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EFFECTS OF 1 MONTH OF NIGHTLY ZOPICLONE ON OBSTRUCTIVE SLEEP APNOEA SEVERITY AND MEASURES OF ALERTNESS: A RANDOMISED CONTROLLED TRIAL

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Introduction: Hypnotics have historically not been recommended in obstructive sleep apnoea (OSA) due to concerns they may worsen OSA severity via pharyngeal muscle relaxation and arousal suppression. However, recent physiology studies: 1) do not show systematic impairment in upper airway muscle activity with certain hypnotics and 2) indicate that hypnotics worsen OSA in some patients and reduce OSA severity in others depending on the patient's arousal threshold and severity of nocturnal hypoxaemia. However, clinical trial data is lacking. Accordingly, this study aimed to determine the effects of 1 month of nightly zopiclone on OSA severity and measures of alertness in OSA patients who have low-moderate respiratory arousal thresholds and mild overnight hypoxaemia.

Methods: Initially, a screening physiology night to quantify the respiratory arousal threshold (nadir epiglottic pressure just prior to arousal) and nadir arterial blood oxygen saturation (SaO₂) was performed. Thirty OSA patients (apnoea/hypopnoea index [AHI] = 22.4 ± 11.3/h) with low-moderate arousal thresholds (>25 cm H₂O) and nadir SaO₂ ≥ 75% were then studied in-lab (PSG) on three occasions at baseline, night 1 and night 30. Participants received either nightly zopiclone (7.5 mg) or placebo during the 30 day study according to a double-blind, randomised, parallel design. Subjective sleepiness (ESS and KSS) and a 30 min driving simulator task (AusEd) were performed following each PSG.

Results: The median reduction in AHI on night 30 from baseline was 23 [−4.47]% during zopiclone vs. 12 [−8.29]% during placebo ($P > 0.05$). Change in mean SaO₂ from baseline to night 30 was not different between zopiclone and placebo (−0.1 ± 0.7 vs. −0.1 ± 1.4%). Similarly, neither the change in ESS (−1.3 ± 2.7 vs. −0.2 ± 2.4), KSS (0 [−1.0, 1.5] vs. 0 [−1.0, 1.3]), or steering deviation (7.1 [−1.3, 40.8] vs. 9.4 [−20.6, 34.8]) during the AusEd driving task differed from baseline to night 30 during zopiclone vs. placebo.

Conclusions: A standard dose of nightly zopiclone does not worsen OSA severity, next day sleepiness or alertness during a simulated driving task in OSA patients who have low to moderate arousal thresholds and nadir overnight SaO₂ ≥ 75%. These findings challenge previous assumptions that hypnotics worsen OSA.

008

BRIEF SLEEP PSYCHOEDUCATION PROGRAM IMPROVES SLEEP QUALITY AND REDUCES INSOMNIA SYMPTOMS IN NEW MOTHERS

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Sleep in the postpartum period is fragmented and often difficult. Infants wake frequently in the early weeks of life requiring care and attention. Increased sleep disturbance is associated with mood disorders and postnatal depression. The aim of this randomised controlled trial was to determine whether a brief sleep psychoeducation program delivered to mothers during their third trimester of pregnancy with their first baby could improve sleep and, if so, mood outcomes in the postnatal period.

Method: Two hundred and fifteen mothers were randomised to receive either 2 × 1.5 h slide presentations with a set of sleep & relaxation booklets or general sleep booklets only. Participants were followed up with phone calls at 3 & 6 weeks postpartum and with questionnaires at 6 weeks, 4 months and 10 months postpartum. A Subgroup of participants wore an actiwatch for a week during their third trimester and for a week at 4 months postpartum. The primary outcome was sleep measured by sleep quality (PSQI), Insomnia, (ISI), sleepiness (ESS) and fatigue (MAF). The secondary outcome was mood measured using Edinburgh Postnatal Depression Scales (EPDS) and the depression subscale of the Depression Anxiety and Stress Scales (DASS).

Results: A linear mixed model analysis was used for each factor (PSQI, ISI, ESS and MAF) at each time point (baseline, 6 week, 4 months, 10 months). Results indicated better sleep quality (mean difference 1.27; 95% CI [0.12 to 2.41] $P = 0.032$) and fewer insomnia symptoms (mean difference 1.55; 95% CI [1.66 to 2.93]; $P = 0.028$) at 4 months postpartum in the intervention group than the control group. There were no group differences in sleepiness, fatigue or mood outcomes, nor at other time-points.

Conclusions: These results suggest that there is some short-term benefit of this intervention for women around 4 months postpartum. Given the low cost associated with this intervention, its inclusion in routine antenatal classes could hasten improvements in mothers' sleep.

009

ASSESSING SLEEP IN SCHIZOPHRENIA AND EVALUATING TREATMENT (ASSET) STUDY

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Background: Risk factors for Obstructive Sleep Apnoea (OSA) are very common in people with Schizophrenia, who often experience hypersomnolence, fatigue and vigilance decrements. The presence of OSA may explain many of the co-morbidities of Schizophrenia attributed to the disease or its treatment, but to date well-designed prevalence and intervention studies are lacking.

Methods: The ASSET study is using home sleep studies to diagnose OSA in people with Schizophrenia taking Clozapine. Prevalence data has been matched with a representative cohort (MAILES). ASSET participants with severe untreated OSA (AHI > 30), were treated with Continuous Positive Airway Pressure (CPAP), and assessed at baseline, three and six months of treatment for: physical health, quality of sleep, sleepiness, cognition and psychiatric symptoms.

Results: Thirty people with Schizophrenia were consecutively recruited from a Clozapine clinic, and all accepted and underwent a successful home sleep study. Severe OSA was significantly more common in the ASSET cohort than in matched controls OR 3.4 (95% CI = 1.0, 11.3). Six ASSET participants accepted CPAP which was effective and well tolerated. Mean pre-treatment AHI was 83.16 (SD 47) and mean pre-treatment ODI 58.6, which improved with CPAP with mean AHI 5.5 (SD 3.7), and ODI 4.6. Slow wave sleep increased from mean 4.8% to 31.6%. REM sleep increased from an average of 4.1% to 31.4%. CPAP treatment significantly reduced weight by a mean of 13.6 kg (SD 6.5 kg), and improved cognition and subjective sleep disturbance. Cognitive domains are reported as mean improvement in Z score: Verbal memory 0.90, Token Motor Task 1.02, Tower of London 0.58. Insomnia severity score improved by a mean of 6.6 (SD 2.1). In the first three months of treatment the mean proportion of nights using CPAP for >4 h was 59.8% (SD 30.3%), mean CPAP usage per night was 5.1 h (SD 2.6 h).

Discussion: OSA is prevalent, often severe and potentially under-recognised in people with schizophrenia. CPAP treatment is acceptable and effective and may offer an important and under used approach to address disproportionate cardiovascular risk and poor quality of life in people with Schizophrenia. Further research is required to determine utility of OSA screening tools, the relationships between antipsychotic medications and OSA and the benefits of treating OSA.

010

PERFORMANCE AND VALIDATION OF A MODEL TO PREDICT CENTRAL SLEEP APNOEA FROM PULSE OXIMETRY

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Introduction: The prevalence of sleep disordered breathing is increasing with a resultant increase in wait times for Level 1 sleep studies. Unattended sleep studies are being utilised in an attempt to address the wait times but are not recommended unless there is a high probability of moderate to severe Obstructive Sleep Apnoea (OSA) and is specifically not recommended if there is a suspicion of Central Sleep Apnoea (CSA). Overnight pulse oximetry has been suggested as a screening tool to triage the urgency of sleep studies but has not previously been able to sensitively detect the presence of CSA. A previously presented pilot study suggested that spectral analysis of the overnight oximetry was able to accurately detect the presence of CSA.

Methods: A mathematical model was built using spectral analysis of oximetries extracted from Level 1 sleep studies. Digital signal processing was used to characterise the spectral signal of the oximetry. A model was built using multiple logistic regression and receiver operating curves (ROC) to maximise its efficacy. The model was then validated using unattended oximetries with a Level 1 PSG as Gold Standard. The model was also tested against sleep physicians and technicians for confidence of suspicion of CSA.

Results: One hundred and fifteen Level 1 sleep studies were used to generate the model. These included 24 CSA, 83 OSA of varying severity and 17 normal. 11 of the obstructive sleep apnoea subjects also had a degree of central and mixed apnoeas. The best model combined the characteristics of the spectral peak, the height of the peak above the background noise, and the mean oxyhaemoglobin saturation across the night. The age and body mass index of the subjects were also included in the model. The ROC of the model was 0.93 ± 0.04 with a sensitivity 90% and specificity 95% respectively. This model was then validated for unattended oximetries, showing a sensitivity of 85% and specificity 77% in predicting the presence of central sleep apnoea.

Discussion: This novel analysis of oximetry data provides greatly increased confidence in predicting the risk of CSA. This model has the potential to improve triage and investigation of patients, whilst minimising the risk of inappropriate use of unattended sleep studies.

011

THE PHARMACOGENOMICS OF MORPHINE EFFECT ON OBSTRUCTIVE SLEEP APNEA: A RANDOMISED DOUBLE-BLIND PLACEBO-CONTROLLED CROSSOVER TRIAL

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Introduction: Worsening of obstructive sleep apnea (OSA) from opioid use is recognised in anesthesiology guidelines despite no relevant controlled clinical trial (RCT). Moreover, large inter-individual variability in sensitivity to opioids makes certain patients particularly vulnerable perioperatively. As part of an RCT to investigate effect of

opioids on OSA, variation in three candidate genes previously shown to affect opioid response were evaluated to identify possible genotypes of OSA vulnerable to opioid effects.

Methods: Sixty male OSA patients attended two visits, at least 1-week apart. In a randomised crossover design, a single dose of slow release oral morphine (40 mg MS Contin) or placebo was administered at 5:30 PM. Awake ventilatory chemoreflex tests were performed 3.5 h post-dose near peak concentration and prior to the overnight PSG. Blood was sampled for genotype analyses (*OPRM1* SNP rs1799971; *ABCB1* SNP rs1045642 and *HTR3B* SNP rs7103572).

Results: On average morphine did not significantly change OSA severity or key respiratory parameters despite a large inter-individual variability (Δ apnea/hypopnea index (AHI) = 1.6/h (−1.9 to 5; 95% CI); Δ %sleep time spent $<90\%$ SpO_2 (T90) = 0.4% (−0.8 to 1.6%). In sleep architecture, morphine significantly depressed REM sleep in patients with CC but not CT/TT allele of *HTR3B* (CC Δ REM = −4.1% (−6.3 to −1.9); CT/TT Δ REM = −0.6% (−3.1 to 2.0); $P < 0.05$). In addition, morphine caused significantly greater depression of ventilatory response to hypercapnia (HCVR) in patients with A/G than A/A allele of *OPRM1* (A/A Δ HCVR = −0.15 mL/mmHg (−0.4 to 0.1); A/G Δ HCVR = −0.90 mL/mmHg (−1.5 to −0.3); $P < 0.01$). Paradoxically, subjects with A/G allele of *OPRM1* tended towards improved T90% during sleep with morphine whereas A/A allele tended to be worsened ($P < 0.05$).

Discussion: Genetic variations in morphine effect on sleep architecture and on measures of respiratory depression measured during wake and during sleep were identified. *HTR3B* genome polymorphism may modify morphine effect on sleep architecture through serotonergic pathways. Seemingly paradoxical depression of ventilatory response and improvement in T90 in *OPRM1* SNP rs1799971 may be explained by the OSA high chemosensitivity and ventilatory overshoot pathogenesis.

012

LOOP GAIN PREDICTS RESPONSE TO UPPER AIRWAY SURGERY FOR OBSTRUCTIVE SLEEP APNOEA

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Introduction: Upper airway surgery is an alternative treatment for obstructive sleep apnoea (OSA) but has variable success at reducing OSA severity and previous attempts to predict responses have had poor accuracy. Recent evidence suggests that knowledge of the underlying non-anatomical factors or traits (in particular an unstable ventilatory control system or elevated loop gain) responsible for OSA play a key role in predicting success to oral appliance, which is an anatomically-directed therapy. Therefore, the aim of this study was to examine whether an elevated loop gain at baseline predicts which patients will respond to surgeries aimed at improving the upper airway anatomy.

Methods: We conducted a retrospective analysis of 46 consecutive patients who underwent pre- and post-surgery polysomnography (PSG). Loop gain was determined from the ventilatory patterns contained in the clinical PSG data as previously described (1). In

order to determine the clinical and physiologic characteristics of patients that gained the greatest benefit from surgery, surgical success (i.e. responder) was defined by a reduction in the apnoea-hypopnoea index (AHI) $\geq 50\%$ and AHI < 10 events/hr post-surgery.

Results: Surgical success occurred in 12/46 (26%) patients. While there was no difference in either pre-surgery BMI (31.6 ± 6.3 vs. 32.7 ± 7.0 kg/m², $P = 0.62$) or AHI (32.6 ± 19.7 vs. 41.4 ± 30.9 events/h, $P = 0.36$) between responders and non-responders respectively, responders to surgery were both younger (34 ± 10 vs. 45 ± 14 , $P = 0.012$) and had a lower pre-surgery loop gain (0.49 ± 0.12 vs. 0.67 ± 0.16 , $P = 0.003$). Area under the receiver operating characteristic curve was 0.80 for loop gain predicting surgical success. A loop gain value of ≤ 0.70 was 100% sensitive for success (in other words, all patients with a pre-surgical loop gain > 0.70 [$n = 14$] were surgical failures), and a loop gain ≥ 0.50 was 88% specific for surgical failure (i.e. the majority of patients with a loop gain < 0.50 [$n = 7/11$] were surgical successes).

Discussion: Our preliminary findings suggest that loop gain assessed from a clinical PSG is strongly predictive of response to surgical intervention for OSA. While our findings will need to be validated in future prospective studies, this study suggests that measurement of phenotypic traits will take clinicians one step closer to individualizing therapy for patients with OSA. *Reference 1: Terrill et al, 2015, ERJ, 45, p408–418.*

013

THE MEDIAL PARABRACHIAL NUCLEUS CONTROLS WAKEFULNESS IN RATS

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Patients with brainstem stroke often show the symptoms including dizziness, decreased level of consciousness, even coma, suggesting that there is an essential nucleus around brainstem in controlling arousal. The chemogenetic and optogenetic approach were employed in present study to clarify whether the parabrachial nucleus (PB) in the brainstem plays an essential role in sleep-wake regulation. Bath application of CNO (500 nM) to PB slices isolated from the rats expressing hM3Dq receptors in PB resulted in increased firing frequency and recurrent bursting. EEG recording showed that CNO (0.3 mg/kg) injected intraperitoneally induced continuous wakefulness for 15 h in rats only expressing hM3Dq in the median part of PB (MPB), but not the lateral part of PB. Surprisingly, all rats did not exhibit any rebound in both amount of sleep, and the power spectrum for each stage after long period of wakefulness after CNO administration. Optogenetics results revealed that brief pulses of light (5 ms) evoked a single action potential with high frequency fidelity between 1 Hz and 20 Hz in PB neurons. When the rats were sleepy, blue light pulses at 5-ms in the frequency range of 1–20 Hz were delivered into the rats of MPB neurons expressing ChR2. The latency from sleep to wakefulness was dependent on the pulse frequency with the shortest waking-up latency when stimulated bilaterally at 20 Hz. Photostimulation of ChR2-expressing MPB terminals in the basal forebrain (BF) or lateral hypothalamus (LH) also induced an immediate transition from sleep to wakefulness. Light stimulation for 1 h in the BF/LH portion containing ChR2-expressing MPB terminals remarkably increased wakefulness. Our data indicated that the MPB neurons have a crucial role in controlling wakefulness, and the MPB-BF and PB-LH pathways are the major neuronal circuits for MPB-induced wakefulness.

016

A NOVEL ASSOCIATION OF POLYMORPHISMS IN THE CIRCADIAN CLOCK PERIOD3 GENE WITH SLEEPINESS IN OBSTRUCTIVE SLEEP APNOEA

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Background: Excessive sleepiness and cognitive impairments are common debilitating symptoms in OSA patients. Sleepiness can be influenced by many factors, including age, sex, shift work, medications, and lifestyle factors; however the role of genetic variation has been little investigated to date.

Study objectives: To investigate the association of known sleep-wake regulation candidate genes (Period 2 and Period 3) with “sleepy” phenotypes in subjects with OSA from the Western Australian Sleep Health Study (WASHS).

Methods: Participants were 1,301 OSA cases from the WASHS who completed a questionnaire, provided a DNA sample and had overnight polysomnography. Genetic association analyses between fifty single-nucleotide polymorphisms (SNPs) in two sleep-wake regulation Period genes (*PER2* and *PER3*) and sleepiness were performed, controlling for relevant covariates. All linear and binary logistic regression models were adjusted for age, sex, obesity and caffeine and alcohol use. Apnoea-hypopnoea index (AHI) and hypoxia indices (lowest arterial oxygen saturation [SaO_2] and time spent at less than 90% SaO_2), but not sleep duration were associated with Epworth sleepiness score (ESS) or dozing and were therefore tested in all models.

Design: Within-case analysis.

Results: Increasing age, obesity and caffeine use were associated with an increased risk of an elevated ESS. Three *PER3* SNPs were associated with low somnificity (risk of dozing in an alerting situation, all $P \leq 0.001$), after adjusting for AHI and a SNP*AHI interaction. Genotype-dependent differences related to severity of OSA were apparent in dozers vs. non-dozers. Cases who were homozygous for the minor allele (AA) of rs697693 are at risk of dozing for less severe OSA (a lower AHI of 24) than either major homozygotes (GG) or heterozygotes (AG).

Conclusion: This study found novel associations between *PER3* variants and risk of dozing in OSA cases, mediated by an interaction with severity of OSA. Genotype-dependent differences in response to sleep disruption are suggestive of differential vulnerability to sleep loss mediated by genetic determinants. Further studies are required to confirm this finding.

018

SLEEP WAKE VARIABILITY IN INDIGENOUS AND NON INDIGENOUS CHILDREN

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Background: In addition to sleep duration, variability in both sleep duration and sleep wake scheduling from night to night and week to weekend, are now increasingly proving to be related to and predictive of negative outcomes in children and young people. It is unknown if variability is This paper presents sleep variability data in both Indigenous and non-Indigenous Australian children.

Methods: In cohort 1, 49 non Indigenous adolescent males (mean age 15.6 years SD = 0.9 years), actiwatchers and sleep diaries recorded sleep for one preschool holiday week +10 school term weeks +1 post school term week (80 days in total). In cohort 2, in 1671 Indigenous children aged 6 months and 6 years olds, bedtime and wake time data were obtained in interviews as part of the Longitudinal Study of Indigenous Children.

Results: In cohort 1 variability was significant in TST ($P < 0.01$) and bedtimes and wakes times ($P < 0.001$) between school to non school days with moderate correlations with mood measures. In cohort, reported variability in TST was due to large variations (>60 min) in bedtimes and subsequent wake times in approximately 20% of children. Of those, 40.8% (229) reported no regular bedtime and 30% (173) decided their own bedtime. Variability was negatively associated with school attendance.

Conclusions: Variability is consequential and due to its modifiable nature, needs consideration in sleep health for both non-Indigenous and Indigenous children.

019

INTRAINDIVIDUAL VARIABILITY IN SLEEP/WAKE PATTERNS: SOME DATA, SOME METHODS AND AN ONGOING SYSTEMATIC REVIEW

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Two dimensions govern sleep/wake patterns across multiple days: the mean and the intraindividual variability (IIV). Existing studies focus on the means, and the nature and correlates of sleep/wake IIV are not well understood. Gaps in the literature on sleep IIV included a lack of systematic synthesis of evidence, a lack of robust and flexible methodology in quantifying IIV, and a systematic investigation into how IIV is related to physical and mental health outcomes. This symposium talk will present and discuss latest findings related to these three aspects.

First, findings from an ongoing systematic review (companion website: www.sleepv.org) on mental and physical correlates of sleep IIV will be presented. Overview of key correlates and summaries on most recent studies will be provided.

The second part of the talk focuses on methodological considerations in studying IIV. Methods for quantifying IIV (including current developments), as well as their strengths and weakness will be discussed.

Third, findings from two recent actigraphy studies will be presented. The first study was conducted in 146 adolescents over a 2-week unconstrained sleep opportunity. Findings suggested that both sleep duration and onset latency IIV shared a quadratic relationship with perceived sleep quality, and had subsequent indirect effects on negative mood. The second study examined the associations between sleep IIV and multi-system physiological dysregulation in 436 middle-aged adults. Findings from this study suggest that sleep IIV was associated with higher multi-system physiological dysregulation, and its effects were independent of, and comparable to, the effects of mean sleep variables. This study also suggested that sleep/wake patterns might contribute to the wear and tear across multiple physiological systems in a global, non-specific manner.

021

SLEEP REGULARITY AND BINGE DRINKING IN UNIVERSITY STUDENTSM. CARSKADON^{1,2}¹*Alpert Medical School of Brown University, Providence, RI, USA,*²*University of South Australia, Adelaide, SA, Australia*

Alcohol use among university students in the USA is a serious health concern due to inherent risks of excessive alcohol use and attendant risky behaviors. Evidence for the association of short and delayed sleep with excessive alcohol use has been shown in several populations; however, sleep pattern regularity is less well studied. We examine first-year Brown University students using daily diaries for sleep and alcohol use across the first 9 weeks of their initial term at school. Students were 18–20 years of age, which is below the legal drinking age in the state of Rhode Island, where Brown University is located. Of 878 participants who completed at least 50% of diaries, 647 reported no drinking before University. Of these, 325 (197 female) reported no alcohol use; 199 (121 female) reported at least 1 day of drinking, but no more than one heavy drinking occasion of ≥ 4 drinks (women) or ≥ 5 drinks (men); 123 (59 women) reported at least one episode of heavy drinking. 231 students (111 female) reported drinking before coming to university and more than one heavy drinking episode during the term. A sleep regularity index derived from the daily diary data will be used to determine whether day-to-day sleep patterns are associated with heavy alcohol use (binge drinking) in these young students.

027

EFFECTS OF MORPHINE ON AWAKE VENTILATORY CONTROL AND OSA SEVERITYD. WANG^{1,2}¹*Woolcock Institute of Medical Research,* ²*Royal Prince Alfred Hospital, Sydney, NSW, Australia*

Obstructive sleep apnea (OSA) has been listed as a major risk factor for opioid-related respiratory arrests and deaths by anaesthesiology guidelines despite no relevant randomised controlled trial (RCT). The interaction between opioid and OSA and relevant ventilatory control modulation has not been studied in detail. We conducted a pilot study and a RCT to explore the relevant mechanisms.

In the pilot study, we evaluate awake ventilatory chemoreflex and over-night polysomnograph (PSG) on 10 mild-moderate OSA men before and after using 30 mg oral slow release morphine (MS Contin). For the given dose of morphine, we found a significant cross-correlation between a higher plasma morphine concentration, a higher CO₂ response threshold (VRT), and an improvement in sleep time with SpO₂ < 90% (T90). This may suggest that the mild dose of morphine may paradoxically improve OSA through modulating chemoreflexes. The interesting finding prompted us to conduct a double-blind RCT study to evaluate the effect of a higher dose of morphine (40 mg of MS Contin) on awake ventilatory chemoreflex and over night PSG in 60 mild-severe OSA men. We found that morphine significantly increased VRT and decreased ventilatory response to hypercapnia (HCVR). The reduction in HCVR significantly correlated with the improvement in apnea-hypopnea index (AHI) and the relationship was mainly driven by the severe patients. In addition, we found that in severe OSA patients, a lower baseline VRT significantly correlated with the worsening of T90, AHI, oxygen desaturation index (ODI) and arousal index with morphine use.

In conclusion, the effect of morphine on OSA often shows a paradoxical inaction between a negative direct central depressing effect and positive OSA improving effect from depressing the augmented chemosensitivity, a major pathogenesis of OSA. CO₂ VRT, measured during a 10-min awake chemoreflex test, potentially predicts respiratory depression with morphine in severe OSA patients.

028

EFFECTS OF DIFFERENT SLEEPING PILLS ON UPPER AIRWAY PHYSIOLOGY

J. CARBERRY

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There are four key causes of obstructive sleep apnoea (OSA), e.g. increased upper airway collapsibility, a low arousal threshold (premature awaking), ineffective or loss of upper airway dilator muscle activity during sleep and an overly sensitive ventilatory control system (high loop gain). Recent studies have shown that the contribution of these phenotypic traits to OSA pathogenesis varies, and provides a foundation to explore personalised treatment options for individuals who do not tolerate CPAP therapy.

Hypnotics (e.g. benzodiazepines) might perpetuate sleep apnoea severity by promoting upper airway myorelaxation and delaying arousal, thus potentially leading to prolonged apnoeic events and increased hypoxaemia. However, recent studies suggest that certain non-benzodiazapines may not cause myorelaxation and may help stabilise breathing during sleep in people with certain OSA phenotypes by preventing recurrent premature arousals and breathing instability. Despite the high prevalence of hypnotic use (>5% of the adult population), data on the effects of hypnotics on upper airway physiology in healthy individuals and obstructive sleep apnoea is limited. It is important to determine how different hypnotics alter sleep and upper airway physiology and which OSA patients are at risk of worsening sleep apnoea vs. those who may yield improvement in sleep apnoea severity with certain hypnotics.

This presentation will review the latest findings on the effects of three commonly used sedatives (zopiclone, zolpidem and temazepam) on upper airway muscle activity, arousal threshold and upper airway collapsibility during sleep. The implications of different hypnotics on sleep and breathing stability in healthy individuals and patients with OSA will also be discussed.

029

CENTRAL NERVOUS SYSTEM DEPRESSANTS AND SLEEP APNOEA: FRIEND OR FOE?

D. ECKERT

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Recent advances in knowledge of obstructive sleep apnoea (OSA) pathogenesis have highlighted the heterogeneity of this common disorder. Anatomical compromise (i.e. a narrow or highly collapsible upper airway) is the key cause. However, this trait varies substantially between patients. Indeed, approximately 20% of OSA patients have similar anatomical compromise to many people who do not have OSA. Thus, non-anatomical factors also contribute to the pathogenesis of OSA in many patients. Indeed, approximately 70% of OSA patients have impairment in one or more of the non-anatomical phenotypic traits that contribute to OSA. These include: poor upper airway dilator muscle responsiveness during sleep, a low

respiratory arousal threshold (waking up too easily during airway narrowing) and unstable respiratory control (high loop gain). Central nervous system depressant use (e.g. opioids and hypnotics) is high and continues to grow. Increased use of prescription opioid-based medications has been accompanied with increased rates of opioid-related deaths (many during sleep). How to manage opioid-analgesia postoperatively in people with OSA is also a key clinical concern. Hypnotic use in OSA is not recommended due to fears that these agents may worsen hypoxemia and decrease upper-airway dilator muscle contractility. However, recent clinical and physiological studies reveal seemingly paradoxical effects of common central nervous system depressants on respiratory and upper airway physiology, sleep and breathing. These differences are explained, at least in part, by drug dose, drug class and differences in the causes of OSA between patients.

This presentation will review the latest findings on the role of common central nervous system depressants on respiratory and upper airway physiology, sleep and breathing. The potential role of physiological phenotyping to predict which patients are vulnerable to adverse effects from these agents vs. those who may benefit will also be discussed.

033

PRACTICE NURSE MANAGEMENT OF INSOMNIA IN THE MULTIDISCIPLINARY SLEEP WA CLINIC

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Despite the prevalence of chronic insomnia and the general acknowledgement of Cognitive Behavioural Therapy for insomnia as the gold standard treatment, there are few practitioners in Western Australia offering this service. As a Sleep Physician with frequent referrals from General Practitioners searching for an alternative to pharmacotherapy for insomnia, Dr Jack Philpott, Medical Director of Sleep WA, employed a Registered Nurse with experience in sleep medicine to provide an insomnia management program including CBTi.

Intensive training and supervision were provided by a Clinical Psychologist specialising in insomnia. All patients referred are first seen in consultation by the Sleep Physician and referred on when appropriate. The insomnia program is typically between 4 and 6 sessions at weekly or fortnightly intervals and comprises of a combination of CBTi and other therapy or devices based on the individual need.

The Nurse driven program has been showing impressive results since 2011 with significant post therapy decreases in Insomnia Severity Index scores and sleep latency with increases in total sleep time and sleep efficiency. Details of the initial success were delivered as a poster presentation at the ASA conference in Darwin 2012 and the program has maintained strong clinical outcomes since.

As more registered nurses are attracted to sleep medicine, upskill opportunities in the delivery of CBTi would broaden availability of this much needed service, giving GPs an alternative to pharmacotherapy for insomnia sufferers.

034

INSOMNIA AND CIRCADIAN RHYTHM DISORDERS TREATMENT AT THE RESEARCH BASED MONASH UNIVERSITY HEALTHY SLEEP CLINIC

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Chronic insomnia is a very common condition that presents frequently to the primary care physician. In more than 90% of instances the first line therapy is pharmacotherapy despite evidence that there are effective non pharmacological alternatives such as cognitive behavioural therapy for insomnia (CBT-I). Barriers to effective therapies include lack of awareness, lack of expertise in delivery of CBT-I and patient cost. In addition insomnia may mimic a range of other conditions such as sleep apnoea and circadian rhythm disorders suggesting a comprehensive diagnostic evaluation should pre-empt specific intervention.

We developed a low patient cost multidisciplinary insomnia and circadian disorder service at Monash University commencing in November 2014. The objectives of this service are:

- 1: Provide a much needed and affordable clinical service targeting insomnia and circadian disorders.
- 2: Provide a training facility to improve expertise in these disorders creating the potential for scale-up.
- 3: Provide a platform for research into the nature and intervention of insomnia and circadian rhythm disorders.

The treating team comprised of sleep physicians with expertise in non-respiratory sleep disorders, clinical psychologists specialised in sleep disorders, and trainees across both disciplines. The pathway comprised of initial diagnostic assessment by a sleep physician to ensure correct diagnosis and suitability for a CBT-I program. Patients with confirmed insomnia or circadian rhythm disorders were enrolled in either individual or group CBT-I therapies. Patients with other conditions (e.g., obstructive sleep apnoea) received ongoing management by the sleep physician and not referred to the CBT-I program. An ongoing research database on clinical features and treatment responses of patients attending the clinic has been established via opt-out consent. This session will report on early outcomes of this service and findings from research data collected so far.

