supported by NSERC Discovery.

## P107

### **Obstructive Sleep Apnea Pharmacotherapy: Mapping Potential Drug Targets in the Circuitry Controlling Upper Airway Motor Output**

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** There is currently no pharmacotherapy for Obstructive sleep apnea (OSA): a significant public health problem caused by repeated episodes of upper airway closure during sleep. It is not clear whether the difficulty in treating OSA pharmacologically reflects a deficiency in effective targets or a deficiency in target identification. We performed a genome wide analysis of the differential expression of druggable targets in the circuitry controlling motor output to the upper airway musculature. From the Allen Mouse Brain Atlas database of ~25,000 in situ hybridization experiments we created a database of genes that differentiate the hypoglossal motor nucleus (HMN) and the primary afferents of the HMN (PRE-HMN) from the rest of the brain (i.e., 2-fold greater relative expression in the HMN and/or PRE-HMN). We annotated the gene products in our database according to their status as modulators of neuronal activity and according to their inclusion in protein families associated with high relative druggability: GPCRs and ion channels. Finally, we isolated those genes whose protein products are the targets of approved FDA drugs. 1,492 genes showed enhanced relative expression at the HMN and/or PRE-HMN; of which, 1,168 are specifically enhanced in the HMN, 88 are specifically enhanced in the PRE-HMN, and 236 exhibit enhanced expression in both the HMN and PRE-HMN. A total of 99 genes were classified as being probable modulators of neuronal activity, of which 18 were classified as GPCRs and 37 were classified as ion channels. Protein products of 26 of those 99 genes are targets of 175 FDA approved drugs. Of those drugs trialled for the treatment of OSA, a total of nine act pharmacologically on ten of the targets. Our analysis reveals significant unexplored potential in terms of trialling approved drugs and developing new drugs for differentially expressed targets in the circuitry critical for OSA pathogenesis

## P108

### Gestational intermittent hypoxia (GIH) impairs endothelial function of adult male offspring mice

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**TOPIC:** Sleep Disorders, Respiratory

**Abstract Description** Objective: An adverse maternal environment can increase the risk of cardiovascular disease in adult offspring. Obstructive sleep apnea (OSA) is prevalent in pregnant women and may be characterized by chronic intermittent hypoxia and placental insufficiency. The incidence of maternal and neonatal outcomes such as preeclampsia, preterm birth, low birth weights, and neonatal intensive care unit admission are increased in pregnant women with OSA. We examined the effects of GIH on endothelial function of adult offspring mice. Methods: Female WT C57BL/6 mice (8 weeks) were divided in 2 groups: IH or intermittent air (IA). Mice were subjected to IH while they were asleep during the daylight cycle; IH was by delivering a hypoxic mixture (12% oxygen) with room air every 30s; the IA group received air instead. Pregnant mice were kept under IH during the gestation period. After giving birth, IH was halted and offspring mice were maintained under normal conditions. Sixteen weeks later, male mice were sacrificed and endothelium-dependent relaxation was measured in the aorta using a wire myograph system. Results: After 1 week of delivery, pups in the IH group (2.6 ± 0.3g) weighed significantly less than the IA group (3.8 ± 0.3g, p<0.05); these differences remained significant for 4 weeks. The IH pups later gained weight until there were no significant differences between the groups at 8 weeks of age and weighed significantly more at 16 weeks (39.7 ± 3.2) compared to IA pups (32.9 ± 1.6, p<0.05). Endothelium-dependent relaxation was significantly impaired at 16 weeks between the two groups (Emax IH: 69.2 ± 5.4% vs. IA: 90.8 ± 5.6%, p<0.05). Conclusion: Chronic GIH in mice caused significant growth impairment at birth in the offspring but this difference was reversed later in adulthood. Vascular endothelial function was impaired in 16 week old offspring of mothers subjected to GIH