035

CAN CIRCADIAN PHASE BE ESTIMATED FROM SELF-REPORTED SLEEP TIMING IN PATIENTS WITH DELAYED SLEEP WAKE PHASE DISORDER TO GUIDE TIMING OF CHRONOBIOLOGIC TREATMENT?

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Introduction: The efficacy of bright light and/or melatonin treatment for Delayed Sleep Wake Phase Disorder (DSWPD) is contingent upon an accurate clinical assessment of circadian phase. However, the process of determining this circadian phase can be costly and is not yet readily

available in the clinical setting. The present study investigated whether more cost-effective and convenient estimates of circadian phase, such as self-reported sleep timing, can be used to predict circadian phase and guide the timing of light and/or melatonin treatment (i.e. dim-light melatonin onset, core body temperature minimum and melatonin secretion mid-point) in a sample of individuals with DSPD.

Method: Twenty-four individuals (*male* = 17; *mean age* = 21.96, *SD* = 5.11) with DSPD were selected on the basis of ICSD-3 criteria from a community-based sample. The first 24-hrs of a longer 80-hr constant laboratory ultradian routine were used to determine core body temperature minimum (cBT^{min}), dim-light melatonin onset (DLMO) and the midpoint of the melatonin secretion period ($DLM^{mid} = [DLM^{off} - DLMO]/2$). Prior to the laboratory session subjective sleep timing was assessed using a 7-day sleep/wake diary, the Pittsburgh Sleep Quality Index (PSQI), and the Delayed Sleep Phase Disorder Sleep Timing Questionnaire (DSPD-STQ).

Results: Significant moderate to strong positive correlations were observed between self-reported sleep timing variables and DLMO, cBT^{min} , and DLM^{mid} . Regression equations revealed that circadian phase (DLMO, cBT^{min} and DLM^{mid}) was estimated within ± 1.5 h of measured circadian phase most accurately by the combination of sleep timing measures (88% of the sample) followed by sleep diary reported midsleep (83% of the sample) and sleep onset time (79% of the sample).

Discussion: These findings suggest self-reported sleep timing may be useful clinically to predict therapeutically relevant circadian phase in DSPD.

036

MELATONIN FOR IMPROVING SLEEP INITIATION AND DAYTIME IMPAIRMENTS IN DELAYED SLEEP PHASE DISORDER

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Introduction: Delayed Sleep Phase Disorder (DSPD) is characterised by sleep initiation insomnia when attempting sleep at conventional times. Melatonin administration has been recommended for DSPD but large-scale randomised controlled trials and evidence-based therapeutic guidelines are lacking. This trial tested the efficacy of 0.5 mg melatonin for improving sleep initiation and sleep-related daytime impairments in DSPD patients with a delayed endogenous melatonin rhythm relative to patient-desired bedtime (DBT).

Methods: Participants were 104 patients (53 males; 29.4 ± 10.0 years) who met criteria for DSPD based on clinical interview and had salivary melatonin onset within 30 min of or after patient DBT. Patients were randomised to treatment with 0.5 mg melatonin or placebo for 4 weeks. Treatment was administered 1 h before DBT with bedtime scheduled at DBT at least five nights per week. Actigraphic sleep onset time and sleep efficiency in the first third of sleep (SE T1) were assessed on a week of baseline nights and on all treatment nights. Patient Reported Outcomes Measurement Information System (PROMIS) was completed each week during baseline and treatment as a measure of sleep disturbance and of subjective sleep-related daytime impairments including sleepiness and irritability.

Results: Relative to baseline, sleep onset time was 30 min earlier ($P < 0.05$) and SE T1 was 6.1% greater ($P < 0.01$) with melatonin compared to placebo. Melatonin treatment reduced PROMIS sleep-related impairment and PROMIS sleep disturbance, in addition to insomnia severity index, daytime sleepiness (Epworth Sleepiness Scale), and functional disability (Sheehan Disability Scale) ($P < 0.05$). More patients showed larger clinician-rated improvements following melatonin compared to placebo ($P < 0.05$). Post-treatment melatonin onset in a subset ($n = 44$) was not significantly different between groups.

Discussion: In DSPD patients with delayed circadian rhythms, melatonin treatment 1 h before DBT is efficacious for improving objective and subjective measures of sleep initiation and sleep-related impairments. Improvements appear to be achieved largely through the sleep-promoting effects of melatonin.

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037

SALIVARY ALPHA-AMYLASE: A POTENTIAL BIOMARKER OF REACTION TIME DURING TOTAL SLEEP DEPRIVATION

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Introduction: Discrepancies between common subjective measures of sleepiness and performance during sleep deprivation, have led to a recent interest in the identification of a biological marker of performance. In this study, we investigated the relationship between salivary alpha-amylase (sAA) (a proposed peripheral marker of central noradrenergic activity) and performance during 50 h of total sleep deprivation (TSD).

Methods: Following a 10 h baseline sleep (22:00–08:00), 12 healthy adults underwent 50 h of TSD. Beginning at 09:00 h, participants recorded their sleepiness on a 10-point visual analogue scale, completed a brief 3-min psychomotor vigilance task (PVT-B) and provided a saliva sample every 3 h during the waking period. PVT-B output measures analysed included mean reaction time (RT), mean slowest 10% RT, and total lapses. Separate mixed polynomial growth curve models of each variable (sAA, subjective sleepiness, mean RT, mean slowest 10% RT, and total lapses) were performed with linear and quadratic fixed effects of time, and a random-intercept to represent subject variability.

Results: Ratings of subjective sleepiness exhibited a constant linear increase ($P < 0.001$). In contrast, sAA levels revealed a marked diurnal profile (time², $P < 0.001$), with an initial increase and steady decline towards the evening and early-morning. This diurnal profile did not differ across the 50 h of sustained wakefulness (time² × day, $P = 0.074$), nor was it influenced by age, body mass index, or gender. PVT-B performance also exhibited a diurnal profile (time², $P < 0.001$) with performance worsening towards the evening and early-morning. Further analysis revealed that the diurnal profile of sAA mimicked the performance profile of mean RT and mean slowest 10% RT during sustained wakefulness.

Conclusions: The results of this study suggest that sAA may be a better predictor of performance during extended wakefulness than the most common approach of subjective sleepiness ratings. Changes in sAA levels may be useful for predicting performance impairments prior to safety being compromised or detecting deficits when individuals may not be aware. The simple and non-invasive analysis makes sAA assessment promising for future application in operational environments.

038

SLEEP LOSS AND THE HUMAN GUT MICROBIOME: PRELIMINARY INVESTIGATION OF A NOVEL MECHANISTIC LINK BETWEEN SHIFTWORK AND METABOLIC DISEASE

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Introduction: Obesity continues to impact on the health of the Western world. There is a growing need to identify, and subsequently manage, contributing factors if we are to reduce the health and economic burden on society. Shiftwork is a recognised contributor to metabolic disease, however it is still not clear exactly how shiftwork contributes to this disease state. Shiftworkers habitually self-report less sleep, and insufficient sleep is associated with a physiological stress response.

The human gut microbiome is thought to play a role in disease development and progression, particularly in obesity. When germ free mice are colonized with the microbiota of an obese human they develop an obese profile, gaining significantly more weight and fat mass than germ free counterparts colonized with a microbial transplant from a lean human. To date, no experimental laboratory sleep studies have reported the impact of sleep loss on the human gut microbiome. Mouse models of disrupted microbial communities in the intestine after a period of sleep deprivation suggest there may be a novel pathway (via disruption of gut microbiota) by which insufficient sleep contributes to the relationship between shiftwork and ill health.

Methods: Using a counterbalanced, cross-over design, five healthy male subjects experienced two laboratory conditions: 1: 4 nights of 8 h time in bed, and 2: 4 nights of 8 h time in bed, 64 h sustained wakefulness, and 8 h recovery. DNA was extracted from faecal samples with Bioline Isolate Fecal DNA kit, cat. No#BIO-52082, and 16s rRNA sequencing was performed on the Illumina MiSeq platform using 2 × 300 bp paired end sequencing.

Results and Discussion: Preliminary analyses revealed significant between and within-subject variability in diversity at a genus level,

and no significant effect of sleep deprivation on overall diversity at the operational taxonomic unit (OTU) level ($P > 0.05$). Methodological considerations for future research endeavours in this emerging area will be discussed, including the importance of adequate sample sizes to account for the interindividual variability seen in microbial communities.

039

COGNITIVE PERFORMANCE DETERIORATES DURING CHRONIC SLEEP RESTRICTION IN THE ABSENCE OF EXTENDED WAKE EPISODES

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Introduction: Significant deficits in cognitive function and alertness occur with sleep loss. Sleep loss can be the result of acute sleep deprivation (wake duration >24 h) and chronic sleep restriction (CSR; insufficient sleep duration for consecutive days). Millions of people average <6 h of sleep per night, which usually results in extended wake duration (>16 h). The effect of CSR following durations of wakefulness <16 h is unknown. We investigated whether imposing CSR causes deterioration after wake durations <16 h on psychomotor vigilance task (PVT) performance.

Methods: Seventeen (10 female) healthy participants participated in a 32-day inpatient protocol free of time cues and in dim-lighting (<4 lux). Participants were scheduled to 24 cycles of a 20 h forced desynchrony (FD) protocol and randomized to one of two sleep: wake FD conditions; Habitual (1:2, 6.67 h sleep, 13.33 h wake; 8 participants) or CSR (1:3.3, 4.67 h sleep, 15.33 h wake; 9 participants). Participants completed a 10-min PVT session every 2 h during scheduled wakefulness. PVT data were assigned circadian phase using core body temperature data. Inverse of median reaction time (RT) and number of lapses (RTs > 500 msec) were analyzed using mixed-effect model techniques.

Results: There was a significant interaction between circadian phase, time awake, and condition for both inverse median RT and number of lapses ($P < 0.001$). RT was slower and lapses increased under CSR conditions (vs. Habitual) with increasing time awake and during circadian night phases. When separated to circadian day or night, inverse median RT was slower and lapses were higher in the CSR condition during both the circadian night and circadian day ($P < 0.05$).

Conclusion: PVT performance is affected by an interaction of circadian phase, length of time awake during the current wake episode, and sleep history even without prolonged wake duration. These data suggest that the chronic sleep loss, independent of extended wakefulness, affects vigilance, during both the circadian day and night.

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040

DAILY ENERGY INTAKE DISTRIBUTION DIFFERS IN OBESE VS. NONOBESE ADOLESCENTS STUDIED IN FORCED DESYNCHRONY—PRELIMINARY DATA

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Introduction: Research in adults demonstrates a role for the timing of energy distribution in weight management and obesity, with more favorable outcomes when a greater proportion of energy is consumed earlier in the day. We examined the timing of energy distribution in adolescents with 28-h forced desynchrony (FD), hypothesizing an association of overweight (OW) and obesity (O) with lower proportion of daily energy consumed early in the day and greater consumption later in the day compared to adolescents who were normal weight (NW). Similar associations to circadian phase were also hypothesized.

Procedures: Twenty-six (15 m) adolescents (12 to 15 years) completed 7 full cycles of FD; 17.5 h awake each cycle. Foods were selected about 1 h before each of 6 meals every cycle; Meal 1 began 1.7 h after waking, Meal 2 was 2 h after Meal 1, and Meals 3–6 followed at 3-h intervals. Food was weighed before and after each meal. Proportion of daily energy intake was computed for each meal based on the total energy consumed in that cycle. Weight categorization used BMI percentiles (U.S. CDC): NW >5 < 85 ($n = 14$), OW $\geq 85 < 95$ ($n = 6$), or O ≥ 95 ; ($n = 6$). Analyses were performed using mixed effect models, with cosinor analyses for circadian phase.

Results: A main effect of meal time ($F = 49.49$; $P < 0.001$) showed greatest proportion (22.3%) of energy consumed in Meal 1 and least (13.0%) in Meal 6. A significant interaction ($F = 2.40$; $P = 0.005$) of meal by weight group showed lower proportion of energy (20.0%) at Meal 1 in O than both NW (22.7%) and OW (24.2%). O also ate more daily energy at Meal 6 (15.0%) than NW (12.9%) and OW (11.1%). The OW group had a significantly higher proportion of energy intake at Meal 1 than NW and lower proportion of energy intake at Meals 4 and 6 than NW. Circadian phase and phase by time of meal analysis confirmed that acrophase (peak time) of energy consumption in the O participants was consistently later than the other groups, occurring on average at about 328 degrees, vs. about 315 and 300 degrees in the OW and NW groups, respectively. (Melatonin onset phase is 360 degrees.) Nutrient distribution also showed group differences.

Discussion: These preliminary findings support our hypotheses.

041

COGNITIVE BEHAVIOURAL THERAPY FOR INSOMNIA ADMINISTERED BY PRACTICE NURSES IN RURAL NSW

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Introduction: Insomnia is one of the most common sleep complaints in general practice. Pharmacotherapy is still the usual treatment intervention even though the research has identified the long term effectiveness of Cognitive Behavioural Therapy for insomnia ((CBT-i) Morin et al., 2006 & 2009)), which challenges ineffective behaviours and faulty sleep beliefs. Access to professionals able to provide

these interventions is almost absent in rural communities in Australia. Training Practice Nurses to undertake a CBT-i intervention may provide a treatment which is easily accessible and deliverable. Practice Nurses also play a key role in rural communities helping individuals adhere to varying treatment interventions through education and support. We used an evidence based stepped care model previously delivered by Practice Nurses in the UK (Espie et al., 2007 & 2011).

Methods: This was a randomised pilot control trial where individuals attending their GP practices with an Insomnia Severity Score (ISI) of >14 were randomised to either an active or weight listed (delayed) intervention arm. 6 Practice Nurses were trained to deliver CBT-i at 3 clinics in the Primary Healthcare Network of New England (NSW) with full support from the GP's in the Barton Lane Practice. Patients were seen individually over 4 sessions, facilitated by slides and a matching manual. All sessions were audio recorded. The ISI (primary outcome), mood and other questionnaire data were collected after 6 months. A subset of participants in each group wore actiwatches.

Results: Audio recordings were evaluated by matching the training manual and participant slides with each section. This was checked off by two assessors as the nurses went through this program with their individual participants. To date 33 participants were screened and 26 randomised into the immediate start (15) or to delayed start (11); Two Practice Nurses dropped out of the study. Participant drop outs – 4; 1 in the immediate & 3 in the delayed group; Data collected to the 6 month follow up – 15; 7 more patients' data to be collected. This pilot data when completed will be analysed in the next few weeks.

Discussion: This is the first CBT-i intervention run by Practice Nurses after training compared with other studies where only behavioural measures were used. Assessment of the taped interviews/sessions suggests a high level of skill in these health professions who expressed high levels of satisfaction in the delivery of this intervention. This training appears to be an essential step in opening up CBT training to more rural communities

042

INSOMNIA WITH CO-MORBID DEPRESSION CAN BE EFFECTIVELY TREATED WITH COGNITIVE/BEHAVIOR THERAPY

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Introduction: The aim of this study was to add to the evidence base that cognitive behavioural therapy for insomnia (CBTi) is an effective treatment and to examine the impact of comorbid depression on the treatment effectiveness of CBTi.

Methods: A case series study comparing normal, mild-moderate and severe-extreme depression groups (based on validated cut-off values of the Depression Anxiety Stress Scale) at Baseline, 5-weeks, and 3-months from the start of treatment. The study included 258 (65.9% women) consecutive patients referred to Adelaide Institute of Sleep Health, South Australia for the treatment of insomnia. Treatment included feedback of home based polysomnography sleep recording (PSG), group education session and multiple (4-6) individual sessions of CBTi.

Results: Improvements from baseline to the follow-up time points in insomnia severity, sleep diary total sleep time, sleep efficiency, sleep onset latency, wake after sleep onset, daytime fatigue and other impairments were all statistically and clinically significant with large effect sizes. Importantly, these improvements did not differ between

groups. The only interaction effects between groups and time were larger decreases in depression, anxiety, and stress symptoms for the initially more depressed groups.

Discussion: Results suggest that CBTi works to improve sleep parameters, daytime impairments and insomnia severity equally well in those with co-morbid depressive symptoms as it does in those free of depression. CBTi had additional benefits in this clinical population of improvements in depression, anxiety, stress, and dysfunctional beliefs about sleep.

043

THE BURDEN OF SLEEPING DIFFICULTIES AND RELATED DAYTIME DYSFUNCTION IN AUSTRALIA IN 2016- RESULTS OF A NATIONAL POPULATION SURVEY

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Introduction: With lifestyles and work patterns changing the current prevalence of sleep disorders and problems in the Australian community needs revisiting.

Methods: An on-line survey of 1011 adults aged over 18 years across Australia was conducted in March 2016 on behalf of the Sleep Health Foundation with representativeness for age, sex, location and socio-economic status, from a panel of over 220,000 Australians. The questions are taken largely from the 2002 US National Sleep Foundation Sleep in Adults survey. A three-stage randomisation process was used to minimise the risk of bias. Univariate analyses determined differences in frequencies of sleep variables by sex and 10 year age groups.

Results: At least one third of adults report difficulties sleeping and more than a quarter report daytime symptoms a few times a week or more. Women are significantly more likely than men to experience difficulty in falling asleep (40% vs. 26%), waking too early (47% vs. 37%) or unrefreshed (51% vs. 40%), and report daytime sleepiness (34% vs. 25%), fatigue or exhaustion (45% vs. 33%) and feeling irritable or moody (237% vs. 26%) despite no difference in sleep duration the night before working (424 vs. 417 min) or non-working days (462 vs. 451 min) compared to men. There was little difference across age groups for difficulty falling asleep and waking up too early. However, with increasing age, we observed a significantly decreased frequency of waking unrefreshed and an increased frequency of getting adequate sleep. Similarly, daytime symptoms and an Epworth sleepiness scale score >10 significantly decreased with increasing age. Doctor-diagnosed OSA was significantly more likely in men (13%) compared to women (4%) and increased with age, however insomnia (identified according to the International Classification for Sleep Disorders -3 criteria) was significantly more common in women (23%) than in men (17%). Frequent, loud snoring was reported by 20%, and breathing pauses by 12%.

Discussion: Difficulties sleeping and daytime symptoms are very common particularly in women and younger adults. Sleep problems are not more common in the elderly and when present should be investigated for underlying causes. Diagnosed OSA was less common than found in recent population studies, indicating OSA is often undiagnosed.

044

PSYCHOLOGICAL AND QUALITY OF LIFE FACTORS IN MEN WITH COMORBID OBSTRUCTIVE SLEEP APNEA (OSA) AND INSOMNIA (INS): A POPULATION STUDY

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OSA and Ins frequently coexist together but prevalence and risk factors in the community remain largely unknown. This study examined the prevalence and clinical profile of undiagnosed comorbid OSA and insomnia (COMISA) in a community-based population of Australian men.

Methods: Men ($N = 700$) without a prior diagnosis of OSA completed full at home unattended polysomnography (PSG, Embletta Z100), the Pittsburgh Sleep Quality Index and SF-36 short form health survey (2010-12). Insomnia was defined according to the DSM-IV-TR Research Diagnostic Criteria for primary insomnia. Psychological and behavioural factors (e.g. Beck Depression Inventory-1A/Centre for Epidemiological Studies Depression Scale, Patient Health Questionnaire-9 (PHQ-9), Pearlin Mastery Scale) were also assessed (2007-10). Univariate (X^2 , ANOVA) and multiple linear regressions were used to compare data from four groups of individuals: those with neither disorder, previously undiagnosed OSA (OSA) ($AHI \geq 10/h$) or Ins alone, and those with COMISA.

Results: Prevalence of OSA, Ins and COMISA was 41.3, 8.7 and 11.6%, respectively. The proportion of men with OSA who also had Ins was 21.9%. Depression prevalence was 6.6, 18.0 and 34.6% in OSA, Ins and COMISA, respectively. Men with COMISA had significantly higher (post-hoc, $P < 0.05$) depression scores (e.g. PHQ-9 mean \pm SD, OSA: 11.1 ± 2.7 ; Ins: 13.8 ± 5.6 , COMISA: 15.1 ± 5.3) and lower mastery (OSA: 21.2 ± 2.8 ; Ins: 20.6 ± 2.9 ; COMISA: 19.7 ± 2.9) and quality of life (physical: OSA: 51.7 ± 7.1 ; Ins: 45.2 ± 9.4 ; COMISA: 39.3 ± 10.8 ; mental: OSA: 53.3 ± 6.4 ; Ins: 44.8 ± 9.2 ; COMISA: 39.7 ± 12.2) component scores than both the Ins and OSA groups. This was despite having similar respiratory and arousal indices to that observed in the OSA group, and similar reductions in subjective sleep quality, efficiency, duration and day dysfunction scores to that observed in the Ins group. Associations with depression, mastery and both physical and mental quality of life remained significant in the COMISA group even after adjustment for age, obesity, chronic diseases, erectile dysfunction, sleepiness, mood and financial strain, where appropriate.

Conclusions: Community-dwelling men with COMISA show significantly worse quality of life (both physical and mental), mastery and depression. The quality of life burden is profound and similar to other major chronic illnesses.

045

THE YAWN (YOUNG ADULTS WORKING NIGHTS) STUDY: BARRIERS AND ENABLERS TO MODIFYING SLEEP BEHAVIOUR IN YOUNG ADULTS

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Many young adults obtain less than the recommended sleep duration for healthy and safe functioning. Behaviour change interventions have had only moderate success in increasing sleep duration for this cohort. This may be because the way young adults think about sleep, including their willingness and ability to change sleep behaviour, is unknown.

The purpose of the present study was to determine what changes, if any, young adults are willing to make to their sleep behaviour, and to identify factors that may enable or prevent these changes. Fifty-seven young adults (16–25 years; 57% female) took part in focus groups addressing a) willingness to change, b) desired outcomes of change, and c) barriers to change in regards to sleep behaviour. An inductive approach to data analysis was employed, involving data immersion, coding, categorisation, and theme generation.

Participants were willing to change sleep behaviour, and had previously employed strategies including advancing bedtime and minimising phone use, with limited success. Desired changes were improved waking function, advanced sleep onset, optimised sleep periods, and improved sleep habits. Barriers to making these changes included time demands, technology use, rumination, and bad habits. Young adults want to improve sleep behaviour and waking function; this is an important first step in modifying behaviour. Notably, participants wanted more efficient and better quality sleep, rather than increasing sleep duration. The reported barriers to sleep, particularly using technology for social purposes, will require innovative and specialised strategies if they are to be overcome.

046

SELF-REPORTED SLEEP DIFFERENTIALLY PREDICTS MEMORY AND EXECUTIVE FUNCTION IN YOUNGER AND OLDER-ONSET PARKINSON'S DISEASE

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Background: Both disrupted sleep and cognitive impairment are frequent in Parkinson's disease (PD), but the evidence for a relationship between self-reported sleep disturbance and cognitive symptoms has been equivocal. If sleep symptoms differentially predict cognition in different subtypes, effects may be obscured in a general PD sample.

Objective: First, to determine whether the associations between participant and disease variables, sleep symptoms and cognitive performance vary by subtype (younger and older-onset); then to establish whether these effects remain when the sample is reanalysed as a whole.

Method: Multi-group path analyses were used to model the relationships between participant and PD variables; factor scores derived from our bifactor analysis of the Parkinson's Disease Sleep Scale-Revised; and, measures of memory and executive function. Path analyses were replicated as single group analyses.

Results: Increased general sleep disturbance predicted *better* verbal recall in younger-onset PD and poorer visual episodic memory in older-onset PD. High insomnia scores predicted *better* verbal recognition memory in younger-onset PD, *better* verbal fluency in both groups and *poorer* spatial working memory (SWM) in older-onset PD. Higher OSA and RBD scores predicted poorer spatial recognition memory and spatial working memory in younger-onset PD but did not predict cognition in older-onset PD. Many regression coefficients were weakened or reduced to non-significance in the single-sample models.

Conclusions: There is a markedly different relationship between participant variables, sleep, and cognition in younger and older-onset PD. As PD samples are highly heterogeneous but are not routinely divided by subtype, these findings may explain the lack of association between disrupted sleep and memory and EF impairment in the literature. The influence of sex and premorbid IQ as moderating variables warrant further investigation in a larger sample.

047

THE LONGITUDINAL EFFECTS OF PERSISTENT APNOEA ON CEREBRAL OXYGENATION DURING SLEEP IN EX-PRETERM INFANTS

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Background: While apnoea of prematurity in preterm infants is usually resolved by near-term equivalent age, apnoea of shorter durations may persist during infancy. The aim of our study was to assess the incidence and impact of persistent apnoea on heart rate (HR), oxygen saturation (SpO₂) and brain tissue oxygenation index (TOI) over the first 6 months after term equivalent age.

Methods: Twenty four preterm infants 13 M/11 F born between 27–36 weeks of gestational age were studied with daytime polysomnography at 2–4 weeks, 2–3 months and 5–6 months post-term corrected age. Apnoeas lasting ≥3 sec were included and % changes in HR, SpO₂ and TOI (NIRO-200 Hamamatsu) from baseline were analysed.

Results: Two hundred and fifty-three apnoeas were recorded at 2–4 weeks, 203 at 2–3 months and 148 at 5–6 months. Infants had between 5–27 apnoeas at 2–4 weeks, 1–27 at 2–3 months and 1–16 at 5–6 months with an average of 3 per hour at all three studies. Apnoea duration was significantly longer at 2–4 weeks (mean ± SEM, 4.6 ± 1.4 sec) compared to 5–6 months (4.4 ± 0.9 sec, $P < 0.05$). There was no effect of gestational age, sleep state or sleep position on apnoea duration, nadir HR, nadir SpO₂ or nadir TOI. At 2–4 weeks nadirs in HR, SpO₂ and TOI were all positively correlated with apnoea duration ($R = 0.402$, $P < 0.001$; $R = 0.314$, $P < 0.001$; $R = 0.137$, $P < 0.05$ respectively). At 2–3 months nadirs in HR and TOI were correlated with apnoea duration ($R = 0.283$, $P < 0.001$; $R = 0.195$, $R = 0.220$ $P < 0.01$ respectively) and at 5–6 months only HR nadir was positively correlated with apnoea duration ($R = 0.240$, $P < 0.01$). At 2–4 weeks the nadirs in HR (-6.9 ± 0.6 bpm), and TOI ($-2.7 \pm 0.2\%$) were significantly less than at 2–3 months (nadir HR: -9.5 ± 0.7 bpm, $P < 0.01$ and nadir TOI: $-4.6 \pm 0.3\%$, $P < 0.001$) and at 5–6 months (nadir HR -9.8 ± 0.8 bpm, $P < 0.05$, and nadir TOI $-5.5 \pm 0.6\%$, $P < 0.001$).

Discussion: In ex-preterm infants apnoeas were frequent and apnoea duration was correlated with falls in HR, SpO₂ and TOI over

the first 6 months after term equivalent age. These short apnoeas were associated with decreases in cerebral oxygenation, which were more marked at 2–3 months and 5–6 months than at 2–4 weeks. Although events were short they may contribute to the adverse neurocognitive outcomes which are common in ex-preterm children.

048

CENTRAL ADIPOSITY PREDICTS INCREASED HEART RATE IN CHILDREN AND ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Background: Obstructive sleep apnoea (OSA) and obesity in children have adverse cardiovascular effects, including elevated heart rate (HR), however little is known about the additive effects of obesity and OSA on heart rate in children. Previous studies have used body mass index (BMI) as a coarse measure of obesity. There is now increasing recognition of the contribution of neck and abdominal adiposity in children to the risk of developing OSA and as a consequence, the associated cardiovascular outcomes. The aim of this study was to determine whether BMI z-score, the anthropomorphic measures of neck, waist, hip circumferences, the neck/waist (NWR), waist/hip (WHR) and waist/height (WHtR) ratios, and OSA severity measured by the obstructive sleep apnoea index (OAHl) were predictive of increased HR during wake and sleep in children.

Methods: Children aged 3–18 years undergoing assessment for suspected OSA ($n = 301$) and age-matched non-snoring controls recruited from the community ($n = 98$) underwent overnight polysomnography. They were grouped by age into 3–5 years ($n = 175$); >5–9 years ($n = 91$); and >9 years ($n = 90$). Linear regression was used to identify the determinants of HR during wake and sleep.

Results: OAHl was a significant predictor of increased wake and sleep HR in the >5–9 years group only (wake: 0.22 (β coefficient), $P < 0.05$; sleep: 0.22, $P < 0.05$). BMI z-score was only predictive of sleep HR in the >9 years group (0.36; $P = 0.001$). WHtR was the anthropomorphic measurement that was the best predictor of HR in all of the age groups. WHtR was a significant predictor of increased HR during wake and sleep in the 3–5 years and >5–9 years group (3–5 years, wake: 0.20, $P < 0.01$; sleep: 0.18, $P = 0.01$; >5–9 years, wake: 0.34, $P < 0.01$; sleep 0.32, $P < 0.01$) and in the >9 years group, during sleep (0.37, $P = 0.001$).

Conclusion: Our results indicate the relationship between HR, and OSA severity and obesity is dependent on age. The BMI z-score was predictive of increased HR only in the children over 9 years of age. The only anthropometric measure that was predictive of increased HR in all age groups was WHtR, with the strength of the association increasing with age. This suggests that it may be central adiposity that is primarily driving elevated HR in children with OSA rather than OSA severity or obesity as measured by BMI z-score.

049

CAN OXIMETRY BE USED AS A SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNOEA (OSA) IN OBESE CHILDREN WITH BMI >25 TO HELP REDUCE WAIT TIMES FOR TREATMENT WITH CPAP?

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Introduction: It is estimated that by 2025 1 in 3 children aged 5–19 years will be overweight or obese. Routine screening for OSA is recommended in this group and therefore this global obesity epidemic is likely to have a direct impact on sleep services. Adenotonsillectomy remains the first line of treatment, but approximately 50% of obese children have persistent OSA post-surgery and may require continuous positive airway pressure (CPAP). Long waitlists and limited resources mean that children with obesity often undergo a prolonged wait from clinical assessment to diagnostic polysomnography (PSG) and treatment. In this study we wish to determine if interpretation of overnight oximetry using the McGill score could be used as an alternative to PSG to predict those children in whom adenotonsillectomy/CPAP is likely to be required for ongoing management of OSA.

Methods: A retrospective review of all patients with a BMI ≥ 25 undergoing a diagnostic PSG at our centre Nov 2014–Jan 2016 was performed. Using McGill criteria, the oximetry profiles from each patient's diagnostic PSG were scored independently by a sleep clinical nurse and 2 sleep medicine physicians. Score was correlated with clinical recommendation from diagnostic PSG.

Results: Diagnostic PSG results were available for 36 patients. In 28/36 (78%) patients, the oximetry scored as McGill score 1 (inconclusive). No patients were scored as McGill score 2 (positive). 8 patients were scored as McGill score 3 (positive higher risk). CPAP was recommended in all 8 patients following diagnostic PSG. CPAP was initially recommended in an additional 4 patients (classed McGill 1 on oximetry) but only 2 subsequently required this therapy (1 improved spontaneously, 1 lost weight).

Discussion: In this study, the McGill score was found to be a useful tool to screen for OSA. A positive score correctly predicted the need for CPAP treatment in 100% of patients with BMI > 25 . Therefore, in clinical practice a positive score (i.e. McGill score 3) could be used to assist in prioritising patients for PSG, predicting those children most likely to require CPAP. The negative predictive value was also high with a score of 1 correlating with no intervention in 87.5% of patients. Clinical application of this screening method for OSA in obese children is now planned and will be evaluated prospectively.

050

CRANIOFACIAL MORPHOMETRIC ANALYSIS USING FACIAL PHOTOGRAPHS IN CHILDREN WITH SLEEP DISORDERED BREATHING COMPARED TO NON-SNORING CONTROLS

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Background: Sleep disordered breathing (SDB) in children is associated with craniofacial differences, as demonstrated by cephalometric (x-ray) studies. Given the risk of radiation exposure in children, we aimed to determine whether landmarks on facial photographs could be used in a similar fashion to estimate facial morphology and give information about SDB risk. Specifically, we aimed to determine whether facial measurements were different between children with SDB and non-snoring controls.

Methods: Parents of children referred to a paediatric sleep centre for investigation of snoring (SDB group) and non-snoring controls recruited from the community were asked for consent to take facial photographs. Frontal and lateral digital photographs of the face were taken in a standardised fashion, using methodology previously used in adults. Key angular measurements derived for this preliminary analysis included maxillary depth angle (tragion[t]-nasion[n]-subnasion[sn], cephalometric equivalent SNA), mandibular depth angle (t-n-sublabiale[sl], equivalent SNB) and maxillary-mandibular relationship angle (intersection of Frankfort plane and sn-menton[me] tangent). Standard paediatric attended polysomnography determined the severity of SDB. Facial angular measurements were compared between controls and children with SDB using Student's T tests.

Results: Sixty-eight children (29 F; median age 6.2, range 2–17 years) had photographs analysed, including 10 controls and 58 with SDB (obstructive apnoea hypopnoea index 0–61 events/h). The SDB group had a reduced mandibular depth angle (70.4° vs. 66.0°, $P = 0.02$) and maxillary-mandibular relationship angle (67.5° vs. 62.9°, $P = 0.02$) compared to the control group, suggesting mandibular retrognathia in the SDB group.

Conclusion: These preliminary data demonstrate the feasibility of undertaking quantitative facial analysis in the paediatric setting. We have identified differences in craniofacial measurements between individuals with and without SDB suggestive of mandibular retrognathia. This is consistent with a similar study using cephalometric measurements (Pirila-Parkkinen K et al. *Eur J Orthodontics* 2010). Analysis is ongoing to further elucidate the nature of facial differences in children with SDB and whether or not they can be used to clinically distinguish children most likely to have severe obstructive sleep apnoea.

051

A RANDOMISED TRIAL OF ADENOIDECTOMY AGAINST MEDICAL THERAPIES FOR MILD OSA IN CHILDREN

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Introduction: Several treatment options exist for children with mild to moderate obstructive sleep apnea (OSA). Nasal steroids (NS) and leukotriene receptor antagonists (LA) are commonly used to treat this level of disease. We hypothesised that both Adenoidectomy (AD) and NS + LA would have superior effectiveness compared to NS alone and tested this hypothesis in a randomized, controlled study.

Methods: We recruited children aged 2.5–10 years, referred for symptoms of OSA, with an apnea-hypopnea index (AHI) on polysomnogram (PSG) of >1 to <10 h⁻¹ and no previous treatment. 45 children were randomised to one of three treatment groups ($n = 15$ in each): nasal steroids alone (Nasonex®, or NS), NS combined with a leukotriene receptor antagonist (NS plus Montelukast®, or LA) or surgical adenoidectomy (AD without tonsillectomy).

Results: Mean follow-up period was 8.0 months. Accounting for baseline, the x-ray measures improved in the AD group compared to other groups. For PSG results, comparing AD and NS + LA against NS (as the reference group), we found no treatment-attributable effect for either group using outcomes of AHI, OAH, REMAH or PSQ scores. Combined results for all 3 treatment groups showed AHI at baseline was 6.1 ± 4.4 and 5.7 ± 4.3 at follow-up while OAH showed no change from 3.5 ± 2.8 at baseline to 3.5 ± 3.6 at follow-up. For all groups combined, the PSQ score improved with treatment, with a mean fall of 1.7 ($P < 0.003$) from baseline. Overall improvements (groups combined) between baseline and follow-up were also seen for the arousal index (by 1.7 h⁻¹ from 10.9 to 9.2 hr⁻¹, $P = 0.02$) and the baseline SaO₂ (increased by 0.4%, from 97.6 to 98.0%, $P = 0.015$).

Conclusions: In children with mild OSA randomised to adenoidectomy, NS or NS + LA, after 8 months we found no treatment-attributable effects in any of the groups. The very small overall differences in this study suggest that positive treatment effects are difficult to detect on standard PSG at this level of disease.

052

TIME FOR A REVIEW: INDICATIONS FOR ADENOTONSILLECTOMY IN CHILDREN WITH SLEEP DISORDERED BREATHING IN LIGHT OF NEW EVIDENCE

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Introduction: Adenotonsillectomy is the front-line treatment for sleep disordered breathing (SDB) in children. In Australia and New Zealand, recommendations by the Royal College of Physicians are used to indicate a child for this intervention. This document has not been updated since 2008, despite the limited evidence for treatment efficacy cited, and the lack of controlled randomised studies. Subsequent research has further highlighted limitations in the efficacy and appropriateness of adenotonsillectomy as a treatment for SDB in children, such as studies showing:

- a lack of demonstrated efficacy for children with mild SDB and/or obesity.

- spontaneous recovery from disease status.
- lack of progression from childhood to adult disease.
- the normality of some level of SDB in the young.
- difficulties distinguishing mild from moderate SDB with a clinical history.
- the possibility of negative consequences from the procedure.

Method: We searched relevant databases for articles relating to adenotonsillectomy in children published later than 2008 and those not included in the evidence cited in the indications document published prior to this date. We contrasted this research evidence with that used to produce the indications document by the Royal College of Physicians. We then used the differences to derive recommendations for changes to the indications.

Results: Significant discrepancies were found between current research findings and the evidence used to formulate surgical indications. We also found that there were many unquestioned assumptions in the original document that research has subsequently made at least uncertain. Several recommendations pertaining to diagnosis, treatment options, referral thresholds and patient information were made.

Discussion: The current indications document should be updated and revised to include the findings of recent studies. It is also clear that further randomised-controlled clinical investigation is required to provide better evidence for future guidelines.

053

DO ANTHROPOMETRIC DIFFERENCES EXPLAIN THE INCREASED SEVERITY OF OBSTRUCTIVE SLEEP APNOEA (OSA) SEEN IN CHINESE COMPARED WITH CAUCASIANS?

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Background: Chinese have more severe obstructive sleep apnoea (OSA) than Caucasians at the same body mass index (BMI). Although craniofacial restriction in Chinese is considered to be an important cause, Chinese are prone to deposit fat more centrally. Central adiposity could promote more upper airway collapse in sleep 1. By direct airway narrowing and 2. By reducing caudal traction on the airway.

Aim: To compare anthropometric indices between Chinese and Caucasian OSA patients from the Sleep Apnoea cardioVascular Endpoints (SAVE) study in an attempt to explain the increased OSA severity seen in Chinese.

Methods: Anthropometric indices (e.g. neck, hip and waist circumference) were measured in Chinese ($n = 1701$) and Caucasian

($n = 678$) SAVE trial participants. They were aged between 45–75 years and had oxygen desaturation index (ODI $\geq 4\%$) $\geq 12/h$ and cardiovascular disease. An attempt was made to match each Caucasian patient with a Chinese patient for age (± 2 years), gender, weight (± 2 kg) and height (± 2 cm).

Results: Matched Chinese and Caucasian participants ($n = 407$ per group) showed significant differences in other anthropometric indices and in OSA severity. Chinese had more severe OSA [ODI: Median (IQR), 31 (20 to 41) vs. 20 (16 to 28), $P < 0.001$] but had smaller waists [101.0 (95.0 to 107.0) vs. 105.0 (98.0 to 111.0) cm, $P < 0.001$] and similar neck circumference [41.0 (39.0 to 44.0) vs. 42.0 (39.0 to 44.0) cm, $P < 0.092$].

Conclusion: Matched for age, gender, height and weight Chinese had more severe OSA than Caucasians. This was not explained by increased neck thickness or more central obesity.

Clinical Trials Register: Clinical Trials, <http://www.clinicaltrials.gov>, NCT00738179.

054

THE EFFECTS OF BODY SIZE AND GENDER ON LUNG VOLUMES DURING SLEEP

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Low lung volumes (LV's) are thought to contribute to upper airway collapse and thus obstructive sleep apnea (OSA). LV's are reduced during sleep in normal weight men. Further, obesity and the supine posture also reduce LV's during wake. However, how much LV's are reduced during sleep in women and over-weight individuals is unknown as absolute LV's have not been measured in these groups asleep. Therefore we aimed to measure functional residual capacity (FRC) during wakefulness, NREM and REM sleep in normal weight (NW: BMI < 25) and over-weight (OW: BMI ≥ 25) men and women. Healthy individuals aged between 20–65 years are being recruited. Standard polysomnography with a fully sealed, non-vented, nasal/oro-nasal mask is used for measurement of FRC via N2 washout. Preliminary data on the first 13 subjects are shown in the Table below. FRC predicted is expressed in Litres BTPS. All other means are % of predicted \pm SEM.

	NW Men	NW Women	OW Men	OW Women
BMI (kg/m ²)	21.0 \pm 1.1	21.5 \pm 0.5	28.5	25.8 \pm 0.1
FRC	($n = 4$)	($n = 6$)	($n = 1$)	($n = 2$)
Pred FRC (L _{BTPS})	3.32 \pm 0.04	2.73 \pm 0.05	3.13	2.71 \pm 0.19
Seated Wake	113.5 \pm 5.0	86.9 \pm 6.5	83.1	97.4 \pm 15.5
Supine Wake	74.1 \pm 4.8	54.2 \pm 5.3	33.7	52.1 \pm 7.1
Supine N2	60.2 \pm 4.4	39.2 \pm 6.8	26.8	51.2 ($n = 1$)
Supine N3	56.6 \pm 6.1	48.7 \pm 4.0	27.2	48.5 ($n = 1$)
Supine REM	57.3 ($n = 1$)	45.3 \pm 5.5	25.3	44.96 \pm 11.0
		($n = 2$)		

These preliminary data suggest that body weight may influence LV's during sleep differently between genders. Should these results persist in a larger sample they may provide novel evidence supporting the concept that the high prevalence of OSA in obesity and men is at least in part due to reduced LV's during sleep.

055

UNDERSTANDING THE MECHANISMS BY WHICH OBESITY CAUSES OBSTRUCTIVE SLEEP APNOEA

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Background: Obesity is the strongest risk factor for developing obstructive sleep apnoea (OSA), yet the exact mechanisms by which obesity increases this risk are poorly understood. Current evidence suggests that the pathogenesis of OSA is due to the interactions of several physiological traits including 1) a poor upper airway anatomy evidenced by a highly collapsible airway, 2) the inability of the upper airway muscles to activate and reopen the airway during sleep, 3) a low respiratory arousal threshold and 4) a hypersensitive ventilatory control system. The only data available suggest that obesity increases the collapsibility of the upper airway. However, we do not know how obesity alters these traits (in the same individual) and whether it involves predominantly one or several of the mechanistic pathways. Therefore, the aim of this study is to examine the effect that obesity has on each of the mechanisms and determine whether this information helps predict surgery success.

Methods: In an ongoing study, 6 OSA patients who had been recommended weight loss surgery attended sleep research studies both before and 6-months post-surgery. In each condition, subjects underwent clinical polysomnography to determine OSA severity and research polysomnography to measure the OSA traits by manipulating CPAP and assessing the changes in ventilation. Values are mean \pm SEM.

Results: Weight loss surgery significantly improved the upper airway collapsibility under both passive (2.4 ± 1.6 vs. -3.1 ± 2.3 L/min; $P = 0.003$) and active conditions (3.6 ± 1.3 vs. -1.4 ± 2.8 L/min; $P = 0.03$), as well as reduced the arousal threshold ($P < 0.01$). Furthermore, despite a clearly emerging trend, there was no statistical difference in the sensitivity of the ventilatory control system following weight-loss. Interestingly, individuals that gained the greatest reduction in their apnoea-hypopnoea index had a better upper airway collapsibility under both passive ($r^2 = 0.71$, $P = 0.034$) and active ($r^2 = 0.80$, $P = 0.017$) conditions at baseline.

Discussion: Our preliminary findings suggest that that obesity causes OSA by altering more than just the upper airway anatomy/collapsibility and that an apriori knowledge of the underlying physiology responsible for an individual's OSA is likely to be the key determinant of OSA resolution following significant weight-loss.

056

GENIOGLOSSUS AFTER-DISCHARGE OCCURS FOLLOWING AROUSAL FROM SLEEP BUT IS REDUCED BY HYPOCAPNIA

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Introduction: Arousal induced hypocapnia is thought to predispose to upper airway collapse in obstructive sleep apnea by reducing upper airway dilator muscle activity on return to sleep. However, several studies have demonstrated that dilator muscle activity is actually elevated post-arousal. It is possible that an after-discharge effect causes arousal induced dilator muscle activation to persist into sleep, overriding any potential hypocapnic effects. Thus the present study aimed to determine whether genioglossus after-discharge occurs following arousal from sleep and, if so, whether after-discharge is affected by hypocapnia.

Method: Twenty-four healthy individuals (6 female) had measurement of EEG, EOG, EMG, airflow, $P_{ET}CO_2$ and intramuscular EMG_{GG} . During sleep hypocapnia was induced via mechanical hyperventilation ($P_{ET}CO_2$ reduced by ≥ 2 mmHg below NREM normocapnia). To induce normocapnia ventilator settings remained unchanged and supplemental CO_2 was added. Tones were played during NREM to induce arousals in hypocapnic and normocapnic conditions. Repeated measures ANOVA compared the return to sleep EMG_{GG} between the hypocapnic and normocapnic conditions. Significance was set at $P < 0.05$.

Results: 11 participants (4 female) had useable data. By design, pre-arousal $P_{ET}CO_2$ was significantly lower in the hypocapnic condition (40.74 ± 2.37) than the normocapnic condition (43.82 ± 2.89). This $P_{ET}CO_2$ difference was maintained following arousal. Post-arousal tonic EMG_{GG} was elevated above pre-arousal levels for four breaths following return to sleep, irrespective of CO_2 condition. Peak EMG_{GG} was elevated above pre-arousal levels for two breaths following return to sleep in the hypocapnic condition and six breaths in the normocapnic condition.

Conclusion: If genioglossus after-discharge also occurs following the return to sleep in obstructive sleep apnea patients it may protect against further upper airway collapse. However, if the ventilatory response to arousal is large and hypocapnia is induced, the genioglossus after-discharge effects may be inhibited or reduced.

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AWAKE UPPER AIRWAY COLLAPSIBILITY IS RELATED TO AIRWAY COLLAPSIBILITY DURING SLEEP (PCrit) IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: An anatomically narrow or highly collapsible upper airway is the main cause of obstructive sleep apnoea (OSA). However, the extent of upper airway anatomical impairment varies widely between patients. This is important as patients with highly collapsible airways likely require different therapy (e.g. CPAP) to those who only have modestly collapsible airways (e.g. a dental device). The critical closing pressure (Pcrit) technique is the gold standard method used to quantify upper airway collapsibility. However, it is not feasible for routine clinical use as it requires detailed overnight measurements by a skilled sleep researcher. Thus, development of a simple tool to measure upper airway collapsibility is required to move beyond the current trial and error approach for the treatment of OSA. Accordingly, this study aims to determine if a simple wakefulness assessment is related to Pcrit during sleep.

Methods: 22 (2 female) patients with OSA were instrumented with a nasal mask, pneumotachograph and two pressure sensors inserted via the most patent nostril across the collapsible portion of the upper airway (one at the choanae, the other just above the epiglottis). ~60 brief (250 ms) pulses of negative airway pressure were delivered in early inspiration during a 20 min test during wakefulness to measure the upper airway collapsibility index, UACI = [choanal-epiglottic pressure]/choanal pressure*100. Patients slept with nasal CPAP and the holding pressure was transiently reduced for 5 breaths at a time during sleep to determine the Pcrit. All interventions were performed supine.

Results: To date, the UACI (43.2 ± 5.4 ; range: 5 to 81%) and Pcrit (-0.56 ± 0.62 ; range: -2 to $+3$ cm H₂O) have been quantified in 13 predominantly middle-aged (45 ± 2 ; range: 31 to 62 years), obese (BMI 30.8 ± 1.6 ; range: 23 to 42 kg/m²), patients of varying severity (AHI 32.6 ± 6.7 ; range: 6 to 92 events/h sleep). The UACI significantly correlated with Pcrit during sleep ($R^2 = 0.57$; $P = 0.0027$; $P_{crit} = -4.31 + (0.087 \times UACI)$).

Conclusions: These initial findings indicate that awake upper airway collapsibility is related to the critical closing pressure of the upper airway during sleep (Pcrit) in patients with OSA. This suggests that a simple wakefulness test may be useful to estimate the extent of upper airway anatomical impairment in patients with OSA.

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BRAIN DIFFUSION AND FIBRE DENSITY CHANGES IN OBSTRUCTIVE SLEEP APNOEA

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Aim: Obstructive Sleep Apnoea (OSA) is a disorder characterised by repetitive brief cessation of breathing during sleep, resulting in intermittent hypoxia and fragmented sleep. While OSA is commonly associated with neurocognitive impairments, neuroimaging studies do not show consistent structural changes in the brain. This study exploits recent novel developments in diffusion MRI to investigate brain white matter tract characteristics in OSA.

Method: 12 patients with OSA (7 untreated; 5 treated with CPAP) and 10 neurologically normal controls underwent 3 Tesla (3T) Diffusion MRI. Participant characteristics: OSA patients – mean age 53 years (± 13), average Apnoea Hypopnea Index (AHI) $42.97 (\pm 21.94)$; Control participants – mean age 46 years (± 9), average AHI $6.26 (\pm 2.96)$. Diffusion MRI acquisition: 60 directions, $b = 3000$ sec/mm², 2.5 mm isotropic voxels. Diffusion data analysis: apparent fibre density (AFD) analysis performed using MRtrix3; voxel based fractional anisotropy (FA) and apparent diffusivity coefficient (ADC) analyses analysed using SPM8. Group comparisons were conducted between all 12 OSA patients (All OSA), OSA treated with CPAP (OSA CPAP), and untreated OSA (UNTREATED OSA) compared to controls.

Results: Voxel-based analysis (VBA) showed increased FA in frontal lobe in all 3 group comparisons ($P < 0.001$ uncorrected). FA was increased in arcuate fasciculus in the both ALL OSA and OSA CPAP compared to controls. VBA of ADC map showed decreased ADC average in occipital lobe region in all 3 groups of comparisons ($P < 0.05$ FWE cluster-level). Decreased ADC map was also observed in the cerebellum for ALL OSA patients and OSA CPAP compared to controls. Fixel-based analysis showed increased fibre density in the superior longitudinal fasciculus (SLF) in ALL OSA patients compared to controls ($P < 0.001$ uncorrected).

Conclusion: Our results are suggestive of changes to the motor control and visual regions of the brain. Results also suggest greater white matter abnormalities for OSA patients treated with CPAP, despite no difference in average AHI between treated and untreated OSA groups. This may have implications for upper airway and breathing motor control in OSA patients, but further research with greater subject numbers is required.

059

PROSPECTIVE STUDY OF NON-INVASIVE CENTRAL BLOOD PRESSURE MEASUREMENT TO MONITOR OUTCOMES IN PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNOEA

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Background: Obstructive sleep apnoea (OSA) can result in resistant hypertension and significantly increases cardiovascular morbidity and mortality. Randomised and observational studies have demonstrated that CPAP provides modest improvements in blood pressure (BP) in OSA patients. Non-invasive central BP allows for rapid estimation of aortic BP and a measure of arterial stiffness termed the augmentation index (AI). There is increasing evidence to suggest that cardiovascular risk is more closely related to central rather than brachial BP. We aim to assess whether central BP and AI improve with CPAP therapy at 1 and 6 months in a cohort of patients with severe OSA.

Methods: In a prospective pilot cohort study, 10 patients with severe OSA have been recruited and will have their central and brachial BP, and augmentation index recorded at 3 time points: 1) prior to CPAP initiation, 2) at 1 month, and 3) after 6 months of CPAP therapy. Inclusion criteria: 1) apnoea hypopnoea index (AHI) >30 events/h with a predominance of obstructive events; 2) Baseline brachial systolic BP >140 mmHg or diastolic BP >90 mmHg; 3) Sinus rhythm during diagnostic sleep study. Central BP and AI will be determined using a Pulsecor BP+ digital machine that utilises pulse wave analysis at the brachial artery. Results are presented as mean \pm SD.

Progress to date: 7 hypertensive patients with severe OSA have completed 1 month of CPAP therapy (M: F 4:3; Age: 59 \pm 10 years, BMI: 36.8 \pm 7.2 kg/m², AHI: 64.8 \pm 28.0 events/h; nightly CPAP compliance: 6.5 \pm 1.37 hrs). Results to date demonstrate a mean decrease in brachial systolic and diastolic BP of 2.8 \pm 11.6 mmHg and 13.4 \pm 14.0 mmHg respectively. Central BP measurements have demonstrated a mean decrease of 2.8 \pm 14.3 mmHg in systolic and 6.8 \pm 10.9 mmHg in diastolic BP. On average augmentation index has decreased by 12.7 \pm 14.5 % in these patients.

Intended outcome and impact: This study aims to determine whether CPAP treatment can lead to improvement in CBP and vascular resistance, as measured by AI in patients with hypertension and severe OSA.

060

CHRONIC CONDITION MANAGEMENT PROGRAM IN SLEEP APNOEA: A PROSPECTIVE STUDY

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Background: Obesity is a major, modifiable risk factor for obstructive sleep apnoea (OSA). Given the relative ineffectiveness of usual care (UC) for weight loss, we tested, at 3 and 6 months, the effects of a Chronic Condition Management Program (CCMP) designed to

enhance patient self-management and goal setting for weight loss in obese patients with moderate-severe OSA.

Methods: We recruited 40 patients at our sleep centre meeting the inclusion criteria: age 18–70 years, apnoea-hypopnoea index (AHI) \geq 20 events/h, body mass index (BMI) \geq 30 and Epworth Sleepiness Scale (ESS) score \geq 8. The CCMP was delivered to all participants. Patients were offered the option of a 6-month meal replacement program as part of the CCMP. Change in BMI at 3 months was compared in the first 19 of 40 CCMP OSA patients with 41 historical OSA controls who were given usual care (UC) i.e. standard advice on weight loss by their sleep physicians. The potential change in BMI caused by a patient getting either CCMP or UC was calculated using inverse probability weights and conditioning on covariates age, sex and baseline BMI. Questionnaires were completed at baseline and 6 months including the ESS, Assessment of Quality of Life (AQoL-4D) scale, Hospital Anxiety and Depression Scale and Patient Assessment of Chronic Illness Care scale.

Progress to date: Baseline measures for CCMP ($n = 19$) and control ($n = 41$) participants were 47% cf. 76% males, mean age 49.4 cf. 53 years, BMI 37.3 cf. 33.9 and AHI 55.3 cf. 46.3. We calculated that at 3-month follow-up, the average BMI if all 60 participants were to receive CCMP would be 2.1 points less than the average of 36.1 that would occur if none of the participants had received CCMP (95% CI: -3.4 to -0.84 ; $P = 0.001$). Interpreted as a percentage, the average BMI falls by an estimated 5.9% when every participant receives CCMP relative to the case of every participant under UC conditions (95% CI: 2.4% to 9.3% reduction). To date, 6-month measures have been performed in 8 participants.

Intended outcome and impact: These preliminary results suggest that a structured CCMP that includes a meal replacement option is likely to be more effective than standard advice for weight loss in OSA. We intend to compare the sustainability of weight loss at 6 months in the whole study population and measure the impacts of the CCMP on subjective sleepiness and psychosocial parameters.

061

INCIDENCE OF POST-OPERATIVE COMPLICATIONS IN PATIENTS WITH SUSPECTED OBSTRUCTIVE SLEEP APNOEA (OSA) USING THE STOP-BANG QUESTIONNAIRE AT A TERTIARY LEVEL PRE-ADMISSION CLINIC UNDERGOING MAJOR SURGERY

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Background: Several reports demonstrate an association with suspected/proven obstructive sleep apnoea (OSA) in patients undergoing major surgery and post-operative complications, however there are no controlled trials to demonstrate causality. We aim to evaluate the strength of this previously demonstrated relationship between suspected OSA (STOP-BANG questionnaire) and post-operative complications among a selected high-risk population with major comorbidities that incurred a high post-operative event rate.

Methods: This is a prospective observational cohort study of patients with major co-morbidities attending a high-risk pre-admission clinic prior to major surgery. Patients were selected for clinic attendance from telephone assessments identifying major co-morbidities. Patients were screened for OSA (STOP-BANG questionnaire,

Epworth sleepiness scale) excluding those currently treated. All subjects received standard perioperative care and were followed during their surgical admission for post-operative complications. Data obtained at the pre-admission clinic and subsequent admission was collected from the medical record at discharge. Patients with a STOP-BANG score of ≥ 4 were regarded as high risk of OSA, which has a previously reported probability for at least mild OSA of 73%.

Preliminary Results: An initial sample of 96 patients (45 male; aged 71 ± 12 years (mean \pm SD); BMI 30 ± 7 kg/m²) has been analysed. 3 patients have documented OSA not on treatment, and 17 patients have missing neck circumference measurements. The majority underwent gastrointestinal, orthopaedic and gynaecological surgery (44%, 29%, and 11% respectively), with 84 (88%) patients receiving general anaesthesia. 27 (28%) patients experienced significant post-operative complications, with equal findings between both patient groups with high and low STOP-BANG scores (14/46 (30%) vs. 13/50 (26%)). Majority were cardiovascular related complications ($n = 5$ in both groups). Other complications seen included respiratory failure, pneumonia, bleeding requiring blood products and delirium.

Conclusions: Findings demonstrate a very high post-operative complication rate among this cohort. Preliminary analysis does not demonstrate a clear relationship between high risk of OSA and post-operative complications. An expanded dataset with more detailed analysis will be subsequently presented.

062

LOOP GAIN IN PAEDIATRIC PATIENTS WITH AN ELEVATED CENTRAL APNOEA INDEX

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Background: Central apnoeas are a common physiological phenomena during sleep in children. A central apnoea index (CAI) of >5 /h is statistically abnormal (Narang et al 2011) and may be indicative of an underlying neurological abnormality. However frequent central apnoeas are sometimes observed in otherwise healthy children outside the neonatal period, and the pathophysiology and clinical implications of a CAI >5 /h is currently unknown. In control systems theory, loop gain (LG) is a measure of the sensitivity of the negative feedback system controlling ventilation. A raised CAI could either be indicative of underlying ventilatory control instability (i.e. elevated LG) or a depressed ventilatory control system (i.e. low LG) – which would require different treatment interventions. The aim of this study was to evaluate LG in otherwise well children with an increased CAI and a group of healthy controls.

Methods: A retrospective review over 5 years identified children aged >6 months who had undergone polysomnography (PSG), and had a CAI >5 /h in the absence of other sleep-related disorders. A healthy control with a normal CAI was selected from the database for each subject, matched for age and gender. Central apnoeas were defined as cessation of respiratory effort for ≥ 2 respiratory cycles with associated desaturation $\geq 3\%$ and/or arousal. Spontaneous sighs were identified during non-rapid eye movement (NREM) sleep, and breath-breath measurements of ventilation were derived from the nasal pressure signal 60 sec prior and 120 sec following each sigh. A standard model of ventilatory control (gain, time-constant, delay)

that transforms ventilatory fluctuations seen in response to a sigh into ventilatory-drive signal that best matched observed ventilation was used to calculate LG at the natural 'resonant' frequency.

Results to date: Subjects with an elevated CAI ($n = 9$) had an identical sigh index (sighs/h) in NREM sleep of 2.4/h as controls ($n = 5$). The LG in subjects with raised CAI was higher: mean (range) 0.4 (0.22–0.68) compared to 0.35 (0.26–0.44) in the controls.

Intended outcome and impact: Preliminary results suggest ventilatory control instability in children with a high CAI. Further subjects and matched controls are being identified. An improved understanding of the pathophysiology of central apnoeas in this patient group may help guide clinical management and reveal potential therapeutic options.