## Sleep In Psychiatric Disorders

**P109**

### **NonREM sleep EEG slow waves in children with autism**

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Introduction: Autism is a developmental disorder with a neurobiological etiology. Studies of the autistic brain point toward atypically organized brain networks which may lead to a lower capacity to synchronize the EEG during sleep. We compared the intrinsic characteristics and topography of nonREM sleep EEG slow waves (SW) in autistic and neurotypical children. Methods: The sleep of 13 autistic boys (mean age = 10.23, SEM = 0.57) and 13 neurotypical boys (mean age = 10.23, SEM = 0.57) was recorded in a laboratory for 2 consecutive nights. None of the participants were medicated, intellectually disabled, nor complained of poor sleep. SW (0.3-3.99Hz, >75V) were detected for the whole night with an automatic algorithm on artefact free sections of nonREM sleep in frontal, central, parietal and occipital derivations. Three-way Anovas with one independent factor (2 Groups) and 2 repeated measures (4 Derivations X 4 nonREM periods) were performed to compare SW density (number per minute of NREM sleep), SW slope (velocity between SW negative and positive peaks), SW amplitude (V), and SW duration (sec). Results: Significant interactions between Groups and Derivations were found for SW density ( $p < 0.01$ ), slope ( $p < 0.05$ ), amplitude ( $p < 0.05$ ) and duration ( $p < 0.01$ ) showing lower topographical (inter-derivations) differences in autistic than in neurotypical children. No interaction between Groups and nonREM periods were found, indicating that these differences were stable across the night. Conclusion: SW characteristics are more evenly distributed along the anteroposterior axis in autistic children than in neurotypical children. These differences are not modulated by the dissipation of homeostatic sleep pressure across the night and probably reflect atypical cortical organization in autism. Support: Canadian Institutes of Health Research and Kids Brain Health Network Canada.

**Presentation Type:** Oral Presentation with Poster Presentation

## P110

### Are sleep difficulties associated with gastrointestinal disorders in children with autism?

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Introduction. Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized with impaired social functioning and restricted repetitive behaviors, interests and activities. Sleep and gastrointestinal disorders (GID) are among the most frequent comorbidities in ASD and they worsen the clinical picture. Here we report on sleep in ASD children with and without treatments for GID. Methods. We reviewed the medical charts of 262 patients from a specialized sleep clinic for children with mental health disorders and extracted four groups matched for age, sex and body mass index: 16 ASD children treated for GID (ASD+GID: 6.30.9 yrs), 16 untreated ASD children (ASD: 6.250.87 yrs), 16 non-ASD children treated for GID (nonASD+GID: 7.080.99 yrs) and 13 healthy controls (CN: 7.080.99 yrs). All completed two clinical sleep scales: the Childrens Sleep Habits Questionnaire (CSHQ) and the OWL-SI (a 9-item adaptation of the CSHQ (see APSS 2016)). A standard sleep inventory, including sleep latency, number of awakenings and total sleep time was also filled by all. Results. ASD children not treated for GID were reported more to sleep poorly on the OWL-SI than those who were treated ( $p=.05$ ). This effect was due to an increased index of nocturnal hyperarousal ( $p=.05$ ). The CSHQ did not reveal significant differences between these 2 groups. No differences were found between the nonASD+GID and the CN groups on these 2 scales but the nonASD+GID children reported waking up more often at night than CN children on the sleep inventory ( $p<0.01$ ). Conclusion. These results suggest that poor sleep and GID potentiate each other in children and point toward the need for assessment of GID in children with poor sleep.

## P111

### Development of a Novel Tool, the OWL-Sleep Inventory, for the Assessment of Sleep Disorders in Children with Comorbid Psychiatric Illness