063

RESULTS OF THE MULTIPLE SLEEP LATENCY TEST (MSLT) USING DIFFERENT DIAGNOSTIC CRITERIA. A QUATERNARY CENTRE EXPERIENCE

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Background: The International Classification of Sleep Disorders, 3rd Edition, 2014 (ICSD3) and the 2005 American Academy of Sleep Medicine Practice Parameters (AASM05) recommended ≥ 7 h and ≥ 6 h of total sleep time (TST) respectively on polysomnogram (PSG) preceding the MSLT. ICSD-3 and AASM05 require a mean sleep latency (MSL) of ≤ 8 min for the diagnosis of Narcolepsy or Idiopathic Hypersomnia (IH), and ≥ 2 Sleep Onset REM periods (SOREMP) for Narcolepsy. The Australian Pharmaceutical Benefits Scheme (PBS) requires ≤ 10 min and ≥ 6 h of TST on PSG preceding the MSLT for prescription of Modafinil for Narcolepsy. This study investigated the results of the MSLT using these 3 diagnostic criteria.

Methods: A retrospective audit of all MSLTs in the 2011 to 2016 financial years in our centre was performed. MSLT data was analysed for MSL and SOREMP, and PSG data was analysed for TST and apnoea-hypopnoea index (AHI).

Progress to date: Interim data of the 97 patients studied in 2014–2016 showed 4 patients meeting AASM05 MSLT criteria for Narcolepsy and 26 patients meeting criteria for IH. Applying PBS MSLT criteria resulted in 7 Narcolepsy and 35 IH patients diagnosed, while 3 Narcolepsy and 10 IH patients were diagnosed using ICSD-3 MSLT criteria.

Intended outcome and impact: Significant changes in diagnostic categories have resulted from the use of these 3 different diagnostic criteria for MSLT interpretation pending completion of the rest of the study. The results of this study may have a significant impact on clinical practice.

064

HOME MECHANICAL VENTILATION IN WESTERN AUSTRALIA: PATTERNS OF USE AND OUTCOMES IN A TERTIARY CENTRE

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Backgrounds: Home mechanical ventilation (HMV) is used to manage hypoventilation and ventilatory failure in an expanding range

of breathing disorders. In Western Australia (WA), HMV using positive airway pressure therapy has been used since the 1980s. However pattern of use and outcomes have not been reported. We hypothesize that our survival outcomes are comparable to published studies.

Methods: We conducted a retrospective observational study of long term HMV users at the West Australian Sleep Disorders Research Institute over a 6 year period (2005–2010). Users were identified from electronic medical records, and research and equipment management databases. Primary outcome of the study was survival status at 1 June 2016.

Progress to date: A total of 222 users were identified. At initiation, mean (SD) age was 56 (17) years and body mass index 31.7 (12.2) kg/m². Users were predominantly male (61%) and most (68%) lived within 30 km driving distance from our centre. The five most common diagnoses were motor neuron disease (MND) 31%, obesity hypoventilation syndrome 19%, chronic obstructive pulmonary disease 12%, muscular dystrophies 5% and diaphragm weakness 4%. HMV users were divided into four subgroups based on primary diagnoses for survival analysis: 1) MND, 2) lung disease, 3) sleep disordered breathing and 4) other neuromuscular weakness or chest wall disorder. The median survivals of subgroup 1 to 4 from initiation of HMV were 14, 42, 99 and 114 months respectively. Kaplan-Meier analysis showed survival difference between all subgroups ($P < 0.0001$) except subgroups 3 and 4 ($P = 0.95$). At initiation, subgroup 2 had the worst lung function (FEV₁ 0.83 (0.38) L, 29 (11) %predicted) followed by subgroup 4 (FEV₁ 1.02 (0.51) L, 37 (18) % predicted). There is no correlation between distance from home to our centre and survival ($r^2 = 0.016$; $P = 0.15$). Collection and analysis of co-morbidities, blood gases, HMV interface, ventilator settings and polysomnography data are in progress.

Intended outcome and impact: Survival of HMV users in WA is comparable to that of published European cohorts. We aim to further describe HMV user characteristics and factors associated with poor survival outcome in WA. The present study yields important information for clinical decision making and health service planning in the provision of HMV.

065

SLEEPY, SPACEY, SURLY, SCARY, SUGARED-UP AND A BIT LESS SMART: CASUAL IMPACT OF SHORT SLEEP IN ADOLESCENCE

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Introduction: Three major sets of guidelines for adolescent sleep duration were released in 2015 and 2016, all of which suggest that adolescents in developed countries get too little sleep on school nights. Those guidelines are based upon a correlational literature that is prone to confounding variables, as well as a much smaller experimental literature that has too often used non-representative samples, unrealistic “doses” of sleep restriction, and non-applied outcome measures. Here we summarize findings from an experimental research program that examines the impact of realistic changes in sleep duration on demographically diverse adolescents across a number of real-world outcome domains.

Methods: Two research designs have been used with healthy adolescents. For the first, adolescents underwent 5-night spans of 6.5 hrs vs. 10 hrs in bed per night in counterbalanced order during

summer break from school. For the second, adolescents who typically sleep 5–7 hrs on school nights completed 2-week spans during the school year in which they maintained their habitual sleep patterns vs. extending their time in bed by 1.5 hrs on school nights. Outcome measures included parent- and teen-reported questionnaires, scores on attention tests, dietary interviews, a simulated classroom and a driving simulator.

Results and Discussion: Actigraphy confirmed that the summer protocol yields ~2.5 h more sleep during sleep extension than restriction, and that the school year protocol yields ~1 h more sleep during sleep extension than is habitual for short-sleeping adolescents. Although not all outcome measures were used with both research designs, findings suggest that (a) short sleep, at a level experienced by many adolescents, is causally related to daytime sleepiness, inattention, negative mood, poorer mood regulation, poor learning, obesogenic dietary behaviours, and poor lateral vehicle control; and (b) “naturally” short-sleeping adolescents would often benefit from getting longer sleep.

066

THE SLEEP APNEA CARDIOVASCULAR ENDPOINTS (SAVE) STUDY RESULTS – A TRIAL OF CPAP VS. USUAL CARE IN 2717 HIGH CARDIOVASCULAR RISK PATIENTS WITH MODERATE-SEVERE OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Observational studies suggest continuous positive airway pressure (CPAP) treatment can reduce risks of serious cardiovascular (CV) events in people with OSA, but randomized data are lacking. We report results of the SAVE trial (ClinicalTrials.gov number NCT00738179) designed to close this evidence gap.

Methods: SAVE was an investigator-initiated and conducted, international, multicentre, open-label, blinded endpoint, randomized controlled trial designed to test for superiority of CPAP plus usual care vs. usual care alone on the primary efficacy composite endpoint of CV death, non-fatal myocardial infarction, non-fatal stroke, and any hospitalization for unstable angina, heart failure, or transient ischaemic attack. Eligibility criteria: age 45–75 years, prior cerebro- or coronary CV disease, OSA ($\geq 4\%$ oxygen desaturation index [ODI] $\geq 12/h$), Epworth sleepiness score (ESS) < 16 , and sham CPAP adherence > 3 h/night over 1–2 week run-in phase.

Results: 2717 patients were randomised between December 2008 and November 2013: 1359 to CPAP plus usual care and 1358 to usual care from 89 hospitals in 7 countries, with patient follow-up completed in January 2016. Groups were well balanced for baseline demographic/clinical characteristics (mean age 61 years, 81% male, 63% Asian) with BMI 28.6, ODI 28.2, snoring “almost every day” 83%, ESS 7.4. The main results will be presented at the conference.

Conclusions: The large, multinational study, SAVE, provides the first definitive randomised controlled trial evidence on the effect of CPAP therapy on the risk of future CV events in patients with CV disease and co-occurring OSA.

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067

DRIVING PERFORMANCE IS WORSE AFTER EATING DURING THE NIGHTSHIFT

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Introduction: Performance can be influenced by prior food intake. This has not been investigated at night, when impairments may be greater due to the effects of eating and performing when there is greater sleep propensity.

Methods: This study explored the effects of eating a meal during the nightshift on simulated driving performance, vigilant attention and subjective sleepiness. Healthy, non-shiftworking males aged 18–35 years ($n = 10$) were allocated to an eating at night ($n = 5$) or a no-eating at night condition ($n = 5$) and worked four simulated nightshifts. At 1730 h, 2030 h and 0300 h, participants performed a 40-min driving simulation on the York driving simulator, 3-min Psychomotor Vigilance Task (PVT-B) and recorded their ratings of sleepiness on a subjective scale. The eating at night condition ate a large meal (30% of their 24 h energy intake) during the nightshift at 0130 h whereas the no-eating condition did not eat during the nightshift. Total 24 h energy intake was consistent across both conditions.

Results: Mixed model analyses were conducted, with fixed effects of eating condition and time of night, and a random effect of participant ID. A significant time of night by eating condition interaction was found, such that at 0300 h those in the eating at night condition displayed significant decreases in time spent driving in the safe zone ($P < 0.05$; percentage of time within 10 km/h of the speed limit and 0.8 metres of the centre of the lane), and significant increases in speed variability ($P < 0.001$), number of crashes ($P < 0.01$) and subjective sleepiness ($P < 0.01$). Further, a significant main effect of time of night was found, such that participants in both conditions experienced greater subjective sleepiness and PVT-B impairments at 0300 h compared to 1730 h and 2030 h ($P < 0.001$).

Discussion: Food intake adversely affected driving performance. Additionally, sleepiness increased throughout the nightshift, as shown by PVT-B performance and subjective sleepiness. The timing of meals may be a modifiable factor affecting the performance of shiftworkers, and it may be advisable to avoid large meals during the nightshift.

068

THE TIMING OF SHIFT START AFFECTS PRE-WORK SLEEP DURATION AND SUBJECTIVE RATINGS OF SLEEPINESS AND FATIGUE AMONG MOTORCOACH DRIVERS

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Introduction: The present analyses are focused on the relationship between the timing of work periods, pre-work sleep duration, and start of work ratings of sleepiness and fatigue among motorcoach drivers.

Methods: $n = 78$ commercial motorcoach drivers were monitored for approximately one month as they completed their usual work and rest schedules. Drivers kept a sleep/work diary, continuously wore an actigraph to record sleep/wake, and self-rated their sleepiness (Karolinska Sleepiness Scale) and fatigue (Samn-Perelli Fatigue Scale) at the start of work periods. Sleep duration within each 24-h period preceding duty start was summed, time since end of last sleep period until reported shift start time was calculated as time awake, and shift start times were binned into morning (06:00 to 13:59), afternoon (14:00 to 21:59), and night (22:00 to 05:59). Sleep duration and sleepiness and fatigue ratings were analysed using linear mixed-effects models.

Results: A total of 1518 work periods were observed. Work periods tended to start in the morning (mean = 08:15 \pm 00:57) and averaged 9.2 (\pm 3.0) h in duration. Drivers obtained a mean of 6.4 (\pm 1.6) h of sleep during the 24 h prior to duty start, and drivers obtained the most sleep prior to shifts that started between 14:00 and 21:59. Subjective sleepiness and fatigue ratings were lower with increasing total sleep time (TST) in the 24 h prior to duty start. Time awake was not significantly related to sleepiness and fatigue ratings.

Discussion: On average, drivers obtained near the recommended 7 h of sleep for sustaining cognitive performance during the 24 h prior to shift start. Drivers obtained more sleep prior to work shifts that started in the afternoon/evening relative to morning or night-time starts, likely as a function of an unrestricted night-time sleep opportunity. Sleepiness and fatigue ratings varied as a function of shift start time, reflecting the effect of the circadian rhythm of alertness. Though shift start time is usually dictated by commercial demands in motorcoach operations, these data suggest that shift start time may be an important consideration in hours-of-service limitations designed to prevent fatigue.

069

SLEEPING DIFFICULTIES AS SOURCES OF RISK ON ROADS AND IN WORKPLACES IN AUSTRALIA IN 2016- RESULTS OF A NATIONAL POPULATION SURVEY

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Introduction: The scope of sleep problems in Australia has been examined in only a few studies. The pervasiveness of the “24/7 society” means the impact of sleep disorders and problems in the Australian community needs revisiting.

Methods: An on-line survey of 1011 adults aged over 18 years across Australia was conducted in March 2016 on behalf of the Sleep

Health Foundation with representativeness for age, sex, location and socio-economic status, from a panel of over 220,000 Australians. The questions are taken largely from the 2002 US National Sleep Foundation Sleep in Adults survey and included the Stanford Presenteeism Scale (SPS). A three-stage randomisation process was used to minimise the risk of bias. Univariate analyses determined differences in frequencies by sex and 10 year age groups. Sleep problems are defined as difficulty falling asleep, waking up a lot overnight, excessive daytime sleepiness (EDS), daytime fatigue or exhaustion, feeling irritable or moody or pathological EDS (Epworth Scale Score >10)

Results: A quarter of adults report that their typical weekday routine does not allow them to get enough sleep. Overall, 44% of adults (47% women, 40% men) are on the internet just before bed almost every night of whom 59% have ≥ 2 sleep problems (26% overall). Device use is frequent in younger people (18–24 years:75%; 25–34 years:55%) but even in over 65 years, 22% use devices before sleeping. Similarly, 16% of all working adults do work ≥ 3 nights/week just before bed and report ≥ 2 sleep problems. In the past month 17% have missed work because they were sleepy and 17% have also fallen asleep on the job. In the past 3 months 29% of adults report making errors at work due to sleepiness or sleep problems. People with ≥ 2 sleep problems are significantly more likely to report decreased work productivity on the SPS. Driving while drowsy at least every month is reported by 29% of people, 20% have nodded off while driving and 5% have had an accident in the past year because they dozed off.

Discussion: It is common for people to do activities in the hour before bed including work that may affect their sleep and daytime function. Sleepiness and sleep problems are a major source of risk on our roads and have a major effect on work performance.

070

HOW DOES THE LIKELIHOOD OF A CALL DURING AN OVERNIGHT ON-CALL SHIFT AFFECT SLEEP AND NEXT DAY COGNITIVE PERFORMANCE IN A LABORATORY ENVIRONMENT?

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On-call is a type of work which is undertaken by many Australians in a variety of different work settings (e.g. medicine, emergency response). However, to date there is little research on the impact of being on-call on sleep and next day performance when no call occurs. Previous research has indicated that the stress and anxiety associated with being on-call may result in decreases in both sleep quality and duration, which may, in turn, impact next day performance.

This study aimed to investigate the effects of being on-call, and variations in the likelihood of being called, on sleep and subsequent cognitive performance. Twenty-four healthy males, with a mean age of 24.5 years (SD = 3.6) were recruited for the study. All of these participants were within the healthy body mass index range, with a mean of 23.3 kg.m² (SD = 1.9). The protocol consisted of four nights in a sleep laboratory, with an adaptation night, a control night and two on-call nights, with the on-call nights being counterbalanced. Bedtime on all four nights was 2300, and wake time was 0700. On one of the on-call nights, participants were told they were *definitely*

going to be called, whereas on the other on-call night told that they *may* be called. Sleep was assessed through polysomnography, and next day cognitive performance was measured using a 10-min psychomotor vigilance task (PVT). PVTs were administered at 0930, 1200, 1430 and 1700 each day. Mixed model analysis of mean reciprocal response time (RRT) showed a significant effect of day on performance of the PVT task, $F(2,135) = 4.11$, $P < 0.05$. Performance after the control night ($M = 4.23$, $SD = 0.59$) was significantly better than performance on the day after participants were told they *may* be called during the night ($M = 4.12$, $SD = 0.73$), $P < 0.05$. While performance following the night participants were told they were *definitely* going to be called ($M = 4.20$, $SD = 0.73$) was worse than following the control night, this difference was not significant.

The preliminary analysis suggests that next day performance is impacted by uncertainty about being called and this may be a result of changes to sleep. Sleep data are being analysed currently.

071

THE ABILITY TO SELF-MONITOR PERFORMANCE DURING 66 H OF TOTAL SLEEP DEPRIVATION AND RECOVERY

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Introduction: Adverse cognitive consequences of sleep deprivation (SD) are well documented. The ability to accurately assess one's current performance during SD is critical in an operational context. Despite limited existing studies, evidence suggests the ability to monitor performance may not be affected by total SD. That is, individuals remain capable of recognising deficits when sleep deprived. This may have important protective effects in reducing negative consequences of SD. Given the lack of research, we aimed to investigate whether participants could accurately self-monitor performance during total SD.

Method: Forty healthy adults (18 females, aged 19–39 years) underwent a 5-day protocol, including a well-rested day, 66 h of total SD, and 2 nights of recovery sleep. Working memory was assessed using a subtraction task with 3 levels of difficulty. Vigilance was assessed using the PVT. Objective performance was measured with subtraction accuracy and PVT median reaction time. Subjective performance was measured with self-reported subtraction accuracy and self-assessed PVT speed (relative to baseline). Objective-subjective differences assessed self-monitoring ability (SMA). Daily testing occurred at 2 and 12 h post-habitual wake-time across 5 days.

Results: For subtraction, there was a significant Day by SMA interaction ($P = 0.006$, $\eta^2 = 0.07$), such that participants overestimated deficits during SD. There was a significant SMA by Task difficulty interaction ($P = 0.001$, $\eta^2 = 0.13$), with greater underestimation of performance as difficulty increased. On the PVT, there was a significant interaction of day by SMA ($P = 0.008$, $\eta^2 = 0.094$), with individuals overestimating deficits during the first day of SD and overestimating the extent of recovery on the second recovery day.

Discussion: Results indicate that sleep-deprived individuals overestimated their deficits in both tasks. This has positive implications, as individuals may avoid potentially dangerous tasks if they believe they are cognitively impaired. However, there was a different pattern of results observed between tasks on recovery days, suggesting that the effect of recovery sleep on SMA may differ across cognitive domains. On the PVT but not on the subtraction task, individuals overestimated the effect of recovery. This could have serious real world implications as individuals may perform tasks or engage in behaviours despite

being cognitively impaired. Findings emphasise a need to further examine SMA during both SD and immediate recovery.

072

EXERCISE EFFECTS ON THE CIRCADIAN RHYTHM OF ADOLESCENTS WITH EXTREME EVENING-TYPE CIRCADIAN PREFERENCE: A NOVEL TREATMENT TO IMPROVE SLEEP HEALTH

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Background: Over the course of adolescence, biological sleep patterns shift to later sleeping and waking times, leading to a greater gap between sleep duration on every night of the week. Chronobiologists describe this preferred sleep-wake pattern as *eveningness preference*. Delayed sleep pattern seem to be a normal part of adolescent development. However a severe form of eveningness has been identified as delayed sleep-wake phase disorder (DSWPD). The disorder affects the timing of sleep onset and waking, peak period of alertness, the rhythm of core body temperature, hormonal and other daily cycles. The delay in falling asleep can be a hindrance to academic achievement. In contrast, morning exercise before school may be a novel intervention that can be easily incorporated into adolescents' weekly routine, with beneficial effects on sleep.

Objective: The main goal is to measure short-term effects of morning exercise on phase of melatonin rhythm in adolescents with an extreme eveningness preference.

Participants: 24 male adolescents aged 15–18.

Method: The study is a RCT, with exercise as the between-subjects factor. The primary outcome variable is the timing of dim light melatonin (DLMO) and core body temperature. Secondary outcomes include daytime sleepiness, sleep, and mood. Data assessment will be collected during each 2-week school holiday (July, October 2016) allowing participants to spend 5 consecutive nights at the sleep laboratory. Morning procedure includes either 45 min walking on a treadmill (IG) or sedentary activities (CG) in dim light. Saliva DLMO, core body temperature and mood will be assessed during the first and last night of laboratory attendance. The treatment protocol for morning exercise is based on the bright light approach described by Bjorvatn & Pallesen (2009). Sleep and physical activity will be controlled in the week prior and throughout study assessment subjectively and objectively.

Perspective: Preliminary data will be presented at the conference. Given the dearth of knowledge on adolescent sleep, this study will determine the relationship between exercise-induced phase advances and the human melatonin rhythm. Research in this area will add to the identification and current treatment procedures of young patients with a DSWPD. Furthermore, the findings could help specify the current PA recommendation to refer to sleep benefits in addition to cardio-respiratory gains.

073

OVERNIGHT VIDEO AND MATERNAL QUESTIONNAIRES TO INVESTIGATE THE USE OF PĒPI-PODS (PLASTIC BASSINET-SIZED CONTAINERS) AS AN IN-BED SLEEP DEVICE FOR VULNERABLE BABIES AT RISK OF SUDI

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In New Zealand Māori babies continue to be over-represented in SUDI deaths. The Māori community has developed the wahakura (flax bassinet) and pēpi-pod (plastic bassinet-sized container with a fitted mattress) as alternatives to bedsharing, particularly where mothers smoked in pregnancy. The pēpi-pod is now being provided by District Health Boards (DHBs) for vulnerable infants despite no prior studies of its safety. The aim of this study was to investigate the use of pēpi-pods for overnight sleep in the home.

Methods: Forty five infants identified through a DHB Safe Sleep Action Project to receive a pēpi-pod were recruited by a local Māori research nurse. Questionnaires were administered at baseline, 1 and 3 months and at 1 month an overnight sleep study including infra-red video was completed. Infants recruited from a similar demographic for a study of sleep in a bassinet or wahakura served as comparison groups.

Results: Participants were mainly Māori (88%), 68% from the most deprived quintile in the NZ Deprivation index, and 67% smoked daily during pregnancy. Mean maternal age was 27 years and 18% had ≥4 children. There was no significant difference between these characteristics and those of our bassinet or wahakura groups. At 1 month 48% slept in the pēpi-pod, reducing to 25% at 3 months. The main alternative was the bassinet with some infants sleeping in mother's bed (5% 1 month, 14% 3 month). Infants mainly slept on their back and 50% reported full breast feeding at 1 and 3 months. No measures were significantly different to comparison groups although more pēpi-pod infants were receiving medication at 1 month. Overnight video analysis for behaviours was not significantly different to infants sleeping in a wahakura or bassinet. Head covering was identified in 45% of babies, 55% slept lateral or prone (mean 86 min) and 99% slept some time in the maternal bed (mean 122 min). Breastfeeding was observed in 73%.

Discussion: While the pēpi-pod provided a separate in-bed sleep space, several risk behaviours were identified. These risk behaviours were not greater than for infants from a similar high risk demographic using bassinets, suggesting that the pēpi-pod could be promoted for vulnerable infants, as an alternative to bedsharing. Further research is needed to understand how to reduce behaviours such as head covering and prone or lateral sleep position in these infants, wherever they sleep.

074

OBJECTIVE MEASURES OF SLEEP (ACTIGRAPHY) IN NEW ZEALAND CHILDREN AGED 7–9 YEARS: ASSOCIATIONS WITH ETHNICITY, SCHOOL DECILE, BEHAVIOUR AND LEARNING

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Introduction: There is limited knowledge of sleep of Māori children, and children from low-decile schools. This study examined differences by ethnicity and school-decile in sleep data in children aged 7–9 years, and associations with child behaviour and learning.

Method: Four groups of parent-child dyads were recruited: Māori, low-decile schools ($n = 18$); Māori, high-decile schools ($n = 17$); Pakeha, low-decile schools ($n = 18$); Pakeha, high-decile schools ($n = 17$). Measures were: actigraphy over 1 week with sleep diary, actigraphy, parent and teacher report of daytime sleepiness, and internalising and externalising behaviours, and child report of anxiety symptoms. Teachers assessed children as achieving “at”, “above”, or “below” national standards in reading and math.

Results: Weekday actigraphy data differed by school-decile, but not ethnicity, with low-decile schools showing later sleep onset by 34 min ($F(1,66) = 12.17$; $P = 0.001$) and later wake by 40 min ($F(1,66) = 16.440$; $P = 0.001$). Children from low-decile schools spent less time asleep ($F(1, 66) = 12.168$, $P = 0.001$), were more likely to be observed to be sleepy by teachers ($t(68) = -3.345$; $P < 0.001$), were more likely to live in overcrowded homes (Pearson $\chi^2 = 17.920$; $P < 0.001$), and to have parents less knowledgeable about children's sleep ($t(68) = 2.788$; $P = 0.007$). Children reporting more anxiety symptoms had shorter sleep duration ($r = -0.293$; $P = 0.016$). Children reading “above”, “at”, or “below” learning expectations in reading, and math, differed in their sleep onset and sleep efficiency; children performing “at” or “above” expectations had earlier onset and greater efficiency. Binary logistic regression models were used to predict the likelihood that a child was “below” national standards in reading or mathematics. Those with high sleep efficiency were less likely to be “below” expectations in reading (OR = 0.86, 95% CI 0.77–0.96, $P = 0.003$) and mathematics (OR = 0.84, 95% CI 0.74–0.94, $P = 0.003$) beyond what was explained by school-decile, ethnicity, parent-education, or annual household income.

Conclusions: Children at high and low decile schools differ in their sleep patterns but sleep the same amount of time. Children in low decile schools appear to be at greater risk of sleep problems and therefore at greater risk of related adverse affects on learning. However the main risk factor for learning failure in this study was reduced sleep efficiency.

075

IMPACT OF SUGAR ON SLEEP AND BEHAVIOUR IN CHILDREN

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Introduction: Sleep and behaviour are commonly thought to be influenced by dietary factors, however there is a paucity of information regarding the interaction between sugar intake, sleep and daytime behaviour in school-aged children. Australian dietary guidelines state that children's total sugar intake should be <20% of their total caloric intake, and the current WHO guidelines recommend that energy consumed from free sugars should be no more than 10%.

Data from national surveys indicate many children exceed these values. This study investigated the relationship between sugar, sleep and daytime behaviour in Australian children.

Methods: Children and parents/guardians completed a battery of questionnaires assessing child diet, sleep and daytime behaviour on one occasion. All children were 8–12 years old and free of any clinically diagnosed sleep, behavioural or dietary problems.

Results: Data from 287 children (10.65 ± 1.3 years; 48.8% male) showed average total sugar intake was 134.9 g per day, with 81% of the sample consuming more than the recommended guidelines. Percent energy from sugar differed between males ($25.0\% \pm 6.5$) and females ($26.9\% \pm 7.3$), $P = 0.024$, but not between categorically grouped TST ($P = 0.369$), sleep onset latency ($P = 0.348$), or age ($P = 0.567$). A hierarchical regression showed that sleep variables contributed significantly to total behavioural problems accounting for 20.1% of the problems, $F(5,281) = 15.345$, $P < 0.001$. Percent energy from sugar was not associated with sleep variables (sleep routine, bedtime anxieties, night arousals, sleep disordered breathing and restless sleep) or behavioural variables (internal, external and total). When sugar as a percentage of energy was added to the model it did not significantly contribute to total behavioural problem scores.

Discussion: Our results show that children consume higher than recommended amounts of sugar. However, the excess intake does not further exacerbate chronic problematic daytime behaviour, which is negatively affected by poor sleep. Future research would benefit from identifying acute effects of sugar consumption, and investigating the impact of specific sources of sugar.

076

THE EFFECTS OF A RANDOMISED-CONTROLLED GROUP SLEEP IMPROVEMENT INTERVENTION ON SLEEP AND BEHAVIOURAL PROBLEMS IN ADOLESCENTS

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Introduction: As a consequence of developmental changes many adolescents have inadequate sleep. Adolescents who experience both sleep disturbance and anxiety may be at-risk for developing subsequent behavioural problems, yet intervention studies are lacking. The current study examined the efficacy of a 7-week cognitive-behavioural and mindfulness-based group sleep intervention for improving sleep and behavioural problems in at-risk adolescents using a randomised controlled design. Specifically, it investigated the extent to which intervention-related sleep improvements were associated with improvements in behavioural problems. The study also examined whether gender modified these relationships.

Methods: Adolescents (12–16 years old; $n = 118$, 59.3% female) with elevated levels of sleep disturbance and anxiety were randomised to a *sleep* (treatment) intervention ($n = 59$) or a *study skills* (active control) intervention ($n = 59$). Assessments of subjective sleep and daytime functioning (Pittsburgh Sleep Quality Index; Paediatric Daytime Sleepiness Scale), objective sleep (actigraphy), and behavioural problems (Child Behavior Checklist–Youth Self-Report, four subscales) were conducted pre- and post-intervention.

Moderated mediation analyses were performed, including an examination of the role of gender.

Results: Analyses of covariance procedures showed that adolescents in the *sleep* intervention showed greater improvement in sleep (sleep quality, sleep onset latency and daytime sleepiness), compared to adolescents in the control intervention, with small to medium effect sizes. Males who completed the *sleep* intervention showed greater improvement in social problems, with a small effect size. Moderated mediation analyses revealed that, compared to the control, the *sleep* intervention decreased social and attention problems in males (but not females), which led to improvements in subjective and objective sleep.

Conclusion: This study demonstrates the efficacy of a cognitive-behavioral and mindfulness-based group sleep intervention in improving sleep and daytime functioning in at-risk adolescents. The results support the relationship between behavioural problems and sleep, particularly in males. Future sleep interventions could target behavioural problems in adolescent males to maximise sleep improvement.

077

A BRIEF SCHOOL-ENTRY SLEEP INTERVENTION IMPROVES CHILD AND PARENT OUTCOMES: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Identifying and treating sleep problems in the first year of primary school using a brief, behavioural intervention has demonstrated efficacy in reducing sleep problems and has positive roll-on benefits for the child's psychosocial health, behaviour and parent mental health up to 12 months. However, whether such benefits present when the same intervention is delivered by school nurses in a translational, effectiveness randomised controlled trial (RCT) are unknown. We aimed to determine whether a brief, behavioural sleep intervention improves child psychosocial health (primary outcome), sleep, and behaviour and parent mental health in children commencing primary school.

Methods: Design: RCT nested within a population survey of parents of school entry children in 46 Melbourne primary schools. Participants: Children with moderate/severe sleep problems. Intervention: 1–2 consultations between parents and a school nurse trained in flexible yet standardized sleep management techniques. Controls received "usual school nurse care". Outcomes: (1) Parent-reported child psychosocial health (PedsQL, primary outcome), sleep, and behaviour (SDQ) and parent mental health (DASS-21) at 6 and 12 months post-randomization. Analyses: Intention-to-treat analysis using linear and logistic regression, adjusting for confounders; generalised odds ratios for DASS.

Results: Eighty one percent (5323/6635) of parents completed the survey. Child sleep problems were common (23% mild, 13% moderate/severe); 334 (60% of those eligible) families entered the trial. Compared to controls at 6 months, intervention families reported fewer child sleep problems (53% vs. 35%, OR = 0.49, 95% CI 0.32 to 0.76, $P = 0.002$), less bedtime delay (mean diff = 9 min, 95% CI 1 min to 18 min $P = 0.03$) and longer school night sleep durations (mean diff = 10 min, 95% CI 1 min to 19 min, $P = 0.03$) and parents were less likely to report poor mental health symptoms, particularly

depressive symptoms (OR 0.7, 0.6 to 1.0, $P = 0.03$). However, children had similar psychosocial health and behaviour outcomes, and all 12 month outcomes were similar.

Discussion: A brief sleep intervention program, delivered soon after school entry by school nurses, initially improved children's sleep problems and parent depressive symptoms, but benefits did not exist at 1 year post-randomisation.

Our findings highlight the potential for utilising school nurses directly in interventions at the health and education interface thereby reducing barriers and improving access to healthcare for children and families. Nurses identified benefits personally and for their role within the school system, but also the challenges of intervention implementation.

078

TEMPORAL AND BIDIRECTIONAL ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY AND SLEEP IN PRIMARY SCHOOL-AGED CHILDREN

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Purpose: The directionality of the relationship between children's physical activity and sleep is unclear. This study examined the temporal and bidirectional associations between objectively-measured physical activity and sleep in primary school-aged children.

Methods: This cross-sectional study consisted of a sub-group of children ($n = 65$, aged 8–11 years) from the Fitness, Activity and Skills Testing (FAST) Study conducted in Melbourne, Australia. Sleep and physical activity were measured using the SenseWear Pro Armband for eight consecutive days. Outcome measures included time spent in light- (LPA), moderate- to vigorous-intensity physical activity (MVPA), time in bed (TIB) and total sleep time (TST). Multilevel analyses using generalized mixed models were conducted to determine whether physical activity on one day was associated with sleep outcomes that night, and whether sleep during one night was associated with physical activity the following day.

Results: On any given day, every additional 60 min spent in LPA was associated with approximately 5 min more TIB and 6 min more TST that night. Reciprocally, every additional 60 min spent in TIB or TST was associated with 13 min and 18 min more LPA, respectively, the following day. No significant associations were observed between TIB, TST, and MVPA in either direction.

Conclusion: Greater levels of LPA were associated with increases in nocturnal sleep outcomes. Furthermore, increases in TIB and TST were associated with increases in LPA the following day. This is the first time a bidirectional relationship has been observed between LPA and sleep outcomes. Further investigations into the directionality of this association is important for overall health and potential intervention targets.

079

PRIMARY CARE MANAGEMENT OF INSOMNIA IN AUSTRALIA: THE BEACH STUDY (2000–15)

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Study Objectives: To characterize the presentation and management of insomnia in general practice in Australia.

Methods: We used the Bettering the Evaluation And Care of Health (BEACH) database to assess the number of encounters for insomnia (aged 15+) or difficulty sleeping, annually from 2000–2015. We assessed trends in treatment described for these encounters in this yearly nationally-representative cross-sectional survey of 1000 primary care practitioners' activity in Australia.

Results: Insomnia management frequency was relatively steady until 2007–08 when there was a marked reduction in insomnia management occasions ca. 1531 per 100,000 to ca. 1309 per 100,000. Pharmacotherapy for insomnia also decreased from 99.6 prescriptions per 100 insomnia problems managed in 2006 to 94.5 between 2010–15. The mix of pharmacotherapy also changed. The Prescriptions of Temazepam (Australia's market leader) dropped from 54 to 42 per 100 insomnia problems in 2001 when Zolpidem entered the market. Zolpidem prescriptions peaked in 2006 (14.6 per 100) then halved in 2007–8, largely being replaced with Temazepam. Prescribing of slow release melatonin steadily increased since marketing approval in 2009. The mix of patients also changed since 2000 with older individuals (particularly 75+ years) less likely to be seen. The gender proportion remained consistent over time at about 52–55% female.

Conclusions: The 2007 decrease in GPs management of insomnia may have been due to a stimulated reporting event surrounding the purported side-effects of zolpidem and increased publicly funded access to psychologists but have remained steady since. Prescribing has changed over the last 15 years and Australian general practitioners remain largely reliant on pharmacotherapy for insomnia management.

080

A NATIONAL MODEL OF PRIMARY SLEEP CARE NOW IN IT'S 4TH YEAR

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Commercial forces have greatly changed the management of OSA in Australia. There no longer exists a clear division between the delivery of medical care and commercial interests. In many current Australian models no doctor, skilled in the management of this significant disease, is directly involved in the patient's care. OSA management often requires broad consideration of co-morbidities and, as such, is best dealt with in a primary care setting by an up-skilled doctor and team. This presentation briefly outlines the essential elements of a working primary care model for the comprehensive management of OSA.

081

REMOTELY CONTROLLED CPAP TO TREAT PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA LIVING IN RURAL AND REMOTE WESTERN AUSTRALIA

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Introduction: Western Australia has large areas of remote and very remote sites based on the accessibility remoteness index Australia (ARIA). For patients living in these areas access to specialist sleep services is very limited; patients must travel long distances to access public sleep services.

Aim: The aim was to use telehealth and remotely controlled CPAP to minimise the number of patients' visits to the hospital and ensure a satisfactory rate of CPAP uptake and compliance.

Methods: Using department databases we identified rural patients who completed a trial of remotely controlled CPAP (Resmed™ Airsense 10 Autoset™). All patients had an initial consultation (physical or telehealth), a sleep study (diagnostic or split night) and standardised CPAP education. Compliance, leak, residual AHI data and pressure changes were managed remotely (Airview™) or during a physical visit if there was no cellular coverage. Patients were followed up during the trial by telephone by a sleep scientist. Patients initially started on automatic positive airway pressure (APAP) and then were fixed to CPAP at a pressure that was the 95th centile.

Progress to date: A total of 12 patients completed a trial of remotely controlled CPAP therapy. Mean age (standard deviation) was 59.0 (15.1) years and body mass index 34.5 (7.2) kg/m². Mean distance from the Sleep Centre was 761 (688) kilometres. Mean apnoea hypopnea index was 32.7 (23.6) per hour. First consultation was performed by telehealth in 75% of patients. Eleven patients (91.7%) initially had a trial of APAP and one patient trialled fixed pressure. Mean trial length was 56.8 (26.0) days. At the completion of the trial eight patients continued fixed CPAP, one patient continued APAP, one patient changed to ASV, one patient discontinued CPAP and one was lost to follow-up. The mean pressure was 12.4 (1.7) cm H₂O, Residual AHI 1.8 (0.7) per hour, 95th % leak 22.4 (2.1) litres per min and average usage (all days) 4:19 (1.54) h: minutes. The mean number of physical visits was 3 (1.05), telehealth consultations was 0.8 (0.6), and telephone calls 3.1 (2.8). The number of pressure changes was 1.18 (0.75) and mask changes 0.7 (1.0). In 3 of 12 patients data was unable to be accessed remotely.

Conclusions: A model of care using remotely controlled CPAP and telehealth for OSA may reduce physical visits for patients living in rural and remote Australia with acceptable CPAP uptake and adherence.

082

BARRIERS AND ENABLERS FOR SUCCESSFUL UPTAKE OF CPAP TREATMENT FOR INDIGENOUS AUSTRALIANS WITH OSA

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Introduction: This study is the first to engage Australian Aboriginal and/or Torres Strait Islander peoples (Indigenous Australians) to better understand their experience of treatment for obstructive sleep apnoea (OSA). The aim of the study was to explore Indigenous Australians' experiences of continuous positive airway pressure (CPAP) treatment, and enablers and barriers to CPAP therapy.

Methods: A qualitative content analysis was employed. Data were collected by in-depth interviews with 12 Indigenous CPAP users.

Results: Barriers to Indigenous Australians' successful uptake of CPAP include a lack knowledge and understanding of sleep-related breathing disorders and their health consequences. This lack of knowledge can lead to Indigenous Australians enduring severe symptoms for a long duration of time before seeking medical consultation. Cultural issues such as shame can also be a barrier preventing Indigenous people from talking about sensitive health issues with family members or a health care provider. The concept of using a machine or device to assist breathing is not common among Indigenous people make this a particularly confronting and unusual experience for those requiring treatment. Enablers to successful CPAP use were support from family, friends, staff at the Sleep Disorders Centre, pharmacists, and health services funded to provide free CPAP machine consumables (masks and tubing). Participants recommended regular workshops as an enabler for new CPAP users to learn how to use and maintain the CPAP machine correctly, to answer any questions, and to address challenges and concerns early.

Discussion: Raising awareness through education about the symptoms and health risks of untreated OSA and the benefits of treatment will be an important first step for Indigenous Australians to recognise and understand they have a medical condition and to seek treatment. Working with community-based primary health care providers and services will be key to achieving this.

083

DESCRIPTION OF AN INPATIENT OVERNIGHT WARD SLEEP OXIMETRY SERVICE

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Introduction: Overnight oximetry is used extensively in sleep laboratories and domiciliary settings to assess sleep disordered breathing (SDB). It is simple to use and can provide a rapid, reliable test that is specific for identifying SDB & nocturnal O₂ status and sensitive to severe disease. We have previously reported that oximetry can obviate the need for diagnostic polysomnography in 75% of patients referred to a specialist Sleep Clinic & 83% of our domiciliary overnight oximetry service is used to assess SDB. There is a paucity data on the use of specific sleep overnight oximetry monitoring in the inpatient ward setting.

Aim: To describe the Alfred inpatient ward sleep oximetry service over a 17 month period.

Methods: Retrospective review of inpatient ward oximetry database from 1 Jan 2015–30 May 2016. All patients were referred to the Sleep and Ventilation Service (SVS) and were assessed face to face by team members including; physicians, advanced trainee & nurse/scientists. 254 patients underwent inpatient ward oximetry at this time. We determined: Source of referral, indication for test, failure rate, ODI₃ results were stratified into <10, ≥10 & <20, and ≥20/h groups & SpO₂ ≤ 88% were stratified into %TRT time ≥33%.

Results: 254 patients studied, 2 failed to record ie <1% failure rate. Age 56 median (16–90 range) years, 66% male. All inpatient referrals to SVS were assessed within 24 h of referral. The majority (45%) of referrals were from respiratory units (lung transplant, cystic fibrosis and general respiratory), 15% from cardiac medicine/surgical and general medicine respectively, 9% trauma/orthopaedics. 78% of all inpatient ward sleep oximetry was used to assess SDB (40% high pretest probability, 22% CPAP pressure review, 13% Bi-level pressure review & 3% reassessment severity SDB). 22% for assessment of nocturnal O₂ status. 19% high pretest probability patients had ODI₃ ≥ 10 & <20, & 77% had ODI₃ ≥ 20/h. 20% of those assessed for nocturnal oxygen status had a SpO₂ ≤ 88% of %TRT time ≥33%.

Conclusion: Inpatient ward overnight oximetry was primarily (78%) used to assess patients for SDB. Most studies (77%) were strongly positive (ODI₃ ≥ 20/h) for SDB.

084

THE SLEEP HEALTH APPLICATION: A DIGITAL SOLUTION FOR A BURGEONING WORKLOAD

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Background: In 2008, increasing demand on Tertiary Sleep Services at Christchurch Hospital resulted in the creation of a Primary Care sleep apnoea assessment pathway (Sleep-Pathway). In the 8 years since inception there has been a 360% increase in new patient referrals via the Sleep-Pathway. This rapid expansion created significant business risks including processing bottlenecks; document control issues; inefficient communication with primary care; and treatment delays. A critical review of the Sleep-Pathway was required to improve service quality and ensure sustainability.

Aim: The purpose of this project was to create a product to (1) improve the quality of clinical information gathering, (2) decrease patient processing time and (3) decrease the cost of healthcare delivery.

Methods: A critical review of the Sleep-Pathway was performed by the Sleep Governance Group. Eleven significant risks were identified. The solution was to implement an online Sleep Health Application to replace the previous paper-based process. A commercial software development team in conjunction with the Hospital Information Services Group were engaged to complete this project. The system went live in September 2015, with all sites transitioned in January 2016. Project outcomes were assessed by using surveys and analysis of processing times.

Results: The Sleep Health Application has significantly reduced the time from referral to clinical decision (48 vs. 34 days; median, $P < 0.001$). This was primarily from improvements in processing times (15 vs. 3 days; median, $P < 0.001$). For the Tertiary Sleep Service and the Primary Health Organisation administration, the decrease in time spent per referral has resulted in cost savings of \$30

000 per annum. Approved Sleep Assessors have reported a preference for the Sleep Health Application over the previous paper based referral process.

Conclusion: The Sleep Health Application is a cost and time effective online tool for managing assessments of patients in primary care with suspected Sleep Apnoea.

085

MODIFIED UVULOPALATOPHARYNGOPLASTY AND TONGUE CHANNELLING AS A SURGICAL OPTION FOR TREATING OBSTRUCTIVE SLEEP APNOEA

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Introduction: Uvulopalatopharyngoplasty is one of the most common procedures used to treat OSA¹ and the purpose of this study was to compare pre and post-operative apnoea hypopnea indices (AHI) and oxygen desaturation index (ODI) in patients with sleep study confirmed OSA who had failed or declined device therapy.

Methods: This is a retrospective cohort of 22 patients who underwent modified uvulopalatopharyngoplasty and coblation tongue channelling performed by a single surgeon between 2012 and 2015. Pre and post-operative AHI and ODI were formally measured by polysomnogram. Surgery was considered successful where the preoperative AHI was reduced by greater than 50% and the post-operative AHI was less than 20. A Wilcoxon's signed rank test was used to compare pre and post-operative values.

Results: A total of 22 patients underwent surgery, which resulted in a statistically significant reduction in AHI ($P < 0.01$). The median preoperative AHI was 46.4, and the median preoperative ODI was 27.6. The median post-operative values for AHI and ODI were 13 and 8.8 respectively. There were a total of eleven patients with both a reduction in post-operative AHI by greater than 50% and AHI < 20 .

Discussion: Modified UPPP and Coblation tongue channelling remains a successful treatment option in the management of OSA in patients who have failed or declined device treatment. Future studies should also include clinical symptoms in the definition of surgical success.

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086

POLYSOMNOGRAPHIC ASSESSMENT OF AUTOMATIC ADJUSTABLE VS. FIXED EPAP INTELLIGENT VOLUME ASSURED POSITIVE AIRWAY PRESSURE SUPPORT (IVAPS) IN CHRONIC HYPOVENTILATION

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Introduction: To evaluate efficacy of the iVAPS AutoEPAP algorithm compared to iVAPS FixedEPAP in treating chronic hypoventilation.

Methods: Randomized, double-blind, cross-over, non-inferiority trial of AutoEPAP vs. FixedEPAP iVAPS on sleep and breathing over 2 nights of attended polysomnography (PSG). Fixed EPAP was determined at a preceding PSG.

Results: 25 adults (obesity hypoventilation = 11, COPD = 9, neuromuscular disease = 5) aged 57 ± 7 years, 14 (56%) males established on non-invasive ventilation ≥ 3 months and apnoea/hypopnoea index (AHI) > 5 . The mean \pm SD EPAP was 11.8 ± 4.2 on FixedEPAP and 10.9 ± 4.1 cm H₂O on AutoEPAP nights ($P = 0.20$). There were no statistical differences between the FixedEPAP and AutoEPAP iVAPS for measures of sleep disordered breathing (Table). All PSG sleep parameters and subjective device comfort reports, including patient mode preference, were equivalent between the two modes.

Outcome	Fixed EPAP (n = 25)	Auto EPAP (n = 25)	P value
AHI, events/h	2.40 (0.25–5.95)	2.70 (1.70–6.05)	0.86
ODI 3%	3.50 (1.45–9.60)	4.20 (2.05–11.05)	0.31
ODI 4%	1.10 (0.20–4.65)	1.60 (0.05–5.90)	0.41
Oxygen saturation: mean, %	94.13 ± 2.22	93.75 ± 2.18	0.07
Time saturation <90%, mins	0.40 (0–5.70)	0.50 (0–21.95)	0.64
Lowest/nadir saturation, %	87.95 ± 2.82	86.54 ± 4.74	0.13
TcCO ₂ mean, mm Hg (n = 24)	46.84 ± 5.98	47.44 ± 5.04	0.55

Discussion: The iVAPS AutoEPAP algorithm demonstrated equivalent treatment of breathing and sleep parameters to iVAPS FixedEPAP in chronic hypoventilation patients over the course of a single night's therapy. Advantages over manual titration include ease of implementation of therapy and continuous overnight autotitration to optimise upper airway control.

087

SIX MONTHS OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) TREATMENT IMPROVES NEUROBIOLOGICAL FUNCTION AND QUANTITATIVE SLEEP ELECTROENCEPHALOGRAPHIC (EEG) PARAMETERS IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Untreated obstructive sleep apnea (OSA) is associated with impaired neurobehavioral function and altered brain electrophysiology. We examined the effects of 6 months of CPAP treatment on the inter-relationship between electroencephalographic (EEG) spectral power and neurobehavioural function in OSA.

Methods: We studied 162 OSA patients (age 50 ± 13 , AHI 35.0 ± 26.8) before and after 6 months of CPAP treatment. Neurobehavioural tests were performed to assess working memory (2-back and 3-back accuracy), sustained attention (Psychomotor Vigilance Task, PVT), visual-spatial scanning (Letter Cancellation Task, LCT) and executive function (Stroop). All participants attended

the sleep laboratory for overnight PSG at baseline and after CPAP. Power spectral analysis was performed on all-night EEG data (C3/A2) and absolute EEG delta and sigma power in NREM and a measure of EEG slowing in REM were calculated in a sub-set of 90 participants. All outcomes analysed as change from baseline, and are mean [95% CI] or median [IQR].

Results: Six months of CPAP improved neurobehavioural function across all cognitive domains: 2-back (accuracy: 4.5[24%], $P < 0.0001$); 3-back (accuracy: 6[24%], $P < 0.0001$); and PVT (mean slowest 10% RRT: 0.12[0.8], $P = 0.002$; lapses: 0[4], $P = 0.001$) LCT (average hits: 3.8[8.5], $P < 0.0001$ and final trial duration: -21.8[5.2 sec], $P < 0.0001$) and Stroop colour (accuracy: 2.0[19.2%], $P < 0.0001$; reaction time: -0.09[0.38 sec], $P < 0.0001$). In our sub-set, CPAP increased EEG power in delta (slow wave activity, SWA, 105.3[61.7 to 148.8 μV^2], $P < 0.0001$) and sigma (spindle activity, 1.50[0.70 to 1.18], $P = 0.0003$) in NREM. Associations between baseline sleep EEG and change with CPAP were found with less SWA in NREM and increased sustained attention (PVT mean fastest reaction time: $Rho = 0.24$, $P = 0.03$) and greater EEG slowing in REM and increased working memory (3-back accuracy: $Rho = 0.25$, $P = 0.01$).

Discussion: Six months of CPAP treatment improved performance in working memory, sustained attention, visual-spatial spanning and executive function with increased sleep EEG spectral power. Reduced SWA activity in NREM and greater EEG slowing in REM at baseline showed the greatest improvement in some measures of performance with CPAP. Sleep EEG activity via PSG may provide information on which patients are most at risk of neurobehavioural dysfunction.

088

A RANDOMIZED CONTROLLED TRIAL OF AUTO-TITRATING CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT FOR OBSTRUCTIVE SLEEP APNOEA AFTER ACUTE QUADRIPLÉGIA (COSAQ)

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Quadriplegia is a severe, catastrophic injury that acutely causes obstructive sleep apnoea alongside lifelong physical disability. Treatment with nasal continuous positive airway pressure (CPAP) is particularly challenging in this group. We hypothesised that 3 months of auto-titrating CPAP would improve neuropsychological function, sleepiness, quality of life, anxiety and depression more than usual care in acute quadriplegia.

Methods: 11 spinal cord injury centres across Australia, New Zealand, Canada and the UK screened 1628 people (July 2009-October 2015) who sustained a new, traumatic quadriplegia. 337 people met the inclusion criteria and underwent full, portable polysomnography. 265 had an apnoea hypopnoea index greater than 10, were classified as "OSA positive" and proceeded to a 3 night CPAP trial. 160 tolerated at least 4 h of CPAP during run-in and were randomized.

Results: 149 participants (134 men, age 46 ± 34 , 81 ± 57 days post-injury) completed the trial. Linear modelling revealed no differences in improvement in attention and information processing, as measured by the Paced Auditory Serial Addition Task, on intention-to-treat ($P = 0.59$; mean difference 2.6, 95% CI, -6.9 to 12.1) or per protocol for adherence (primary outcome). Intention-to-treat analyses

revealed that CPAP significantly improved the secondary outcome of sleepiness ($P = 0.01$, 1.17, -2.1 to -0.25).

Discussion: CPAP significantly improved sleepiness after acute quadriplegia but did not improve attention and information processing beyond that seen with post-injury, spontaneous recovery.

Trial registration: Australian New Zealand Clinical Trial Registry ACTRN12605000799651.

089

THE EFFECT OF CPAP THERAPY ON LEVELS OF TROPONIN AND PRO-BNP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA: A RANDOMISED CONTROLLED TRIAL

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Introduction: Untreated OSA is associated with an increased incidence of coronary artery disease and heart failure. Troponin (Trop-T) and Brain Natriuretic Peptide (NT pro-BNP) are sensitive biomarkers for myocardial injury and heart failure respectively. No randomised controlled trials have examined the effect of OSA treatment with CPAP on these biomarkers and uncontrolled studies show conflicting results. We therefore aimed to examine the effect of CPAP on these biomarkers using frozen plasma samples from a previous RCT that examined the effect of CPAP treatment on post prandial lipidemia.

Method: Male and female patients >21 years old with AHI ≥ 25 /h by overnight polysomnography were recruited. Main exclusion criteria were BMI >35 kg/m², previous CPAP use and any clinically significant comorbidities such as ischaemic heart disease, heart failure, and pulmonary disease. Eligible subjects were randomised to receive CPAP or sham CPAP for 8 weeks each in a crossover design with a wash out period of one month between the treatments. Blood samples collected at 8 pm, 3 am, and 8 am during sleep studies conducted at the end of each 8 week treatment period (CPAP or sham) were analysed for Trop-T and NT pro-BNP levels.

Results: Of the 37 patients who were randomised, 28 patients had stored frozen samples available for biomarker analysis. In comparison to sham treatment, CPAP significantly lowered the pro-BNP level by 0.91 pM (95% CI -0.443 to -1.381, $P = 0.0002$). The reduction in troponin T on CPAP therapy was 0.235 ng/L (95% CI -0.002 to -0.471, $P = 0.052$), which did not reach statistical significance.

Conclusion: Our study confirms CPAP therapy in patients with moderate-severe OSA reduces pro-BNP. This has important clinical implications as high baseline pro-BNP levels have been shown to be predictive of future development of heart failure. This implies that CPAP therapy in patients with OSA without heart failure may prevent future development of cardiac dysfunction. Our findings did not confirm the relationship between CPAP therapy and Trop-T. This may be due to our small sample size. Longitudinal studies will be required to determine if the improvements in pro-BNP translate to clinical benefits.

090

DIET, EXERCISE AND ARMODAFINIL FOR OBSTRUCTIVE SLEEP APNEA PATIENTS UNABLE TO TOLERATE STANDARD TREATMENTS (DEAR). A RANDOMISED, PARALLEL GROUP, PLACEBO-CONTROLLED TRIAL

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Introduction: Obstructive sleep apnea (OSA) patients who are unable to tolerate standard treatments often become lost in the healthcare system with few alternatives. Obesity is the only modifiable risk factor for OSA, but weight loss may take many months while often the primary presenting symptom of excessive daytime sleepiness remains.

We hypothesised that in these patients a wakefulness promoter, armodafinil, used with a weight loss program would improve daytime sleepiness over placebo.

Methods: Overweight patients (BMI > 27 kg/m²) with at least moderate OSA (AHI > 15/h) who had rejected CPAP or MAS and had no major comorbid conditions were invited to enrol in a 12 month weight loss program and randomised to receive 150 mg armodafinil or matching placebo daily for the first six months of the trial.

The primary outcome was the change in steering deviation (cm) in the final 30 min of a 90 min afternoon drive (AusED driving simulator) from baseline to six months.

Results: 113 patients were randomised with six month data available for 87 (77%) patients. Steering deviation was not significantly reduced on armodafinil over placebo at six months. (5.1 cm less deviation on armodafinil, 95% CI -3.4 to 13.5, $P = 0.238$). There was a significant difference between the groups at three months ($n = 90$, armodafinil 12.7 cm less deviation on armodafinil over placebo, 95% CI 4.3 to 21.1, $P = 0.003$).

Conclusions: Driving simulator performance was better on armodafinil over placebo at three months but this was not sustained to six months. The negative result at 6 months may be due to underpowering.

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SLEEP APNEA AND DEPRESSIVE SYMPTOMS IN PREGNANCY

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Background: Obstructive sleep apnea (OSA) is strongly linked to depression, with potential bi-directional cause-effect relationships and shared depressive symptoms. Poor sleep in pregnancy has also been associated with an increase in depressive symptoms. It is possible that a proportion of these pregnancy-related problems result from OSA, which has been shown to during pregnancy. The purpose of this study was to examine the relationship between OSA and depression during pregnancy.

Methods: Depressive symptoms were measured in 189 women >28 weeks singleton pregnant using the Edinburgh Postnatal Depression Scale (EPDS). Respiratory flow and oxygen saturation were monitored overnight (ApneaLink) and manually scored for

apnea hypopnea index (AHI) and oxygen desaturation index at 3 and 4% (ODI3%; ODI4%). Women were excluded from subsequent analyses if there was less than 60 mins of sleep, if SpO₂ or flow signals were of poor quality or if they failed to fully complete the EPDS.

Results: Complete datasets were available in 107 women aged 31 ± 6 years (range, 19–42 years). Mean EPDS scores was 6.6 ± 5 (0–24) and AHI was 5.9 ± 14.3 events/h (range, 0–62 events/h). OSA (AHI ≥ 5) was identified in 20% ($n = 22$) of women: $n = 17$ had mild OSA; $n = 1$ had moderate OSA; and $n = 3$ had severe OSA. Clinically significant symptoms of depression (EPDS ≥ 10) were identified in 26% ($n = 28$) of women. A significant relationship was present between EPDS and AHI ($R^2 = 0.038$ $P = 0.04$), ODI3% ($R^2 = 0.043$ $P = 0.03$) and ODI4% ($R^2 = 0.051$ $P = 0.03$). In each case this relationship was independent of BMI. AHI and ODI3% were not different between those with and without depression although women with depression had a greater ODI4% ($P = 0.01$).

Conclusion: This is the first study to show that, in women in their third trimester of pregnancy, the frequency and severity of OSA-related intermittent nocturnal oxygen desaturations is associated with depressive symptoms and that this association is independent of BMI. Further, women with symptoms of depression had significantly more severe desaturation events than those without symptoms. The sleep fragmentation resulting from the desaturation events and/or the hypoxemia itself may be responsible for these depressive symptoms.

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CHANGES IN SLEEP, SLEEP-RELATED FUNCTIONING, AND PSYCHOLOGICAL DISTRESS IN MOTHERS ATTENDING A 5-DAY RESIDENTIAL PROGRAM FOR UNSETTLED INFANTS

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Introduction: Parents whose infants have sleeping and settling difficulties may experience significant sleep disturbance, sleepiness, fatigue, and psychological distress. Residential Early Parenting Services (REPS) are unique Australian services for treating unsettled infant behavior, but little is known about their impact on parental sleep, sleepiness and fatigue. The purpose of this study was to explore changes in sleep, sleep related functioning, and psychological distress in mothers attending a five-day REPS.

Methods: Participants were 84 mothers (age Mean \pm SD = 34.45 ± 4.10 , infants age 8.62 ± 4.96 months) attending a REPS. Sleep was assessed via self-report and the Insomnia Severity Index (ISI). Sleepiness and fatigue were assessed using the Epworth Sleepiness Scale (ESS), Karolinska Sleepiness Scale (KSS) and Fatigue Severity Scale (FSS). A subset of 49 mothers completed the Psychomotor Vigilance Task (PVT) analyzed using Weibull distribution analysis. Psychological distress was also assessed using the Depression Anxiety Stress Scale (DASS21). All measures were repeated on the first and last full day of the program.

Results: Mothers reported a mean (SD) reduction in nighttime awakenings from 3.99 (1.87) to 1.99 (1.20) times ($P < 0.001$, $d = 1.32$), a reduction in wake after sleep onset from 37.79 (33.33)

to 12.97 (12.33) min ($P < 0.001$, $d = 1.25$), but no change in total sleep time ($P = 0.63$, $d = 0.06$). There were significant reductions in depression, anxiety, stress, insomnia, fatigue and sleepiness scale scores (all $P < 0.001$, d ranges 0.63 to 1.59). For the PVT there was a small decrease in mean 1/RT ($P < 0.002$, $d = 0.31$), but no significant differences between the scale, shift and shape of the reaction time distributions between first and last day.

Discussion: This study is the first to explore how attending a REPS program for treating unsettled infant sleep and settling was also associated with improvement in maternal subjective sleep, sleepiness, fatigue and psychomotor vigilance. Further research is needed to see if these changes are sustained over time, and to better understand therapeutic mechanisms of observed improvement.

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MEMORY PERFORMANCE AFTER SLEEP DEPRIVATION IN ADOLESCENTS

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Introduction: Sleep has been shown to facilitate memory consolidation and learning compared to daytime wake. However few studies have investigated the impact of sleep deprivation on memory processes, especially in adolescents, who are vulnerable to significant sleep loss. This study investigated the effect of one night's sleep deprivation in adolescents compared to a full night sleep on memory performance while accounting for confounding changes in attention.

Method: Twelve healthy adolescents (6 male, 6 female), aged 16.2 ± 0.83 years, completed tests of attention (Psychomotor Vigilance Task lapses; PVT lapses) and memory (word-pair associate learning) before and after both a night of complete sleep deprivation and a 10-h nocturnal sleep opportunity.

Results: Both memory performance and PVT lapses deteriorated across sleep deprivation compared to sleep. However, linear mixed model analysis showed change in lapses was not predictive of memory change. The effect of sleep deprivation condition on memory remained significant even after accounting for the influence of attention performance changes.

Conclusion: These findings suggest sleep deprivation in adolescents inhibits memory processing, independent of changes in attention capacity. Sleep loss in adolescents may contribute to risk of poor academic progress and attainment due to impairment of memory processing.