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Introduction. Sleep disorders are common in children with psychiatric illnesses but are rarely part of the clinical routine due to the lack of short, efficient assessment tools. We developed a short questionnaire filled by parents, the OWL-Sleep Inventory (OWL-SI), and compared it to a standard, longer questionnaire: the Children Sleep Habit Questionnaire (CSHQ). Methods. The OWL-SI contains 9 questions scored 1 to 3: never/rarely (1 point), sometimes (2 points), usually (3 points). Medical charts of 408 pediatric patients with primary psychiatric diagnosis referred to a specialized sleep clinic were reviewed. Within this group, 261 parents/caregivers had completed both the CSHQ and OWL-SI questionnaires between 2011 and mid-2015. Children were 195 boys, 67 girls aged 7.133.54 years. Most children were diagnosed with autism spectrum disorder (ASD, 46.6%) or attention deficit hyperactivity disorder (ADHD, 25.6%). Internal consistency of the items for both the CSHQ and the OWL-SI was evaluated as well as the correlation between the two sleep measures. Results. Most parents took less than 45 seconds to fill the OWL-SI and 10-15 minutes to fill the CSHQ. Total scores for the OWL-SI and the CSHQ were significantly correlated ( $r=0.623$ ,  $p<0.001$ ). The CSHQ cut-off score of 41 successfully identified more than 98% of patients as having sleep disturbance, later confirmed by a clinician. ASD and ADHD patients scored positively on the CSHQ (55.25 and 55.60). Using a cut-off score of 16, the OWL-SI identified 53% of patients, with mean scores of 16.17 and 15.25 for patients with ASD and ADHD, respectively. When the cut-off was lowered to 11, the questionnaire identified 95.4% of children needing a specialized services referral. Conclusion. Parental response to the OWL-SI correlated significantly with the CSHQ scores. The OWL-SI could prove to be useful in pediatric clinics. Control studies in children without sleep complaints are under way.

## P112

### The Relative Effectiveness Of Treatments For Nocturnal Posttraumatic Symptoms In Victims Of Sexual Assault: A Systematic Review.

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Sexual assault victims (SAV) are 7 times more at risk of developing posttraumatic stress disorder (PTSD) than the general population. Daytime posttraumatic symptoms occur and SAV find themselves in a hypervigilance state, with intrusive thoughts, potential dissociative states and avoidance behaviors. Although less studied than those experienced during the day, nighttime posttraumatic symptoms (e.g. recurring nightmares, insomnia) would maintain the SAV in PTSD and persist beyond the usual treatments targeting PTSD. Several treatments addressing directly nighttime posttraumatic symptoms have emerged over the past three decades. Indeed, SAV are more likely to suffer (77%) than other types of posttraumatic populations given that sexual trauma often occurs in the evening at bedtime. The aim of the present project is to systematically review treatments targeting nighttime symptoms in SAV. This review included a diverse and explicit selection of studies and the assessment of the methodological quality of the 22 primary studies according to Cochrane criteria for systematic review. Coding and data extraction were performed by three independent judges (kappa = 0.93). Finally, once the primary data collected from the 22 primary studies, a total of three summary tables on clinical samples, methodologies and interventions were conducted, analyzed and interpreted to highlight relevant information for both research and clinical practice. Despite the heterogeneity within and between primary studies, imagery rehearsal therapy (psychological intervention) and prazosin (pharmacological intervention) are the most recurrent and proven effective interventions to treat nighttime PTSD symptoms (such as a significant reduction of nightmares and insomnia) and to noticeably increase the sleep quality and quality of life in general in SAV. This systematic review suggests that studies with more complexed methodological designs (larger and more representative clinical samples of SAV, more RCTs, more valid and objective sleep measures) are needed to replicate the results found in this current systematic review.

## P113

### The signature of depression on cardiovascular changes during sleep

Parvaresh, Amir <sup>1</sup>; Saad, Maysa <sup>1</sup>; Carrier, Julie <sup>2</sup>; Lafrenière, Alexandre <sup>2</sup>; Bujaki, Brad <sup>1</sup>; Benoit, Antoine <sup>1</sup>; Lalande, Stéphanie <sup>1</sup>; Welch, Katharine <sup>1</sup>; De Koninck, Joseph <sup>1,3</sup>; Douglass, Alan <sup>1</sup>; Lee, Elliott <sup>1</sup>; Busby, Keith <sup>1</sup>; Robillard, Rebecca <sup>4,3</sup>