094

THE EFFECTS OF ACUTE AND CHRONIC ALCOHOL USE ON SLEEP ARCHITECTURE IN MALE AND FEMALE YOUNG ADULTS

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Introduction: Alcohol dependency is associated with major reductions in slow wave sleep (SWS) and ongoing sleep disruption. In

healthy young adults, consuming alcohol prior to sleep initially increases SWS and suppresses rapid eye movement (REM) sleep. This is followed by marked sleep disruption, and significant reductions in SWS. Heavy alcohol use is frequent in both male and female young adults. The current study investigated the effects of a high dose of pre-bedtime alcohol, sex, and habitual alcohol use, on sleep in 18 to 21 year olds.

Method: Six light drinking (LD) males (19.17 ± 0.98 years; 11.36 ± 7.89 standard drinks [SD; 10 g EtOH] in the previous month), 6 LD females (20.17 ± 0.98 years; 17.11 ± 8.79 SD), 8 heavy drinking (HD) males (19.50 ± 1.07 years; 138.20 ± 93.56 SD) and 6 HD females (19.60 ± 0.89 years; 92.59 ± 34.26 SD) took part. Each completed standard laboratory polysomnography under two conditions: pre-bedtime alcohol (BAC at lights out $0.077 \pm 0.020\%$), and placebo beverage (0.0% BAC). Participants abstained from alcohol for 48 h prior to testing. Data were evaluated across the entire night. Participants did not differ significantly in age, BMI or age drinking commenced ($P > 0.05$). By design, HD consumed more alcohol than LD in the previous month ($P < 0.001$), however there were no sex differences ($P > 0.05$). Results: Females had more total sleep time than males ($P = 0.019$). Acute pre-bedtime alcohol increased stage 2 sleep in all groups ($P = 0.022$). However, the largest increase in stage 2 sleep occurred in LD males and HD females (alcohol condition \times habitual alcohol use \times sex interaction, $P = 0.023$). In the placebo condition HD had less SWS % than LD, regardless of sex ($P = 0.043$). Following acute alcohol, males had an increase in all night SWS %, while conversely females had a reduction (alcohol condition \times sex interaction, $P = 0.027$). Interestingly, acute pre-bedtime alcohol elevated SWS in HD males but not in LD males, and HD females showed a greater reduction in SWS when compared to LD females (alcohol condition \times habitual alcohol use \times sex interaction, $P = 0.012$). All night REM sleep % was reduced following pre-bedtime alcohol for all groups ($P = 0.017$).

Discussion: These preliminary findings suggest that acute pre-bedtime alcohol affects sleep differently based upon sex and habitual alcohol use in young adults. These divergent responses may reflect physiological differences in the brain and sleep systems.

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SLEEP DISORDERS AND RISK OF INCIDENT DEPRESSION: A POPULATION CASE-CONTROL STUDY

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Introduction: A number of studies have found that disturbed sleep can precede onset of a psychiatric disorder, and that there is substantial comorbidity between sleep disorders and psychiatric disorders, particularly major depression. However, some studies have not been able to establish the temporal relationship between sleep disorders and psychiatric disorders, have been performed in clinical samples, relied on self-report information or have conditioned on the outcome. We sought to investigate and estimate the risk of developing new-onset depression in those with sleep disorders in the entire population of Denmark.

Methods: Data were obtained by linking longitudinal Danish population-based registers. Information on sleep disorders and major depression was obtained from the Danish National Hospital

Register and the Danish Psychiatric Central Research Register. The registers contain records of all hospital visits with a diagnosis given by ICD-10 codes. To account for variability in depression and sleep disorder risk over time, we used a nested case-control design. A total of 65,739 individuals who had first onset of depression between 1995 and 2013 were selected as cases. For each case, a set of 20 controls of the same sex, birth month and year and who had not had depression by the date that the case was diagnosed were selected at random from the population ($n = 1,307,580$ in total). We examined whether there was an increased rate of prior sleep disorders in MDD cases compared to controls using conditional logistic regression.

Results: We found that there was an increased risk of incident depression in cases for all sleep disorders analysed. Highest incidence rate ratios were found for circadian rhythm disorders (IRR = 7.06 (2.78–17.91)) and insomnia of inorganic origin (6.76 (4.37–10.46)). The lowest estimated IRR was for narcolepsy (IRR = 2.00 (1.26–3.17)). We also estimated the incidence rate ratio based on time since a sleep disorder diagnosis. Those diagnosed with a sleep disorder in the last 6 months were at highest risk of developing depression compared to those with at least 1 year since diagnosis (3.10 vs. 2.36).

Discussion: Our study shows that in the entire population of Denmark, the likelihood of developing MDD is nearly 3-fold higher in those diagnosed with any sleep disorder.

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SLEEP, MOOD AND SHIFT TIMING INFLUENCE EATING BEHAVIOUR IN SHIFTWORKERS

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Introduction: Factors associated with shiftwork such as sleep restriction and mood disturbances have been found to impact on eating behaviour. However, limited studies have analysed these variables when investigating the eating behaviour of shift workers. The aim of this study was to examine whether sleep and shift-related factors along with mood would explain alterations in shift workers' eating behaviour.

Methods: Nurses ($n = 52$, 46 female; age: $m = 40.3 \pm 12.1$ years) employed on various shiftwork schedules were recruited to participate in a 14-day within- and between-subjects repeated measures study. Eating behaviour was recorded daily in a food diary. Sleep-related factors (sleep duration, quality and efficiency) were measured throughout the study using actigraphy. Mood (happiness, anxiety, depression, stress and tiredness) was measured before and after shifts on visual analogue scales. Shift-related factors (shift schedule and shift type) along with demographic (e.g. gender and BMI) and work-related factors (e.g. shift work history) were completed on a questionnaire.

Results: Mean daily energy intake was 7908 ± 3341 kJ and was distributed in the following way: 31% energy from fat (including 12% from saturated fat), 42% from carbohydrate and 21% from protein. Mean sleep duration in the 24 h period prior to a shift was 6.9 ± 1.8 h. Linear mixed model analysis indicated the following significant relationships: nurses were more stressed when working a night shift compared to afternoon shift and more tired on night shift than either morning or afternoon shifts. Sleep episodes prior to morning shift were shorter than those prior to night shifts, however, lower sleep quality was reported prior to night shifts. Increased stress

predicted an increase in fat intake, whereas lower sleep efficiency predicted higher carbohydrate intake. Working a night shift resulted in higher energy and carbohydrate intake compared to afternoon shift and less protein was consumed on morning shift when compared to other shift types.

Discussion: Sleep quality, working a night shift and stress predicted alterations in eating behaviour. Predictors of eating behaviour for shiftworkers are complex, however, this study has provided an insight into mechanisms other than shift type and shift schedule that impact on eating behaviour. These factors could be explored further in future research.

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COMPARISON OF OVERNIGHT OXIMETRY DOWNLOAD WITH POLYSOMNOGRAPHY IN CHILDREN

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Introduction: The diagnosis of obstructive sleep apnoea (OSA) in children is challenging given the high prevalence (2–3%), the significant associated morbidity and the resource intensity of the Polysomnography (PSG) which remains the gold standard. The limited availability of PSG often results in a delay in diagnosis and management of significant OSA. The aim of this study is to evaluate the reliability of the overnight oximetry download for the diagnosis of OSA in children.

Method: A retrospective analysis of all children with clinical suspicion of OSA who underwent an oximetry download and a subsequent PSG in a tertiary Paediatric Hospital from January 2014 to April 2016. Oximetry was reported based on McGill Scoring System and diagnosis of OSA was based on mixed obstructive apnoea hypopnoea index (MOAHI).

Results: During the study period, 110 patients had overnight oximetry download as well as PSG. The youngest child in the group was 7 days and the oldest was 13 years. Sixty-one children (56%) had normal, 30 (27%) had mildly abnormal and 19 (17%) had moderately/severely abnormal oximetry. Sixty-four percent of children with normal oximetry did not have OSA on PSG. Seventy percent (70%) of children with mildly abnormal oximetry had either normal PSG or mild OSA. Of the children with severely abnormal oximetry, 100% had severe OSA in PSG. The overall sensitivity and specificity of oximetry for identification of OSA were 63% and 78% respectively. The overall positive and negative predictive values (PPV and NPV) were 78% and 64%, respectively. The sensitivity and specificity of moderate/severe abnormal oximetry for diagnosis of moderate/severe OSA were 59% and 100%, respectively. PPV and NPV of moderate/severe abnormal oximetry were 100% and 78%, respectively.

Conclusion: Children with moderate/severe abnormal oximetry do not need a PSG to diagnose OSA. They can be treated based on the oximetry result. However, a normal oximetry does not rule out OSA in children and they still require a PSG.

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FOUR YEAR OUTCOMES FOR A NEW ZEALAND HOSPITAL COHORT OF OSA PATIENTS MANAGED ON CPAP IN 2012

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Background: In 2012 our DHB moved to a computerised dataset of all patient consultations with regards to their CPAP machines, and an earlier discharge to primary care because of service constraint. OSA severity, initial treatment response, ethnicity, age and level of socio-economic advantage are factors that we have previously shown affect initial adherence. OSA incidence is increasing and it is a chronic condition. There is limited long-term data on follow up of OSA. Services are becoming increasingly financially constrained whilst the societal burden of OSA is ever increasing.

Methods: We intend to contact all OSA patients newly diagnosed in 2012 on our database to obtain a download of their CPAP machine to review adherence and efficacy. We will assess this using a combination of a usage questionnaire and a download of their device to assess both objective and subjective outcomes from CPAP therapy. We intend to analyse this data with regards to basic demographics. Ethnicity, Sex, Socioeconomic level (as per the domicile based "NZ Dep Score") and initial severity of disease will all be part of our initial analysis. We are particularly interested in whether age has a significant impact upon adherence having undertaken a pilot study into this last year which showed that older people did not do any worse than those under 65. We have a significant Maori and Pacific Island population in our region. It is well established that these ethnic groups have worse health outcomes. We need to know if our approach is fit for purpose.

Progress to date: The study is still ongoing, we have identified our cohort, numbering 460 patients in our database from 2012, and data collection is ongoing. We do not have enough compliance and outcome data as yet to draw any useful conclusions but will have figures ready to present by the time of the conference.

Intended outcomes and impact: We do not know how successful our new model of care is. The findings may have a significant impact upon how we follow patients up. We are interested in the impact of ethnicity and age on outcomes. We may have to adjust our follow up approach to target specific groups in order to ensure effective treatment.

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OBSTRUCTIVE SLEEP APNOEA IN COMMERCIAL VEHICLE LICENSE HOLDERS: A SINGLE-CENTRE AUDIT OF ASSESSMENT AND MANAGEMENT PRACTICES

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Introduction: The prevalence of obstructive sleep apnoea (OSA) and fatigue related motor vehicle accidents (MVA) is higher in commercial vehicle license (CVL) holders compared with the general population. Accordingly, management decisions should incorporate the patient's fitness to safely operate a vehicle. Although national guidelines exist as a framework for these decisions, management practices vary between sleep physicians. This study aimed to describe the clinical characteristics and management of CVL holders diagnosed with OSA at the Prince Charles Hospital.

Methods: A retrospective cohort analysis of CVL holders diagnosed with OSA between July 2011 and July 2013. Clinical records and databases were analysed for the following: 1. Baseline characteristics 2. Diagnostic outcomes 3. Management practices.

Results (progress to date): 108 CVL holders were diagnosed with OSA over a 2 year period. Baseline characteristics: Mean patient age was 53.41 years (SD 11.81) and 95.37% (95% CI 91.41–99.33) of patients were male. Mean BMI was 37.24 Kg/m² (SD 5.56) and mean baseline ESS was 10.46 (SD 5.56). 15.74% (95% CI 8.87–22.61) of patients reported a history of fatigue related MVA or near misses. Diagnostic findings: Mean AHI 42.28/h (SD 30.52), mean nadir SpO₂ 75.88% (SD 12.99). Obstructive Sleep Apnoea Syndrome (OSAS) defined as AHI > 5 AND ESS > 10 was diagnosed in 53.70% (95% CI 44.3–63.1) of patients. Management findings: Positive airway pressure (PAP) treatment was initiated in 88.89% (95% CI 82.96–94.82) of patients with 70.83% (95% CI 62.26–79.40) of these patients remaining on PAP during follow-up. Maintenance of Wakefulness Test (MWT) was performed in only 1.85% (95% CI 0.69–4.39) of patients.

Discussion: CVL holders assessed at The Prince Charles Hospital have predominantly severe OSA although only a minority of patients have a history of fatigue related driving incidents. PAP therapy was instituted in the majority of patients. Vigilance testing was infrequently performed. Further outcomes to be assessed include whether decisions regarding a patient's fitness to drive were in accordance with Austroads "Assessing Fitness to Drive" guidelines. The results of this study will guide the development of a departmental guideline for the management of CVL holders diagnosed with sleep disordered breathing.

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CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) COMPLIANCE AND CONTROL OF OBSTRUCTIVE SLEEP APNOEA (OSA) USING A HOME-BASED AUTO-TITRATION MODEL OF CARE ARE COMPARABLE WITH CONVENTIONAL MANAGEMENT METHODS: A 5 YEAR REVIEW

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Background: Our large tertiary centre manages OSA using a home-based auto-titration model of care. Eligible patients are issued government-funded CPAP (gfCPAP) devices if they are compliant to treatment. Previous work showed 10.7% of patients on gfCPAP returned their devices mostly due to poor tolerance. This study aims to identify the compliance rate and control of OSA in the previous study patient group.

Methods: A retrospective audit was done on patients diagnosed with moderate or severe OSA (Apnoea Hypopnoea Index (AHI) ≥20 events/h) who were issued long-term gfCPAP between April 2009 and April 2014. 'CPAP retainers' were defined as those who kept their device for the duration of the study. Data obtained from review of the first polysomnography (PSG), CPAP data and medical correspondence were analysed for baseline and residual AHI, average daily usage (ADU), and duration of treatment. 'Compliant' was the average all days gfCPAP usage ≥4 h/night and OSA was 'uncontrolled' if the residual AHI was >10 events/h or <2 h/day ADU. 'Undetermined' was AHI not available in CPAP data.

Progress to date: Of the 292 patients studied, 111 were excluded as they were either on other PAP devices, had short-term loans, were deceased or misclassified, leaving 181 'CPAP retainers'. 17 patients

(9.4%) returned their devices with the remaining 164 (90.6%) identified as 'true retainers'. 120 true retainers (73.2%) were compliant to treatment (mean ADU, 6:48 hh: mm) whereas 44 (26.8%) were non-compliant (mean ADU, 2:33 hh: mm). 86.7% of the compliant patients had good control (mean residual AHI, 2.7 events/h). 104 true retainers (63.4%) were both compliant and controlled. The remaining 60 patients (36.6%) were either non-compliant, uncontrolled or undetermined. Comorbidities from nasal or sinus problems and complex sleep apnoea were the primary contributors for non-compliance and poor control, respectively.

Intended outcome and impact: Interim 12-month data show that the majority of patients were both compliant to, and controlled by gfCPAP using this model of care. Rates of control and compliance are comparable to published data. This model minimises laboratory titrations and allows better targeted interventions for non-compliant and/or uncontrolled patients using CPAP for OSA management.

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PREScription AND OUTCOMES OF HOME VENTILATION IN MND

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Background: Motor neurone disease (MND) is a progressive neurodegenerative disorder with a median survival of 30–37 months. Non-invasive ventilation (NIV) has become standard care in patients with MND and has been shown to increase quality of life and survival. However there is little information as to which subgroups of MND benefit the most, when to commence NIV (and whether this differs between the subgroups) and which measures of respiratory function best predict the need for NIV treatment.

Methods: Retrospective review of all patients with MND who attended the Department of Pulmonary Physiology and Sleep Medicine, Sir Charles Gairdner Hospital between 2003 and 2015. Patients were identified and data extracted from several Department and hospital databases. Information extracted will include: age and clinical phenotype at onset (e.g. bulbar onset, limb onset/ALS, primary lateral sclerosis), demographic information, anthropometric measurements, respiratory function tests (spirometry, maximum respiratory pressures), blood gases, oxygen saturation, time of initiation of NIV, acceptance and compliance with NIV, effectiveness of NIV, and date of death.

Progress: We identified 275 patients, of whom 152 received out-patient care only and, 123 received in-patient \pm out-patient care. We have extracted data on 60 patients thus far and this sub-sample had the following characteristics: mean age (SD) at onset of symptoms 64.5 (9.5) years, male gender 51.7%, and clinical phenotype 39% bulbar onset and 61% limb onset/ALS. Forced vital capacity at referral was 2.4 (1.2) L or 67 (25)% predicted. Fifty patients (83%) received NIV, at a mean duration of 174 days after diagnosis, and had a mean survival from diagnosis of 664 days (1.8 years).

Intended outcome and impact: 1. Survival with and without NIV within the different sub-groups of MND (bulbar onset, limb onset/ALS, primary lateral sclerosis).

2. Measures of respiratory function associated with commencement for NIV overall and within the subgroups.

3. Patient factors and measures of respiratory function associated with successful implementation of NIV overall and within the subgroups.

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A MULTIVARIATE COMPARISON OF THE DURABILITY AND COST EFFECTIVENESS OF CPAP DEVICES: THE EXPERIENCE FROM A SLEEP DISORDERS CENTRE AT A TERTIARY INSTITUTION

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Background: The provision of continuous positive airways pressure (CPAP) devices as part of a publically funded sleep medicine program is an essential part of our tertiary hospital sleep service. Equipment failure and maintenance costs account for a significant burden on resources and as such, assessing equipment durability and cost effectiveness is vital for service planning.

Methods: The service history of 7068 devices was retrospectively reviewed from the Sleep Disorders Centre Database. Overall and device-specific lifespan was assessed by Gehan-Breslow survival analysis. Device survival was also assessed by year of manufacture, with devices grouped into categories: pre-2000s, 2000–2005, 2005–2010 and 2010–2016. The reasons for equipment condemnation and the frequency and cost of repair were compared between devices.

Preliminary Results: Of the 7068 machines issued, mean device lifespan was 12.44 ± 0.15 years. When grouped into year of manufacture, there was no significant difference in equipment failure rate for the first 9 years, with the exception of the 2005–2010 equipment which had a reduced lifespan ($P < 0.001$). There were differences in lifespan between different devices associated with specific patterns of equipment failure as well as manufacturer policy regarding repairs ($P < 0.001$). Specific faults included faulty buttons/dials, faulty displays or even insect infestation (which was seen in only three device models). Most models began to fail after the first two years of life but some models did fail much earlier.

Intended Outcome and Impact: Service planners can predict a mean lifespan for CPAP devices of almost 12.5 years. There are differences in lifespan between devices and devices appear to have specific pattern of faults. Service providers should consider the survival pattern of specific devices when negotiating warranty periods for government programs. The durability of devices does not seem to have changed overall in the last 20 years.

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BIPHASIC INSPIRATORY WAVEFORMS (DOUBLE TRIGGERING) IN NON-INVASIVE VENTILATION IN A SIMULATED LUNG MODEL – CAUSATIVE FACTORS AND SUBSEQUENT EFFECT ON VENTILATION

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Background: Biphasic inspiratory waveforms, otherwise known as double triggering (DT), have been demonstrated to occur in patients receiving non-invasive ventilation. These events cause ventilator dyssynchrony and patient discomfort. Using a simulated lung model our laboratory has previously explored factors causing DT. This study aims to build on this earlier work to identify and explore further variables implicated in the generation of DT.

Methods: The IngMar ASL5000 Lung Model was connected to a physiological upper airway manikin via a Medium ResMed Quattro

Mask. Two devices were tested – The ResMed S9 VPAP STA and a Philips Respironics Omnilab device. A restrictive lung compliance setting of 15 mL/cm H₂O was used in our model. The variables analysed included respiratory rate, respiratory effort, EPAP, pressure support and rise time. The primary outcome measure was percentage of breaths where biphasic ventilatory waveforms (double triggering) was noted. Secondary outcome measures included work of breathing, minute ventilation, degree of overshoot and peak inspiratory flow.

Preliminary Results: Our preliminary results suggest lower rise time, and lower respiratory rate on the ResMed device causes DT. 100% rate of DT was noted at respiratory rate of 15, rise time of 1, pressures of 20/5 cm H₂O and respiratory effort of –15 cm H₂O. These events were eliminated when the rise time was increased to 3. DT was also significantly reduced to 26% when pressure support was reduced to 5 cm H₂O. However, a reduced respiratory effort of 8 cm H₂O at these settings once more resulted in a 100% DT rate.

Intended Outcome and Impact: This study will build on prior research from our laboratory in investigating the factors leading to biphasic inspiratory waveforms in patients with reduced lung compliance, for example in neuromuscular disease. In doing so, it is hoped individual patients can have their settings tailored to ensure maximal NIV tolerance in those who have evidence of DT on treatment studies.

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ANALYSIS OF TREATMENT UPTAKE AND RESPONSE FOR OUTPATIENTS ON LONG-TERM WAITING LISTS WITH SLEEP DISORDERED BREATHING – A TERTIARY HOSPITAL SLEEP LABORATORY EXPERIENCE

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Background: Patients with suspected sleep disordered breathing often wait years for outpatient review in our sleep disorders clinic at a tertiary hospital. The aim of this study is to explore the effect these long waits have on treatment uptake and outcomes for patients with sleep disordered breathing.

Methods: The sleep clinic database has been used to retrospectively analyse the results from 960 patients referred with diagnosed or suspected sleep disordered breathing from 2007 to present. Descriptive statistical analysis has been undertaken on the cohort, including demographics, home location, and whether they had been previously investigated or commenced on therapy externally. Treatment factors will also be reviewed, including treatment modality, compliance data and symptomatic response after 2 months of treatment. These results will be correlated with wait time.

Preliminary Results: The average waiting time from referral to outpatient review (mean \pm SD) was 333 ± 467 days. 59% of patients were male with an average age of 54 ± 16 years. The average Epworth Sleepiness Score at initial review was elevated at 10 ± 6 . 29% of patients referred failed to attend clinic. 29.9% of patients referred had already undergone a diagnostic study at an external laboratory with 15% having undergone a prior treatment study. 6% of patients were already on treatment at time of initial

review (88% of these on CPAP). For those patients that proceeded to a diagnostic study, the average RDI was 29.92 ± 27.20 /h. Ultimately 492 patients proceeded onto CPAP. After 2 months of CPAP, average compliance was 5.58 ± 1.99 hrs.

Intended Outcome and Impact: Due to limited resources, patients have significant delays in accessing the sleep disorders service despite significant OSA that should be managed expeditiously. Many have been diagnosed in the private sector but do not progress to treatment. There are high fail to attend rates which further impact the efficiency of the service.

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RETROSPECTIVE COHORT REVIEW OF PEOPLE WITH NARCOLEPSY TREATED WITH SODIUM OXYBATE: AN AUSTRALIAN EXPERIENCE

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Background: Sodium oxybate (SXB, brand name: Xyrem) has been shown to significantly reduce cataplexy and excessive daytime somnolence in people with narcolepsy and is considered well tolerated. Although SXB is not approved for use in Australia, it is no longer a schedule 9 (prohibited) substance, so is available for use in individuals under the TGA special access scheme. We have had the opportunity to commence SXB in a select group of people with narcolepsy who have either not responded to or had troubling side effects with existing treatments.

Methods: A retrospective chart review of patients from our centre commenced on SXB between April 2015 and April 2016. The aim of this study was to identify patterns of clinical response, common side effects, and practical and logistical issues with usage of SXB in Australia.

Progress to date: Fourteen patients at our centre were commenced on SXB in the 12 months from April 2015. Primary diagnoses were: narcolepsy with cataplexy (narcolepsy type 1, NT1, $n = 6$), narcolepsy without cataplexy (narcolepsy type 2, NT2, $n = 6$), or idiopathic hypersomnia (IH, $n = 2$). The mean daily starting dose was 3 g. The mean daily dose at week 12 was 5.5 g. A crude measure of efficacy was willingness to self-fund treatment beyond 12 weeks of industry-funded trial, at a cost of AUD600 per 90 g bottle. Thirteen of fourteen patients (93%) elected to continue SXB beyond 12 weeks. For those with NT1 and difficult cataplexy symptoms ($n = 6$), the mean number of cataplexy episodes per week reduced from 15.5 to 2. For a subset with paired Epworth Sleepiness Score (ESS), mean ESS reduced from 16 to 10.5. The most common side effects were nausea and anxiety. 1 patient had to be started on anti-emetics and 2 needed adjustment of anxiolytic medications. 1 patient had to discontinue SXB due to lack of efficacy.

Intended outcome and impact: We conclude that SXB is a helpful adjunct treatment for people with narcolepsy and lack of efficacy or intolerable side effects to conventionally available treatments. Its utility is reflected in the ongoing usage of SXB in the majority of people commenced despite its expense. Side effects are generally mild-moderate in nature and readily manageable.

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A QUALITATIVE AUDIT ON A SLEEP MULTIDISCIPLINARY TEAM MEETING AND A NATIONAL SURVEY ON MULTIDISCIPLINARY REFERRAL PRACTICES FOR THE MANAGEMENT OF OBSTRUCTIVE SLEEP APNOEA

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Background: Newcastle Sleep Disorders Service (NSDS) commenced holding sleep multidisciplinary team meetings (MDM) for the management of Obstructive Sleep Apnoea (OSA) in 2012. MDMs have been shown to improve patient outcomes in medical conditions such as breast and lung cancer. Although a multidisciplinary approach is recommended in the management of OSA, there are no guidelines that have addressed how to deliver this with no consensus on multidisciplinary referral practices amongst sleep physicians.

Aims: 1: Audit the meeting proceedings held to date. 2. Evaluate if the meetings are achieving the needs of the participants in managing their patients with OSA. 3. Understand the multidisciplinary referral practices across Australasia.

Results: 1: A total of 82 patients were discussed over 4 years with 42 after surgical interventions and 8 after mandibular advancement splint (MAS) treatment. 37 patients were presented for consideration of surgical or orthodontic intervention, with 19 undergoing evaluation during the meeting with nasendoscopy. 2. A survey of surgical and orthodontic participants of the MDM revealed that all found the meeting valuable and that it had impacted on their practice to improve confidence in appropriate patient selection for procedures. They reported an increased understanding of sleep studies, which has helped to guide selection of appropriate surgical procedures, and an improvement in their understanding of the goals of surgery and their prediction of outcomes. Recommendations for quality improvement included more evidence-based education, a possible research component and the addition of a dietitian. 3. A national survey of sleep physicians found that most feel they would benefit from a sleep MDM with 50% already conducting a similar meeting. Most (88%) referred patients to surgeons for either nasal corrective surgery to improve CPAP adherence or tonsillectomy for large tonsils although more than half of public patients wait longer than 12 months for surgical review. Referral for uvulopalato-pharyngoplasty (UPPP) was low with 58% never referring. Most (92%) have access to an orthodontist for MAS fitting and do not refer for non-custom fitted MAS devices.

Conclusion: A sleep MDM is a useful way to deliver a multidisciplinary approach to OSA management. There is a wide variety of referral practices amongst sleep physicians.

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LINKS BETWEEN SLEEP-DISORDERED BREATHING, NUMERACY PERFORMANCE, AND NEUROBEHAVIOURAL AND COGNITIVE FUNCTIONING OF EIGHT-YEAR-OLD CHILDREN

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Introduction: There is a growing body of research that suggests sleep is important for health and cognitive development in children, and research into sleep and sleep-disordered breathing (SDB) is bringing with it increased recognition that SDB is associated with more than just adverse physical health outcomes. It is also linked with negative developmental progress in cognitive, behavioural, and academic domains. The purpose of this study is to examine the association between SDB, factors related to learning, and numeracy performance in 8-year old children.

Methods: One-hundred and fifty-four children, aged 7.9–8.3 years (recruited at age 3 as part of a larger, longitudinal study of SDB and academic progress) were assessed and assigned an SDB score (possible maximum of 86) combining a parent-reported history of symptom score with a clinical examination score of SDB features. Children completed numeracy tasks assessing addition, and subtraction facts, computation, and application. Parents and teachers completed ratings of cognitive and neurobehavioural correlates of children's learning and academic performance.

Results: A statistically significant negative relationship between the SDB score (median = 13, range = 0 to 48) and the academic domain of numeracy (mean = 58%) was found ($\beta = -0.46$, $P = 0.017$). Given that learning related ratings were statistically significantly predicted by SDB symptoms ($\beta = 0.02$ to 0.30 , $P = 0.041$ to <0.001), and that these ratings also predicted achievement in numeracy ($\beta = -0.66$ to -0.80 , $P = 0.001$ to 0.006), we tested for indirect relations from SDB through learning related factors and found that functional communication problems and learning problems mediated the links between SDB and numeracy performance.

Discussion: These findings in the numeracy domain add to the evidence base linking SDB to poorer neurobehavioural, cognitive functioning, and academic performance in school-aged children. The results indicate a need to include screening for sleep difficulties in children when exploring barriers to their learning and behavioural progress, with further recommendations for assessment and possible intervention as appropriate.

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THE RELATIONSHIP BETWEEN SLEEP APNOEA SEVERITY AND WORKING MEMORY DEFICITS IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT AND OBSTRUCTIVE SLEEP APNOEA

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Introduction: Studies have reported poorer working memory in patients with moderate-to-severe obstructive sleep apnoea (OSA). While mild cognitive impairment (MCI) has generally been associated with impairment in episodic memory, studies have also reported working memory deficits in MCI patients. Since OSA is a suggested risk factor for MCI and dementia, investigating the relationships between objective sleep measures and cognitive performance in patients with comorbid OSA and MCI may help to identify the specific cognitive domains that could benefit from treating OSA. The aim of this study was to examine if OSA severity is associated with digit span performance in patients with OSA and comorbid MCI.

Methods: To date, 10 participants with OSA and MCI (mean age 65.7 ± 9.1 years, 2 female) have completed an overnight sleep study and a 90-min neuropsychological test battery. After an in-lab or at-home night of polysomnography, participants completed the WAIS-IV Digit Span (forward, backwards and sequencing) subtest on the following morning.

Results: A significant negative correlation was found between the Apnoea-Hypopnoea Index (AHI) and the digit span backward score ($\rho = -0.65$, $P = 0.042$). No significant correlations were found for digit span forward ($P = 0.43$) or sequencing ($P = 0.35$) performance. Higher oxygen desaturation index (ODI) values were significantly associated with lower digit span backward scores ($\geq 3\%$ $\rho = -0.74$, $P = 0.015$; $\geq 4\%$ $\rho = -0.72$, $P = 0.020$), whereas no significant correlation was observed between the digit span backward score and arousal index ($\rho = -0.57$, $P = 0.876$).

Conclusion: While more data are needed to confirm these results, the present findings suggest that there is an effect of OSA severity, as measured by the AHI and ODI, on working memory in patients with OSA and MCI. Furthermore, the findings indicate that measures of hypoxia, but not sleep fragmentation, are associated with working memory deficits in these individuals. It remains to be determined whether treatment of OSA improves working memory in patients with MCI.

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THE EFFECT OF AN ENRICHED ENVIRONMENT LIFESTYLE INTERVENTION ON SLEEP AND MEMORY IN OLDER ADULTS WITH MEMORY COMPLAINTS: PRELIMINARY FINDINGS

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Increasing mental stimulation, physical activity, and social engagement have been shown to improve both sleep and memory. This study aims to investigate whether an "enriched environment", which

combines mental, physical, and social activities, would improve sleep and memory outcomes in older adults at risk of developing dementia.

Older adults aged 60–80 with subjective memory complaints were recruited from the community. Participants had no current psychiatric diagnoses, no diagnosed memory disorders or sleep disorders, and had an AHI < 15.

Participants underwent at-home sleep monitoring with sleep diary and actigraphy for a minimum of one week, prior to being admitted to the sleep laboratory for a two-night stay. Sleep was monitored with PSG and participants underwent extensive cognitive testing. Participants were then randomised into the enriched environment intervention or control group.

The enriched environment involved participants completing three weekly activities: 1 cognitive, 1 creative, and 1 physical activity, for 8–10 weeks. All activities were community-based group activities. The control group was asked to continue their pre-existing lifestyle, and not enrol in any new activities during that time.

Following the intervention, subjective memory complaints and geriatric depression scores were improved compared to baseline, with no change in the control group.

Habitual sleep timing and quality measured using sleep diaries and actigraphy was not altered in either group, and there was no change in subjective reports of daytime sleepiness.

Preliminary analysis suggests that an enriched environment alleviates depressive symptoms and subjective memory complaints, without altering subjective reports of sleep. While actigraphically defined sleep was also not improved, further investigation using polysomnography and measures of circadian timing are required.

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ACTIGRAPHIC AND POLYSOMNOGRAPHIC SLEEP DISRUPTION IN OLDER ADULTS WITH AMNESTIC MILD COGNITIVE IMPAIRMENT

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Sleep disturbance has long been understood to be a feature of Alzheimer's disease (AD), and is increasingly being recognised as a potential early marker or risk factor for emerging AD. Recent studies have demonstrated some alterations to sleep-wake characteristics in people with amnesic mild cognitive impairment (aMCI), the pre-clinical stage of AD. However, findings have been inconsistent across studies. A further issue is that the majority of studies have been laboratory-based. Given prominent memory deficits, people with aMCI may be more prone to sleep disturbances when sleep measurement is undertaken in a foreign environment (i.e., a laboratory). Currently, there is a lack of comprehensive assessment of sleep undertaken in naturalistic environments, in terms of the gross sleep disturbance/movement level and sleep architecture/EEG. The aims of the current study, therefore, were to determine whether sleep wake-disturbances in aMCI persisted when measured in naturalistic, home-based settings, and assess the relationship between sleep and memory.

Methods: Twelve participants with aMCI (77.17 ± 5.72 years), and 17 healthy older adult controls (75.00 ± 5.75 years), equivalent in age and education, wore an actigraphic sleep monitor for two weeks,

then completed two non-consecutive nights of in-home polysomnography (9 aMCIs, 12 controls). Neuropsychological evaluation was conducted.

Results: Participants with aMCI had significantly greater actigraphic wake after sleep onset (54.27 vs. 49.86 min, $P = 0.039$) and sleep fragmentation [Actiware 6, Phillips Respironics, 2013] (40.56 vs. 30.01, $P = 0.01$), and they spent longer in bed than controls (8:46 vs. 8:10 hrs: mins, $P = 0.046$), but the groups did not differ on other actigraphic variables. Preliminary analyses on polysomnographic parameters indicated aMCIs had less slow-wave sleep (28.94 vs. 46.58 mins, $d' = 0.63$), but greater rapid eye movement (68.06 vs. 57.67 %, $d' = 71$) than controls. Although effect sizes were medium to large, group differences were not statistically different, likely as a result of small sample size.

Discussion: These preliminary data demonstrate that actigraphic and EEG sleep changes in aMCI are present during assessment of sleep in naturalistic settings, and highlight sleep disturbance as an important factor in the preclinical stages of AD.

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THE USE OF ACTIGRAPHY TO ASSESS SLEEP PATTERNS IN VIETNAM VETERANS WITH AND WITHOUT POST TRAUMATIC STRESS DISORDER

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Background: For many Vietnam veterans, post-traumatic stress disorder (PTSD) is a major health issue associated with significant morbidity and mortality. Up to 87% of PTSD patients have reported sleep disturbances. Untreated sleep issues may exacerbate their underlying psychiatric condition and adversely affect their health. This study aims to use the non-invasive tools of actigraphy, sleep diaries and a sleep history questionnaire in Vietnam veterans to assess the prevalence and severity of sleep pattern disturbances in those with PTSD compared to those without PTSD. The actigraphy data will also be compared to participant's sleep diaries to assess for sleep perception discrepancies and to assess for correlations with underlying PTSD severity.

Methods: 40 participants were recruited from a large cross sectional cohort study of male Vietnam veterans and included 20 with PTSD of varying severity and 20 controls. Participants wore an accelerometer (ActiGraph GT3X+) on their non-dominant wrist for 2 weeks while completing a daily sleep diary. Participants completed a self-report comprehensive structured clinical sleep history questionnaire. Actigraphy data downloaded will be correlated with sleep diary information to determine sleep variables including total sleep time, wake after sleep onset and sleep fragmentation index. These parameters will be analysed to compare participants with and without PTSD in terms of sleep duration, circadian rhythm patterns and overall sleep patterns. Differences between actigraphy data and patient perception will be determined and actigraphy data will be correlated with PTSD symptom severity.

Progress to date: 28 participants have completed the study, 7 are underway and 5 are still to be recruited. Data collection will be completed mid-July.

Intended outcome and impact: This study will investigate the utility of actigraphy as a tool to objectively assess sleep patterns in veterans. An increased prevalence of sleep issues in veterans with

PTSD should lead to increased awareness and education to diagnose and treat these conditions early. Knowledge gained can then be applied to contemporary soldiers, and screening pre- and post-combat may enable early identification and treatment of these sleep disturbances and improve the health and quality of life of such patients.

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GENETIC CORRELATION ANALYSIS SUGGESTS ASSOCIATION BETWEEN INCREASED SELF-REPORTED SLEEP DURATION IN ADULTS AND SCHIZOPHRENIA AND TYPE-2 DIABETES

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Introduction: We sought to examine how much of the heritability of self-report sleep duration is tagged by common genetic variation in populations of European ancestry and to test if the common variants contributing to sleep duration are also associated with other diseases and traits.

Methods: We made use of the results from the CHARGE consortium genome-wide association study of self-report sleep duration. An analytical technique called Linkage Disequilibrium Score (LD-score) regression was applied to the results to estimate the proportion of the heritability that was tagged by genetic variants with a minor allele frequency of 0.05. We also used bivariate LD-score regression to investigate the genetic correlation of sleep duration with other publically available GWAS datasets from a range of quantitative traits and diseases.

Results: In addition to the genome-wide significant loci for sleep duration, we found that 6% of the variation is explained by common genetic variants throughout the genome in European populations. Furthermore, we find evidence of a positive genetic correlation (r_G) between sleep duration and schizophrenia ($r_G = 0.19$, $P = 0.01$) and between sleep duration and type 2 diabetes ($r_G = 0.26$, $P = 0.02$).

Discussion: Our results show that the heritability tagged by common variants for sleep duration is small when compared to other traits and diseases. These results also suggest that those who carry variants that increase risk to type 2 diabetes and schizophrenia are more likely to report longer sleep duration. A number of studies have shown that self-reported sleep quality is poorer in schizophrenia cases than in controls. Less focus has been placed on sleep duration specifically, but there is some evidence that patients with schizophrenia have longer time in bed. Epidemiological studies suggest a U-shaped relationship between sleep duration and type 2 diabetes. These results suggest that the genetic variants that predispose to type 2 diabetes also predispose to longer sleep duration. Therefore, there may be environmental factors that lead to short sleep duration and risk of developing diabetes. Genetic variants associated with diabetes and schizophrenia should be investigated further for their potential role in sleep regulation.

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DOES CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) TREATMENT FOR OBSTRUCTIVE SLEEP APNOEA IMPROVE MOOD IN PATIENTS WITH COMORBID DEPRESSION?

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Objectives: Obstructive sleep apnoea (OSA) and depression are highly prevalent and comorbid conditions. While there is some evidence that CPAP improves depressive symptoms in unselected patients, there is limited data regarding the effectiveness of CPAP therapy for OSA patients with major depressive disorder (MDD). This study aimed to determine whether CPAP improves clinical outcomes in patients with OSA and MDD.

Methods: $n = 60$ participants were recruited from patients attending a sleep laboratory clinic for treatment of OSA. Participants were randomised to one of 3 groups: treatment as usual (TAU; $n = 19$), intensive CPAP program (CPAP; $n = 21$) or a wait-list ($n = 20$). Participants in the TAU and CPAP groups were treated with CPAP for 4 months. Participants completed the Center for Epidemiological Studies-Depression (CES-D) scale and the Epworth Sleepiness Scale (ESS) at baseline, and 1 and 2 months. A Structured Clinical Interview for Depression (SCID) was conducted at baseline and 4 months. One-way ANOVAs were conducted to compare CES-D and ESS scores between groups. Paired samples t-test were used to compare scores from baseline to 2 months within groups. Descriptive analyses examined the proportions of MDD cases at baseline and after 4 months of CPAP.

Results: There was no difference between groups on the CES-D or ESS at baseline. Significant difference in ESS scores ($P = 0.013$), and a trend-level difference in CES-D scores ($P = 0.056$), between groups at 2 months was found, with the CPAP group reporting less sleepiness than WL group. At 2 months, there was a significant reduction in ESS ($P = 0.03$) and CES-D ($P = 0.002$) in the TAU group. For the CPAP group, there was a significant reduction in ESS ($P = 0.012$) and a trend for CES-D ($P = 0.066$). There was no change in the WL group. 13 of 52 participants (25%) who were assessed with the SCID at baseline had current MDD, and 20 of 56 participants (35.7%) had a past MDD episode. Of the 20 participants who have completed the SCID at baseline and 4 months, 7 (35%) had MDD at baseline, and only 1 (5%) of these had MDD at 4 months.

Conclusion: MDD is prevalent in this sample of untreated OSA patients. This study suggests that CPAP significantly improves daytime sleepiness and depressive symptoms, and may reduce the incidence of clinical depression in this population.

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MEDITATION CAN REDUCE SLEEPINESS AND IMPROVE ATTENTION FOLLOWING ACUTE SLEEP RESTRICTION

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Introduction: Optimal information processing requires efficient engagement of neural processes. Sleep loss increases homeostatic sleep pressure thereby reducing neural efficiency and consequently

diminishing attention capacity. Meditation techniques engage attention processes and mobilise neural resources needed to sustain control of these processes, suggesting meditation may act as an effective alternative strategy in counteracting attention deficits associated with sleep loss.

Methods: After a 3-week meditation training period, 12 adult participants completed tests of sustained attention and interference control, and reported sleepiness and fatigue before and after a 5-h restricted sleep period, and then again after meditation or control task following a cross-over design.

Results: Sustained attention, sleepiness and fatigue, but not interference control, were impaired following a single night of sleep restriction (all $P < 0.05$). Following meditation, sustained attention performance improved ($P < 0.001$) and sleepiness decreased ($P < 0.05$) to baseline levels. Deficits remained following the control task.

Conclusion: These findings provide preliminary evidence that meditation can improve attention deficits and reduce subjective sleepiness following sleep loss. A brief period of meditation training appears to be sufficient to elicit meditation benefits for attention following sleep loss. However, the duration of improvement following a session of meditation practice remains unknown.

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REPRESENTATIONS OF THE EXPERIENCE OF NIGHT AND SLEEP IN LITERATURE AND THE ARTS: A QUALITATIVE ANALYSIS

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Qualitative analysis – the identification of categories and sub-categories and their organization into themes – was conducted on about 400 items of prose and verse which focused on issues of sleep, mainly from English and American works of literature, but also from works in translation from French, Spanish, Russian and Chinese. Keywords were used to describe the quotations, and these were entered into a small database. Sub-categories of items which shared keywords were identified, which were then organized into categories. The categories were then organized into four major themes:

- 1) experience of the night.
- 2) sleep disorder.
- 3) disturbance of sleep.
- 4) ideas about sleep and the night.

This presentation will focus on the first theme – ‘experience’. Three major categories comprise this theme – dreams, habits, and children’s sleep and lullabies

Within the first, there are hypnagogic and hypnapompic experiences, revelatory dreams, whether drug-induced or communications from deities, nightmares, explanations for the provenance of dreaming, including wish-fulfillment, and pre-Freudian accounts, such as Clarence’s dream in Richard III.

Within the second, there are many humorous accounts of sleep habits, including notions of ‘owls and larks’.

The third category, on children’s sleep and lullabies, includes accounts of children keeping their parents awake, as well as lullabies, both for children and adults.

Examples will be given from all these categories, and there will be illustrations from works of art – for instance

Dante’s Dream, Rosetti.

Jacob’s Dream, William Blake.

Constantine's Dream, Piero della Francesco.
Dream of St Ursula, Capaccio.
The Nun's Dream, Bruilov.
Queen Katherine's Dream, Fuseli.
 Among others.

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COMMITMENT LANGUAGE DOES NOT PREDICT THERAPY COMPLIANCE IN ADOLESCENTS WITH DELAYED SLEEP-WAKE PHASE DISORDER

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Introduction: Recent evidence indicates that motivation to change sleep-wake patterns in adolescents with Delayed Sleep-Wake Phase Disorder (DSWPD) is low. Our aim was to evaluate components of adolescents' motivation, and subsequent changes in behaviour.

Methods: 31 adolescents diagnosed with DSWPD (age: 15.87 ± 2.3 , 32.3%*m*) underwent 3 individual behavioural therapy sessions involving morning bright light therapy to phase advance sleep patterns. Adolescents wore portable light glasses each morning and were instructed to advance wake-up times by 30-mins daily. Motivation ratings (0 = low–10 = high) of desire, ability, need and commitment to change sleep patterns were taken at baseline. Sleep diaries were used during therapy, with sequentially earlier wake-up times in 30-min intervals indicating behavioural compliance.

Results: Following therapy, clients' sleep-onset times were significantly advanced, total sleep time increased and sleep latency decreased. Adolescents attended all 3 sessions, with only 2 dropping out. Adolescents indicated strong desire ($M = 9.1 \pm 1.6$) and need ($M = 8.2 \pm 1.3$), yet moderate ability ($M = 6.82 \pm 1.31$) to advance sleep-wake patterns. Verbal commitment to therapy was associated with ability ($r = 0.77$, $P < 0.001$) and need ($r = 0.40$, $P = 0.02$), but not desire ($r = 0.28$, *n.s.*). While therapy lasted 10–21 days ($M = 18.3 \pm 3.0$), clients complied between 4–17 days ($M = 11.1 \pm 3.5$). Compliance percentage ranged 31.6%–83.3% with a mean of 60.7% compliance. Adolescents' desire to change was positively correlated with compliance ($r = 0.34$, $P = 0.08$), but their ability, need, and their commitment language did not predict compliance ($r = 0.08$, *n.s.*).

Discussion: Our findings do not support commitment language predicting behaviour change in DSWPD. Instead, clinicians should focus on adolescents' ratings of desire to change when undertaking chronobiologic treatments.

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THE ACCURACY OF TCCO₂ MONITORING COMPARED WITH PCO₂ AND THE FREQUENCY OF PAIRING THESE MEASUREMENTS IN POLYSOMNOGRAPHY PERFORMED IN A TERTIARY HOSPITAL

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Introduction: Transcutaneous carbon dioxide (TcCO₂) monitoring is an important tool in the evaluation of hypoventilation syndromes and their treatment with Non-Invasive Ventilation (NIV). In Queensland public hospital sector these measures are also used to assess patient eligible for NIV devices. The ability to perform paired arterial carbon dioxide (pCO₂) measurements assists in determining the validity of the TcCO₂ measurement trends. Pairing of the pCO₂ and

TcCO₂ measurements is determined by the availability and proficiency of junior on call medical staff. This audit looked at the accuracy and correlation of the TcCO₂ measurement compared with pCO₂ in the clinical setting and how often measurements could be paired with pCO₂ samples.

Methods: All patients undergoing TcCO₂ monitoring with requested paired pre and/or post Arterial Blood gases (ABG) over an 18 month period were included. TcCO₂ readings from Radiometer TCM4 monitors were recorded 2–3 min after the pCO₂ were performed. Correlation and agreement was assessed using the correlation coefficient and visually with a Bland Altman plot respectively. The frequency of paired measurements is expressed as a percentage of number of paired measurements performed successfully to the number of paired measurements requested.

Results: pCO₂ vs. TcCO₂ correlation was $r = 0.94$. Agreement using the Bland Altman showed a mean difference of -1.1 mmHg with an upper limit of 5.5 mmHg and a lower limit of -7.7 mmHg. 75 (50%) paired TcCO₂/pCO₂ measurements were performed out of a possible 150 requested.

Conclusions: There is good correlation between pCO₂ and TcCO₂ with $r = 0.94$. Agreement using the Bland Altman showed an error of ± 6.6 mmHg. One of the requirements for NIV equipment access in Qld relates to CO₂ time above 55 mmHg. Therefore as a standalone measurement TcCO₂ does have limitations. This highlights the importance of pairing the TcCO₂ and pCO₂. Due to the availability of medical staff obtaining ABGs during polysomnography can be difficult as demonstrated by the paired frequency of (50%). One solution would be to train overnight Nursing/Allied health staff in this procedure. Despite recognised limitations, TcCO₂ provides continuous monitoring and is an invaluable tool in the evaluation of hypoventilation and titration of NIV investigations.

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IS A SINGLE-ITEM NUMERIC RATING SCALE VALID FOR PATIENT SELF-REPORT OF THEIR PREVIOUS NIGHT'S SLEEP?

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Introduction: While attended overnight polysomnography (PSG) is the gold standard for objective sleep assessment, patient self-report measures can play a useful complementary role. Allocating a numeric value to the patient's previous night's sleep quality could contribute to more objective clinician assessment. Two subjective tools were examined for association with PSG variables: the 5-item Richards-Campbell Sleep Questionnaire (RCSQ) and a single item numeric rating scale (NRS). The RCSQ was originally developed for patients to report on their previous night's sleep in the critical care environment. The scale takes between 2 to 5 min to complete, with each item set to a horizontal 0–100 mm visual analogue scale (VAS). Responses are scored by measuring the millimetres from the left end of the scale to the respondent's mark. Item values are summated and divided by five providing a mean score, otherwise known as a global score, reflecting the patient's perception of their sleep. The night's sleep quality can be assessed by quartiles, for example, with very poor sleep rated 0–25 or very good sleep scoring 76–100. The NRS is scaled from 0–10 with 0 = 'worst possible sleep' and 10 = 'best possible sleep'. Answers to the following questions were sought. Does the RCSQ meet reliability requirements? Does the RCSQ demonstrate convergent construct validity with PSG? Does a single-

item NRS demonstrate construct validity in assessing sleep quality? What is the level of concordance between the RCSQ and NRS?

Method: Participating patients completed the RCSQ and NRS on waking from PSG. The PSG variables of interest were sleep onset latency (SOL); wakefulness after sleep onset (WASO); sleep stages N1, N2, N3, REM; total sleep time (TST); cortical arousals per hour of sleep time (AI) and sleep efficiency (SEf). Gender-split correlations were also examined.

Results: Seventy-four predominantly middle-aged patients participated: 47 males and 27 females. The RCSQ showed excellent internal consistency, Cronbach's $\alpha = 0.90$. Significant relationships were noted between individual RCSQ items and PSG variables affirming content validity. In the all-group analysis, the RCSQ global score correlated very significantly with SEf, $r = 0.54$ and TST, $r = 0.38$. There was also a very significant inverse correlation with WASO, $r = -0.52$. The NRS also showed significant relationships as correlated with the PSG variables, SEf, $r = 0.45$; TST, $r = 0.36$; WASO, $r = -0.46$. Some differences were noted with regard to gender. There was excellent intra-class correlation between the RCSQ global score and NRS using an absolute agreement definition ($r = 0.93$; $P = <0.001$; 95% CI = 0.89-0.95).

Conclusion: This study aimed to distil patients' self-report of their previous night's sleep quality into a more objective numeric response. The RCSQ VAS and a single-item sleep quality NRS were evaluated with PSG variables. Statistically significant moderately strong correlations were found between individual PSG variables and the scales. The RCSQ is a reliable, valid tool for subjective sleep assessment. A strong intra-class correlation exists between the RCSQ and the NRS. Implementation of a simple numeric subjective sleep outcome measure like the NRS has the potential to enhance the quality of investigation reporting and clinical practice.

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EVALUATING SENSITIVITY OF LITERACY AND NUMERACY MEASURES TO ASSESS EFFECTS OF SDB TREATMENT IN CHILDREN

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Background: SDB in children is associated with a wide range of effects on behavioural and cognitive functioning, which in turn creates an increased risk of poor school performance. Treatment of SDB can result in improvements in daytime functioning, but whether these positive effects extend to school performance is relatively unexplored. Past research has used standardised measures of academic achievement, which are not always sensitive to treatment effects. The current research employs literacy and numeracy indicators that have successfully demonstrated treatment effects for other types of interventions.

Methods: Nineteen children aged between three and eleven years undergoing adenotonsillectomy and 19 matched controls were assessed using measures of literacy and numeracy designed to be sensitive to growth. Control children were matched on age, gender and achievement level. Assessment took place prior to surgery, three months after surgery, and again seven months after surgery.

Results: Before surgery, case children had poorer daytime functioning than matched controls, including in school performance as measured by the numeracy and literacy indicators ($P = 0.024$).

Preschool children who underwent surgery had a steeper trajectory of growth in literacy tasks compared to matched controls ($P = 0.008$), but not in numeracy tasks ($P = 0.866$). Conversely, in school age children, there did not appear to be a difference in academic growth between case and control children when considering literacy tasks ($P = 0.472$), but a trend for case participants to grow more quickly than controls in numeracy tasks approached significance ($P = 0.066$). Standardised tests of achievement did not indicate differences between cases and controls, either at the beginning of the study or after surgery.

Discussion: The literacy and numeracy indicators used in this exploratory case-control series appear to be more sensitive to treatment effects than typically used measures of academic achievement. This research suggests that treatment of SDB may improve academic outcomes, with differential effects for older and younger children.

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OBSTRUCTIVE SLEEP APNOEA AND SUBJECTIVE AND OBJECTIVE MEASURES OF NASAL OBSTRUCTION – WHAT IS THE RELATIONSHIP?

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Introduction: The purpose of this study was to investigate whether objective and subjective measures of nasal obstruction in patients with obstructive sleep apnoea (OSA) were higher than available historical controls.

Method: Adult patients were recruited for the study over a four month period. All patients presenting to the practice of the senior author with sleep, sinus or nasal symptoms underwent objective and subjective assessment of nasal obstruction. The objective measure was the average of the right and left sided logarithmic effective resistance (LER), as measured by active, anterior, four phase rhinomanometry. The subjective measure was a visual analogue scale (VAS), rating nasal blockage from 1 to 10. The diagnosis and severity of OSA was based on the apnoea-hypopnoea index (AHI) from polysomnography. Results of LER were compared to the largest available historical controls, based on rhinomanometry performed on over 2000 subjects.

Results: Of the eighty adult patients who presented to the practice with sleep, sinus or nasal symptoms, twenty seven patients (33.8%) had a diagnosis of OSA ($AHI > 5$). The median objective measure of nasal obstruction (LER) was 0.80, (range 0.23 to 2.01). The median subjective measure of nasal obstruction (VAS) was 4 (range 1 to 9). Patients with mild OSA ($AHI < 15$) had a median objective measure (LER) of 0.80 and subjective measure (VAS) of 4. Similar results were obtained for patients with severe OSA ($AHI > 30$), with a median objective measure (LER) of 0.705 and a median subjective measure (VAS) of 4. There was no significant difference in LER ($P = 0.269$ based on exact significance level, Mann-Whitney U test) and VAS ($P = 0.284$) between the mild and severe groups. The median LER for the largest available historical control was 1.125.

Discussion: Four phase rhinomanometry appears to be more accurate than traditional rhinomanometry techniques. There is little available data on the use of four phase rhinomanometry in OSA patients, who commonly complain of nasal obstruction. The results of this study suggest that daytime subjective and objective measures of nasal obstruction in OSA patients do not differ from historical

controls. Moreover, more severe OSA is not associated with greater scores of nasal obstruction.

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PREVALENCE OF POSITIONAL OSA ACCORDING TO THE AMSTERDAM POSITIONAL OSA CLASSIFICATION IS DEPENDENT UPON HYPOPNEA CRITERIA

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Purpose: The Amsterdam Positional OSA Classification (APOC) system was recently developed to help clinicians identify Obstructive Sleep Apnea (OSA) patients who may benefit from positional therapy. The APOC system categorises patients into 3 groups based on their Apnea-Hypopnea Index (AHI) in the supine and non-supine positions. The AHI however is heavily influenced by the hypopnea criteria used. This study examined the effect of hypopnea criteria on the prevalence of positional obstructive sleep apnea identified under the Amsterdam Positional OSA Classification (APOC) system.

Methods: 303 consecutive patients undertaking polysomnography (PSG) for the suspicion of OSA were included in this retrospective investigation. PSGs were scored using both the 2007 American Academy of Sleep Medicine (AASM) recommended respiratory event criteria (AASM_{2007Rec}) and the 2012 AASM recommended respiratory event criteria (AASM_{2012Rec}). For each respiratory event criteria OSA patients were grouped according to the APOC categories (I, II or III) or else deemed non-APOC if they did not meet the APOC criteria.

Results: The AASM_{2012Rec} increased the prevalence of OSA compared to AASM_{2007Rec}. OSA patients according to AASM_{2007Rec} were more obese and had more fragmented sleep. The AASM_{2012Rec} trebled the number of APOC I patients compared to AASM_{2007Rec} (297% increase) as well as increased the proportion of females in the APOC I group. AASM_{2012Rec} did not change the number of APOC II and APOC III patients. In fact the same patients were present in the APOC II and III categories irrespective of respiratory event criteria. The proportion of non-APOC patients proportionally decreased with the AASM_{2012Rec} criteria.

Conclusions: This study demonstrates that, compared to AASM_{2007Rec}, AASM_{2012Rec} increases the prevalence of who could be successfully treated with positional therapy. The proportion of females with pOSA also increases as a consequence of AASM_{2012Rec}. The authors acknowledge financial support by the Emil Aaltonen and Tampere Tuberculosis Foundations (AK).

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CHARACTERISING SLEEPING POSTURE BY MEASURING TORSO ROTATION AS A CONTINUOUS VARIABLE

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Introduction: Sleeping posture has a significant impact on the presence and severity of obstructive sleep apnoea (OSA), and body

posture modification can be an effective primary or complementary therapy in some people. The majority of polysomnography (PSG) systems categorise posture as supine, left-lateral, right-lateral and prone positions, each with a 90-degree range. Such broad categorisation limits the capacity to identify more subtle relationships between torso posture and OSA severity. In this study, we aimed to characterise sleeping posture by measuring torso rotation as a continuous variable.

Methods: We developed a customised position sensor which uses a tri-axial accelerometer to quantify torso posture as a continuous variable in degrees of rotation from a reference supine position. The position sensor was securely taped to the sternum of participants undergoing diagnostic laboratory-based PSG. Posture data was analysed to determine the percentage of time that each participant slept within reasonable bounds (± 15 degrees) of the standard anatomical positions (supine: 0 ± 15 degrees; left lateral: -90 ± 15 degrees; right lateral: 90 ± 15 degrees, prone: 180 ± 15 degrees). Time spent in positions outside of these ranges was also determined.

Results: Fifteen participants (4 male) with a mean age of 55.5 years (range 28–73), and a mean apnoea-hypopnoea index of 38.2 events/h (range: 10–90.1) were recruited. There was large inter-subject variability in the distribution of sleeping posture(s). The mean percentage of total sleep time spent within ± 15 degrees of supine, left-lateral, right-lateral, and prone was $17.0 \pm 15.8\%$, $5.6 \pm 11.2\%$, $6.5 \pm 8.5\%$ and $16.7 \pm 24.0\%$ respectively. Importantly, $54.3 \pm 11.1\%$ of total sleep time was spent in intermediate positions outside the bounds of these standard anatomical positions.

Discussion: Patients with suspected sleep apnoea spend a significant proportion of their sleep time in intermediary positions outside of the standard lateral, supine and prone sleeping positions. Standard clinical sensors lack the sensitivity to identify these intermediary positions which may have clinical significance. Quantification of posture using a continuous measure of torso rotation may enable identification of more subtle relationships between body posture OSA severity.

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THE UTILITY OF SLEEP STUDIES IN CHILDREN WITH SNORING- PERSPECTIVE OF ENT SURGEONS

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Background: Adenotonsillectomy (T&A) is first line therapy for children with obstructive sleep apnoea. The vast majority of children with snoring and symptoms of airway obstruction during sleep present in the first instance to ear, nose and throat (ENT) surgeons. More than 90% of children undergoing T&A have had no sleep testing prior to surgery. Given that history and examination findings are poor predictors of the presence or severity of OSA, we aimed to understand what ENT surgeons see as the role of sleep testing prior to T&A.