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Introduction It is increasingly thought that sleep dysfunctions may contribute to poor cardiovascular health, notably in people with mood disorders. Depression has been linked to atypical patterns of heart rate changes during sleep, often marked by elevated and unstable heart rate. In this retrospective study, we investigated potential depression biomarkers based on heart rate changes across sleep. Methods This study included 545 adults with unipolar depressive syndromes referred to a specialized sleep clinic (74% females, mean±SD: 45±16 years old) and 448 healthy controls (55% females, mean±SD: 40±18 years old). All participants underwent electrocardiography starting before bedtime and extending beyond sleep offset. A classification algorithm computed from inter-beat intervals was designed to distinguish heart rate profiles between depression and control cases. To train the machine-learning algorithm, a subset of 630 cases (315 depression & 315 controls) was randomly selected. The remaining 259 cases (125 depression & 134 controls) were used for testing the algorithm. This process was repeated 10 times with different subsets to assess classification stability. Results Individuals with depressive syndrome and healthy controls were classified with a mean accuracy of 86%. Classification sensitivity was high, with 82% of the depression cases correctly identified by the algorithm. In terms of specificity, 88% of the cases not classified as depression by the algorithm were from the control group. Conclusion These results suggest that profiles of heart rate changes across can distinguish between individuals with and without depression. This unveils potential new biomarkers which may be useful adjunctives for the assessment of depression. There is a need to investigate the pathophysiological mechanisms underlying cardiovascular changes across sleep in mood disorder and their potential relation to cardiovascular diseases.

## P114

### Trauma-Related Insomnia among Evacuees from the 2016 Fort McMurray Wildfires

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** The Fort McMurray wildfires of May 2016 led to massive displacement of 90 000 people. Many faced threat to their life, which may have led to the development of post-traumatic stress disorder (PTSD). Although disturbed sleep is part of PTSD, the relationship between trauma exposure and insomnia is poorly understood. The objectives of this exploratory study were to evaluate the frequency of insomnia in evacuees three months after the fires and to examine the temporal relationships between insomnia, trauma exposure and PTSD. Fifty-five evacuees (28 women; 27 men; mean age = 43.07, SD = 14.67) were invited in Fort McMurray from July 25th to August 16th 2016 to a clinical interview. The Clinician Administered PTSD Scale was used to diagnose PTSD and insomnia. Insomnia was assigned when participants met the following five criteria: (1) difficulties falling or staying asleep or waking up too early, (2) at least three times a week, (3) associated with daytime disturbances, (4) for at least three months, and (5) occurring despite adequate opportunity for sleep. Questions probing personal antecedents of insomnia were also included. In this sample of 55 evacuees, 16 (29%) had PTSD, 24 (43%) had insomnia, and 14 (26%) had both PTSD and insomnia. In most cases, current insomnia was definitely (65%) or probably (15%) trauma-related, i.e. started or got worse after the fires. Most people with current insomnia (78%) reported having experienced insomnia in the past. PTSD was associated with current insomnia ( $2(1) = 17.65, p < .001$ ), but not with insomnia antecedents ( $2(1) = .432, p = .511$ ). These preliminary findings suggest that traumatic exposure to a disaster can elicit new insomnia problems, or precipitate a new episode in people with personal antecedents of insomnia, and that insomnia is closely associated with PTSD in the aftermath of a disaster.

## P115

### Obstructive sleep apnea in psychiatric patients: A review of the literature

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**TOPIC:** Sleep in Psychiatric Disorders

**Abstract Description** Introduction: Psychiatric disorders and obstructive sleep apnea (OSA) are often comorbid. However, there is limited information on the impact of psychotropic medications on OSA symptoms, on how to manage psychiatric pharmacotherapy in patients presenting with OSA, or on the effectiveness and challenges of OSA treatments in patients with comorbid mental illness. Methods: A literature search on PubMed, Medline, Embase, Cochrane Database, and International Pharmaceutical Abstracts was conducted using predefined keywords. The search was restricted to review publications in the adult patient population. Additional articles in relation to the treatment of OSA in the psychiatric population were obtained by manually searching the guidelines, the bibliography of retrieved review articles, and the position papers of relevant national or international association Web sites. Results: A total of 80 articles were selected for this review. Data extracted from these articles show that OSA is particularly prevalent in patients with psychiatric disorders. The medical care that patients with these comorbidities require can be challenging, as some of the psychiatric medications used by these patients may exacerbate OSA symptoms. Continuous positive airway pressure continues to be the first-line treatment, even in patients with psychiatric comorbidity. Conclusions: More controlled studies are required, particularly to determine continuous positive airway pressure compliance in patients with mental illness, the impact of treating OSA on psychiatric symptoms, and the impact of the use of psychotropic medications on OSA symptoms.

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