Methods: ENT surgeons who perform tonsillectomy in children were asked to complete an anonymous on-line questionnaire via three separate approaches: attendees at a seminar on sleep testing at the

Australasian Otolaryngology Head and Neck Surgery conference in March 2016; via an email request to members of the Australia and New Zealand Society of Paediatric Otolaryngology distributed by the President of that group, and; via an email request to ENT surgeons working for a single tertiary institution.

Results: Given unlimited access, polysomnography (PSG) was felt to be helpful by 99% of respondents, in the following circumstances: 26% in any circumstance, 56% only in clinically ambiguous cases and 34% in medically complicated cases. In their current practice, 5% never referred for PSG, 64% referred <10% of children, 16% referred 10–25%, 7.5% referred 25–50% and 7.5% referred >50%. The reasons for referral were: to determine severity of OSA (59%), if the child was <2 year (44%), parent unwilling to have surgery (58%), planning complex surgery (30%) and surgical planning e.g. site, urgency (34%). Reasons for not referring for testing were: clinical assessment is sufficient (65%), testing does not predict treatment success (12.5%) and testing would not affect surgical planning (22.5%). The main barriers to referral for PSG were waiting time (82.5%), cost (56%), not available locally (41%) and unpleasant for the child/parent (35%).

Conclusion: ENT surgeons surveyed generally felt PSG to be helpful in a sub-set of snoring children only. The main reason not to refer was a belief that testing is not needed in uncomplicated cases. Access to testing is the main barrier to referral.

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DENTOFACIAL MORPHOLOGY IN CHILDREN WITH AND WITHOUT SLEEP DISORDERED BREATHING

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Introduction: Habitual snoring is the hallmark of paediatric obstructive sleep disordered breathing (SDB). The first line of treatment is adenotonsillectomy but residual SDB can persist in 21–72% of those affected. This may be associated with dentofacial features.

Objectives: To identify if dentofacial morphological differences can be found in children with and without sleep disordered breathing (SDB).

Study design: Cross-sectional case-cohort pilot study.

Methods: Children with habitual snoring (>3 times per week) who were referred by their primary physician for the evaluation of SDB to the Otolaryngology Clinic at the Women's and Children's Hospital in Adelaide were recruited as participants if they were scheduled for adenotonsillectomy secondary to adenotonsillar hypertrophy ($n = 10$). The control group ($n = 9$) comprised of healthy non-snoring children recruited from the community and through friends of the children with SDB. Baseline overnight polysomnography (PSG) was performed on all children to stratify SDB severity based on the obstructive apnoea/hypopnea index (OAHI). Standardised frontal and profile photographs and alginate impressions were taken of all children on the same night or up to 15 months later. Linear and angular facial dimensions were measured from the photographs using ImageJ software. Alginate impressions were poured in plaster and digitised. Dental arch dimensions, maxillary arch forms, crossbites and types of malocclusions were recorded using OrthoInsight3D. Three-dimensional palatal vault analysis was measured using SpaceClaim.

Results: Statistical analysis is to be completed. There were 2 females and 8 males (age 8–17) in the SDB group and 2 females and

7 males (age 7–14) in the control group. The cohort consisted of children with mild SDB ($1 < \text{OAHI} < 5$) ($n = 5$) who were being compared with primary snorers ($\text{OAHI} < 1$) ($n = 5$) and healthy controls ($n = 9$). Seven SDB children compared with 1 control were obese with a BMI-z > 95th percentile. Absolute measurements were normalised against Caucasian norms and ratio values are being used where possible to control for differences in age.

Conclusion: The results of this preliminary work will be combined with follow up study of the same cohort to demonstrate if dentofacial morphology is a factor for residual SDB after adenotonsillectomy in children.

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PREDICTING OSA SEVERITY FROM 3-DIMENSIONAL CRANIOFACIAL PHOTOGRAPHY

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Background: The capacity to rapidly identify the presence and severity of obstructive sleep apnoea (OSA) is desirable. As an alternative to polysomnography (PSG) two-dimensional facial photography is quick and has shown promising results. However, the ability of more sophisticated three-dimensional (3D) capture systems, which have the capacity to quantify both Euclidean (linear distance) and geodesic (surface level) facial measurements, for predicting OSA severity is yet to be examined.

Aim: To use Euclidean and geodesic measurements between anatomical landmarks from 3D facial photographs to examine: i) craniofacial features of individuals with and without OSA and; ii) the capacity of craniofacial measurements to predict the severity of OSA.

Methods: Ninety-nine participants underwent diagnostic PSG and facial photography (3dMD; Atlanta, US). OSA severity (apnoea hypopnoea index; AHI) was determined from PSG. Unpaired t-tests were used to identify differences in Euclidean and geodesic craniofacial measurements between OSA ($\text{AHI} \geq 10$ events/h, $n = 66$) and non-OSA ($\text{AHI} < 10$ events/h, $n = 33$) groups. Univariate regression identified the strongest relationships ($P < 0.1$) for Euclidean and geodesic craniofacial measurements and AHI which were entered into separate multiple regression models to predict OSA severity. The Euclidean and geodesic models were compared using Akaike Information Criterion scores (AICc).

Results: Euclidean and geodesic measurements of facial depth, facial height, mandible width, intercanthal width and neck width were significantly greater in the OSA group than the non-OSA group ($P < 0.05$). The sternomental distance was the only measurement (Euclidean and geodesic) which was smaller in those with OSA than without. The model comprising geodesic facial measurements ($r^2 = 0.35$, $P < 0.001$, $\text{AICc} = -26.35$) was more effective than the model comprising Euclidean facial measurements ($r^2 = 0.21$, $P < 0.001$, $\text{AICc} = -11.43$) in predicting OSA severity.

Conclusion: Geodesic facial measurements, unique to 3D photography, predict OSA severity better than Euclidean measurements. Geodesic measurements may be more representative of the

underlying skeletal and soft tissue facial structures that contribute to the pathogenesis of OSA than Euclidean facial measurements.

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EXTENDED CPAP THERAPY MONITORING WITH CPAP NAÏVE PRIVATE PATIENTS OVER 18 MONTHS

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Introduction: CPAP is the first-line treatment in Obstructive Sleep Apnoea (OSA). Long-term studies for CPAP compliance (greater than 6 months) are lacking in the literature. Non-compliance (<4 h per night NC) or ceasing CPAP has been associated with reduced quality of life and greater prevalence of cardiovascular events and dementia.

Objective: To examine CPAP compliance (>4 h/day) at 1, 6, 12 & 18 months.

Method: 650 consecutive patients were started on a 6 week CPAP trial, and then purchased their own equipment or continued to rent. Data was retrospectively taken from the patients' recorded downloads.

Results: This table displays our results so far.

Months after starting trial	1 month	6 months	12 months	18 months
Compliant (%)	82	69	58	52
Non compliant (%)	15	6	6	5
Obtained CPAP elsewhere (%)	-	4	6	6
No data yet (%)	-	3	6	11
Discontinued (%)	4	18	24	25

Patients that obtained CPAP elsewhere (internet, public hospitals, other outlets) were not followed as they would be supported by the provider of the machine. Of the patients for whom we have "no data yet" almost 50% of them have come in for parts for their CPAP, so are presumably still using it, but have not had a download with us for compliance.

Reasons for discontinuing included not coping with therapy 9.1%, side effects 1.4%, medical issues 3.5% and 1.2% found no benefit. Financial difficulty was 1.4%. Other treatments of OSA (causing CPAP discontinuation) included MAS (3.2%) surgery (3.1%) and becoming AHI free (2.2%) by losing weight.

Discussion: CPAP compliance reduces with time, as patients run into difficulties with the treatment. All patients need to be followed up at least annually, and funding should be provided by Medicare or Health Funds to facilitate this. GPs should also be made aware that patients need annual referrals back to their CPAP provider and/or specialist to improve compliance.

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ONGOING CARE OF CPAP USERS

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Introduction: The aim is to learn more about long term follow-up care of CPAP users in a non-clinical community setting, thus allowing involvement of CPAP users who may not present to a sleep clinic.

Particular areas of interest are percentage of users having follow up reviews, frequency of follow up reviews, whether non-compliant CPAP users will attend for review, and expectations of CPAP users. **Method:** A survey collected at a Sleep Apnoea Association meeting on the 16th of April 2016 and also emailed to other association members not in attendance at the meeting. There were 33 respondents.

Results: Thirty-one members (94%) would like ongoing care, but only 20 members (58%) actually had ongoing care. Amongst CPAP users having ongoing care, 35% had a review interval >1 year, while 25% had an annual review, but 74% would prefer an annual review. The majority (58%) of all CPAP users would like an annual sleep physician review, and would still attend for review, even if non-compliant with CPAP therapy. They would like regular scheduled appointments, but also the ability to request a review when required. The majority (76%) of CPAP users find CPAP reviews beneficial. Eighteen out of 19 members having ongoing reviews think long term care helps them stay on therapy. 69% of members not getting ongoing care think that long term care would help them stay on therapy.

Discussion: Many CPAP users who would like ongoing CPAP reviews are not getting them. Those being reviewed would like more frequent reviews. CPAP users find CPAP reviews beneficial and feel that reviews help them to stay on therapy. There is therefore a need to find reason(s) for this discrepancy, and possible barriers to patients accessing ongoing care.

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THERAPEUTIC CPAP LEVEL CAN BE USED TO PREDICT UPPER AIRWAY COLLAPSIBILITY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Background: The severity of upper airway collapsibility is a key determinant of obstructive sleep apnoea (OSA). Recent evidence demonstrates that individuals with a mildly collapsible airway are more likely to respond to therapies targeting both anatomical and non-anatomical causes of OSA (i.e. oral appliances/weight loss and oxygen/sedatives). Currently, there is no simple way to identify patients with a mildly collapsible airway without invasive and technical procedures. Therefore we aimed to develop a method of determining a patient's upper airway collapsibility (characterised by the passive pharyngeal critical collapsing pressure or ' P_{crit} ') using only information acquired from a patient's history or routine polysomnography including CPAP titration.

Methods: Measurements of P_{crit} were obtained in 57 patients with OSA along with demographic, anthropometric and polysomnographic data. Therapeutic CPAP level was measured during the course of obtaining passive P_{crit} measurements and was defined as the pressure sufficient to eliminate all hypopnoeas, snoring and inspiratory flow limitation in supine NREM sleep.

Results: Therapeutic CPAP level demonstrated the strongest relationship to P_{crit} ($r = 0.65$, $P < 0.001$) of all of the variables investigated including apnoea-hypopnoea index, BMI and age. Patients with a mildly collapsible upper airway (defined by a $P_{crit} \leq -2$ cm H₂O) had a lower therapeutic CPAP level compared to patients with a more collapsible airway (7.1 ± 1.1 vs. 10.7 ± 0.4 cm H₂O, $P = 0.001$). Receiver operating characteristic curve analysis illustrated "excellent" discriminatory capacity (area under curve = 0.83 ± 0.10 , $P = 0.001$). A therapeutic CPAP level ≤ 7.0 cm H₂O provided excellent sensitivity (80%) and specificity (89%) for detecting a mildly collapsible upper airway.

Discussion: Our data show that a patient's therapeutic CPAP level can be used to accurately differentiate OSA patients with a mild upper airway collapsibility from those with moderate-to-severe collapsibility. Importantly, this information may help clinicians to personalise the treatments of OSA, by selecting which patients who are most likely to respond to alternative therapies for OSA.

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A CPAP INTERVENTION PROGRAM TO IMPROVE TREATMENT ADHERENCE AND SELF-EFFICACY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Continuous Positive Airway Pressure (CPAP) is the mainstay treatment for Obstructive Sleep Apnoea (OSA), but adherence to treatment is poor. Group cognitive behavioural therapy (CBT) has been shown to improve CPAP uptake and adherence, however it is unclear if this is through an improvement in sleep apnoea self-efficacy. The aims of this study are to determine whether a CPAP intervention program improves 1) CPAP usage, and 2) scores on the Self-Efficacy Measure for Sleep Apnea (SEMSA) questionnaire, compared to a treatment as usual program.

Methods: Thirty OSA patients commencing CPAP were randomised into 2 groups: treatment as usual (TAU; $n = 15$) or a novel CPAP intervention program (CPAP; $n = 15$). TAU participants underwent the usual laboratory protocol to commence CPAP, consisting of an education session, mask fitting, CPAP trial and in-laboratory CPAP titration. CPAP participants underwent the same protocol, plus (i) a 1.5 h intervention program, 2 weeks prior to CPAP titration; and (ii) follow-up calls 1 and 7 nights post CPAP titration. The intervention consisted of a standardised education session and discussion of OSA, CPAP and general health. All participants completed the SEMSA at baseline and on the evening of their CPAP titration. SEMSA subscales are risk perception, outcome expectancies and treatment self-efficacy. CPAP usage data were downloaded 7 days after titration. Repeated measures ANOVAs were conducted to compare SEMSA scores from baseline to post-intervention. An independent t-test was used to compare CPAP usage between groups. Results: The CPAP group had significantly higher CPAP

usage at 1 week compared to the TAU group (mean \pm SD = 5.6 ± 2.4 h vs. 3.4 ± 1.9 h; $P = 0.01$). A significant interaction was found, with risk perception ($P = 0.006$) and outcome expectancies ($P < 0.001$) subscale scores improving from baseline to post intervention in the CPAP group only, but not scores on the treatment self-efficacy subscale ($P = 0.35$).

Conclusion: CPAP adherence at 7 days was higher in the CPAP group compared to the TAU group. Perceptions of health risks and outcome expectancies, but not treatment self-efficacy, improved with a CPAP intervention program. Whether adherence is sustained over the longer term, and how this relates to sleep apnoea self-efficacy, is currently being investigated up to 12 months post CPAP titration.

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CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) FOR MANAGEMENT OF OBSTRUCTIVE SLEEP APNOEA (OSA) FOLLOWING ACUTE, TRAUMATIC TETRAPLEGIA: ADHERENCE RATES AND FACTORS INFLUENCING ADHERENCE

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Background: Prevalence of OSA following acute tetraplegia is reported at 83%. CPAP is the first-line treatment however its effectiveness is limited by poor adherence. Little is known about CPAP adherence in people with acute tetraplegia.

Aims: To determine the rate of CPAP adherence in people with acute tetraplegia and the associated factors.

Methods: Analysis of CPAP adherence in a multinational randomized controlled trial of auto-titrating CPAP treatment for OSA after acute quadriplegia (COSAQ). Participants were only randomised if they could tolerate CPAP for greater than 4 h on 1 of 3 nights. Those in the CPAP treatment arm were "adherent" if they tolerated CPAP for >4 h per night for 5–7 nights a week for at least 50% of the 13 week study. Univariate analyses were undertaken to determine associations between baseline factors and adherence.

Results: 11 spinal cord injury centres participated in the study and 149 participants (134 men, age 46 ± 34 , 81 ± 57 days post-injury) completed the study. 78% of participants with an Apnoea Hypopnoea Index (AHI) ≥ 10 passed the initial 3 night CPAP trial (164/211) and were randomized to CPAP or usual care. Of the 79 COSAQ study participants receiving CPAP, 23 (29%) were adherent. Assuming those who did not pass the initial trial would not have been adherent in the study, the overall CPAP adherence rate in this population was 18% (23/126). Factors associated with CPAP adherence included higher AHI ($P = 0.01$), higher abdominal girth ($P = 0.003$) and study site ($P = 0.02$).

Conclusion: Adherence to CPAP following acute, traumatic quadriplegia is poor. Those with a higher AHI and abdominal girth are more likely to adhere. Clinician support and expertise with CPAP implementation is also likely to be important.

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POSITIONAL MODIFICATION TECHNIQUES FOR SUPINE OBSTRUCTIVE SLEEP APNOEA: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: This review aimed to determine the effectiveness of positional modification techniques in reducing AHI, preventing supine sleep, and other clinical outcomes on participants with supine obstructive sleep apnoea (OSA).

Methods: Randomised controlled trials comparing positional modification techniques with any other therapy or placebo were included. Electronic searches of databases including CENTRAL, MEDLINE, CINAHL, EMBASE, and Web of Science up to April 2016 was performed. Meta-analysis was undertaken where possible.

Results: Nine studies with 293 participants were included in the review. When positional modification techniques were compared to no therapy, there was a significant reduction in apnoea-hypopnea index (AHI) (MD -9.59, 95% CI -12.48 to -6.69), $P < 0.00001$, 4 studies, 206 participants), and percentage of time spent supine (MD -19.48, 95% CI -25.09 to -13.86, $P < 0.00001$, 4 studies, 108 participants), oxygen desaturation index (ODI) and treatment success. However when positional modification techniques were compared to continuous positive airway pressure (CPAP), there was a significant reduction in AHI (MD 6.35, 95% CI 3.05 to 9.66, $P = 0.0002$, 2 studies, 66 participants), favouring CPAP. There was no significant effect on sleepiness or quality of life. Participants were more likely to adhere to positional modification techniques, though the evidence was limited.

Discussion: This comprehensive meta-analysis found benefit for positional modification techniques in those with supine OSA in terms of reduction in AHI, time spent supine, and treatment success. Whilst positional modification techniques were effective, CPAP was more effective than these techniques. A reliable diagnosis of supine OSA should be considered, and further research is required on patient-centred outcomes including comfort, barriers to adherence, cost-analysis, and long term outcomes including the effect on cardiovascular disease, the metabolic syndrome, insulin resistance, and mortality.

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THE EFFECT OF TEMAZEPAM ON THE SEVERITY OF OBSTRUCTIVE SLEEP APNOEA – A RETROSPECTIVE ANALYSIS

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Background: Temazepam, a widely used sedative, is a potential therapeutic option for insomniacs who suffer from comorbid obstructive sleep apnoea (OSA) or to facilitate introduction of continuous

positive airway pressure (CPAP) therapy. However, its safe use in the presence of OSA remains contentious as there are concerns regarding its capacity to reduce muscle activation and depress arousal responses, increasing the possibility of obstruction and asphyxia during sleep.

Aim: To systematically investigate the effect of oral temazepam on subsequent sleep in OSA patients, with the apnoea hypopnoea index (AHI), arousal index (Arl), mean desaturation associated with respiratory events and mean event duration as the primary outcome variables.

Methods: This retrospective study included patients who had undergone polysomnography (PSG) between 2009 and 2012 at the Sleep Disorders Clinic at Sir Charles Gairdner Hospital and had been diagnosed with OSA (AHI > 5 events.hr⁻¹). Two groups were identified: (i) patients who had been administered 10 mg of temazepam (+temaz) and (ii) age, BMI and gender matched patients who had not been administered temazepam (-temaz). ANOVA was used to compare sleep study variables between the groups.

Results: A total of 150 patients were included; $n = 75$ in the +temaz group and $n = 75$ in the -temaz group. The mean AHI was similar in the +temaz and -temaz groups (36.0 ± 25.5 vs. 39.8 ± 30.8 events.hr⁻¹, respectively, $P = 0.72$). No significant differences were noted between the +temaz and -temaz groups for measurements of Arl (34.0 ± 19.1 vs. 39.7 ± 24.1 events.hr⁻¹, respectively, $P = 0.23$), mean desaturation (4.7 ± 2.7 vs. $4.5 \pm 2.7\%$, respectively, $P = 0.81$) and mean event duration (23.3 ± 6.0 vs. 22.4 ± 5.0 events.hr⁻¹, respectively, $P = 0.29$).

Discussion: These data indicate that temazepam does not systematically negatively impact OSA severity. It is likely that temazepam could be safely used as a short-term therapeutic option for some patients with comorbid insomnia and OSA. However there may be a subgroup of patients in whom temazepam use is inadvisable due to its potential to aggravate OSA.

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DOSE-DEPENDENT EFFECTS OF MANDIBULAR ADVANCEMENT ON UPPER AIRWAY PHYSIOLOGY IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Mandibular advancement splint (MAS) therapy is an effective form of treatment for many obstructive sleep apnoea (OSA) patients. However, inter-individual variability in response to MAS treatment is a major barrier for its widespread clinical use. Understanding the physiological mechanisms underpinning MAS action may improve prediction of treatment outcome, thereby facilitating patient selection. Upper airway critical pressure (P_{CRIT}) is a measure of upper airway (UA) collapsibility and has been shown to improve with MAS treatment. Genioglossus (GG) muscle activity is a key determinant of UA collapsibility. GG muscle function may be altered by MAS therapy. We hypothesised that mandibular advancement

would decrease UA collapsibility (P_{CRIT}) and improve GG muscle function in a dose-dependent fashion during sleep.

Methods: A Remotely Controlled Mandibular Positioner (RCMP) device was used to precisely advance the mandible during sleep to three predetermined positions, 0% (habitual bite), 50% and 100% of the maximal advancement for each patient. P_{CRIT} and GG-EMG activity were measured experimentally during brief reductions in CPAP at each predetermined MAS position.

Results: To date, 5 patients (4 men) have successfully completed the protocol (mean \pm SD age 54.0 ± 9.1 years, BMI = 32.2 ± 3.9 kg/m², baseline AHI = 31.9 ± 11.4 events/h and MinSaO₂ = $80 \pm 9.4\%$). In the first 3 patients in whom analysis has been performed, P_{CRIT} decreased (improved) with mandibular advancement from -0.9 ± 3.6 cm H₂O at habitual bite to -3.1 ± 2.8 cm H₂O at 50% and -5.7 ± 5.4 cm H₂O at 100% mandibular advancement; although to a different extent between individuals. Relatively less GG-EMG was required to restore airflow when the upper airway was challenged with mandibular advancement compared to baseline, suggesting improved muscle function with MAS therapy.

Conclusions: Mandibular advancement improves UA collapsibility resulting in changes in genioglossus muscle function in a dose-dependent manner. However, the magnitude of these effects varies between individuals. This may explain the variability in response to MAS treatment. Further research is required to identify the effect of MAS on the interaction of UA anatomy and physiology and its relationship to treatment outcome.

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EFFECTS OF A NOVEL MANDIBULAR ADVANCEMENT DEVICE ON AHI AND SNORING IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA: A PILOT STUDY

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Introduction: In addition to mandibular advancement, the Oventus Clearway device incorporates an enclosed airway bypassing obstructions in the nose and soft palate. A pilot study was conducted to establish the efficacy of this novel device as an alternative treatment for obstructive sleep apnoea (OSA).

Methods: Prospective, single-arm, single-centre study in patients with mild-moderate OSA or CPAP intolerant severe OSA. Ambulatory polysomnography (PSG), subjective sleepiness and subjective nasal congestion was assessed at baseline and following 3–5 weeks of acclimatization with Oventus Clearway. Mandibular protrusion was set at 50% and increased to a max 85% on 2 occasions if required as determined by PSG. Participants with a >50% reduction in AHI were classified as responders.

Results: 29 (20 M:9 F) participants completed the study. Mean \pm SD Age = 49.3 ± 8.6 years, BMI = 29.9 ± 6.1 kg/m². AHI decreased from 41.8 ± 26.5 to 16.2 ± 15.4 ($P < 0.001$) or % change of $62.5 \pm 21.1\%$. SpO₂ T90% improved from $9.3 \pm 12.7\%$ to $2.2 \pm 3.4\%$ ($P = 0.001$). 17 (59%) had nasal congestion (NC) and 22 (75.9%) were classified as responders. Subgroup analysis between those with and without nasal congestion (NC and NNC) revealed no significant difference in AHI % change (NC = $66.3 \pm 18.1\%$, NNC = $57.0 \pm 24.6\%$, $P = 0.280$) or response rate (NC = 76.5%,

NNC = 75%, $\chi^2 = 0.930$). Snoring was abolished in 82% of patients, the remainder had a reduction in snoring severity.

Discussion: This novel device was associated with a clinically and statistically significant reduction in AHI in the order of 62% and improvement in T90% in a relatively severe group of patients. T90% improved even in non-responders. Importantly, the efficacy and response do not appear to be reduced by the presence of nasal congestion. This device is safe and effective for the treatment of OSA and may be of particular benefit in patients with coexistent nasal obstruction. Further studies are required.

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EVALUATION OF REASONS FOR NON-COMPLIANCE WITH CPAP IN THE SINGAPOREAN POPULATION AND PATIENT SATISFACTION FOLLOWING

UVULOPALATOPHARYNGOPLASTY – AUDIT OF PRACTICE

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Objective: 1. To investigate reasons for CPAP non-compliance in the Singaporean population to facilitate and plan interventions to improve CPAP compliance.

2. To evaluate patient satisfaction following uvulopalatopharyngoplasty for obstructive sleep apnea.

Methods: We conducted a retrospective study via a standardised telephone questionnaire of 55 patients who had undergone uvulopalatopharyngoplasty between 2009 and 2015, after failing a trial of CPAP. Pre- and post-operative polysomnography parameters were compared and correlated with patients' subjective perception of change in functional outcome following surgery.

Results: Mean apnoea-hypopnoea index of participants were 38.7 and body mass index of 25.6. The top three reasons for CPAP non-compliance were perception of CPAP as non-curative and required long-term use, restriction of movement during sleep and high cost of CPAP mask and machine. Post-operatively, the mean Epworth Sleepiness Scale (ESS) and AHI scores on repeat polysomnography improved, in congruence with patients' perception of symptom alleviation and preference for surgery over CPAP use.

Discussion and Conclusion: In establishing the reason for non-compliance, we are now able to strategize interventions to improve compliance. Uvulopalatopharyngoplasty does provide subjective and objective improvement in functional outcomes.

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RELATIONSHIP BETWEEN VASCULAR RESISTANCE AND SYMPATHETIC NERVE FIBRE DENSITY IN CHILDREN WITH SLEEP DISORDERED BREATHING

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Introduction: Increased blood flow velocity is evidence of increased vascular resistance and has been linked with cardiovascular disease in adults. Increased blood flow velocity has been demonstrated in children with mild sleep disordered breathing (SDB) and is thought to arise from increased sympathetic activity. Whether there is evidence

of early vascular structural and functional changes associated with sympathetic over-activity in this group of children is unknown.

Methods: Fifteen children, aged 6.3–17.3 years, scheduled for adenotonsillectomy to treat SDB, underwent, pre-sleep onset pupillometry, overnight polysomnography followed by ultrasound measurements of resting brachial artery blood flow velocity (Velocity Time integral, VTi) and flow-mediated dilation (FMD). Participant's blood was analysed for platelet aggregation. The dorsal lingual artery was microdissected from palatine tonsil from each participant and was stained using immunofluorescence techniques for tyrosine hydroxylase (sympathetic nerve fibre marker). A custom algorithm calculated time to reach FMD maximal dilation (FMD_{time-to-max}). The sympathetic nerve fibre density (SNFD) was determined using a region of interest pixel ratio algorithm (custom made), from confocal images.

Results: Resting blood flow VTi was positively correlated to FMD_{time-to-max} ($r = 0.70$, $P < 0.01$) and also SNFD ($r = 0.63$, $P < 0.05$). An inverse relationship was demonstrated between peak pupillary constriction velocity and VTi ($r = -0.77$, $P < 0.005$). This was similar to the relationship between and post pupillary constriction recovery and VTi ($r = -0.079$, $P < 0.005$) and FMD_{time-to-max} ($r = -0.66$, $P < 0.05$). SNFD was negatively associated with percentage change from baseline pupillary diameter ($r = -0.69$, $P < 0.05$) mean and peak pupillary constriction velocity (Mean: $r = -0.65$, $P < 0.05$; Peak $r = -0.62$, $P < 0.05$). Increased platelet aggregation velocity was also positively correlated with SNFD. There was strong association between the pupillary light reflex variables and the platelet aggregation, in particular to the collagen and adenosine diphosphate antigen mediated aggregation and pupillary peak constriction velocity (measure of autonomic balance) ($r = -0.77$, $P < 0.01$; $r = -0.63$, $P < 0.05$) respectively.

Conclusion: Our results suggest that there is a systemic reduction in vascular compliance in children with SDB. These changes are associated with increased sympathetic innervation to the peripheral vessels, autonomic dysfunction and endothelial damage. Blood flow velocity variables using standard ultrasound techniques and pre-sleep pupillometry maybe a useful and non-invasive tools to measure increased sympathetic activity and vascular damage in children whose parents report habitual snoring.

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IN CHILDREN AND ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNOEA, ANTHROPOMORPHIC MEASURES AND SEVERITY PREDICT AUTONOMIC DYSFUNCTION IN AN AGE AND SLEEP STAGE DEPENDENT MANNER

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Background: The number of children with obstructive sleep apnoea (OSA) who are obese is increasing, however little is known about the additive effects of obesity and OSA on the autonomic control of heart rate. Previous studies have identified that anthropomorphic measurements are more sensitive indicators of OSA risk in children than body mass index (BMI), but studies have not investigated the association between these measures and autonomic function. The aim of this study was to determine whether BMI z-score, the anthropomorphic measures of neck, waist, and hip circumferences, the neck/waist (NWR), waist/hip (WHR) and waist/height (WHtR)

ratios, and OSA severity measured by the obstructive sleep apnoea index (OAHl), were predictive of a change in heart rate variability (HRV) as a measure of autonomic control, during wake and sleep in children.

Methods: Children aged 3–18 years undergoing clinical assessment for suspected OSA ($n = 301$) and age-matched non-snoring controls recruited from the community ($n = 98$) underwent overnight polysomnography and were grouped by age into 3–5 years ($n = 175$); >5–9 years ($n = 91$); and >9 years ($n = 90$). HRV was analysed by power spectral analysis for low (LF) and high (HF) frequency power, total power and LF/HF. Linear regression was used to identify the determinants of HRV during wake and sleep stages N1/N2, N3 and REM.

Results: NWR was predictive of increased wake total (0.24 (β coefficient)), LF (0.23), HF (0.24) power and decreased LF/HF (-0.25); N1/N2 total (0.29), and LF (0.37) power; N3 total (0.29), LF (0.39) and HF (0.22) power, $P < 0.05$ for all, in the 5–9 years group. In the >9 years group. WHtR was predictive of decreased wake total (-0.23), LF (-0.24) and HF (-0.29) power $P < 0.05$ for all; BMI z-score was predictive of decreased N3 total (-0.25) and LF (-0.22) power, $P < 0.05$ for both. During REM in both the 5–9 years and >9 years groups, OAHl was predictive of decreased HF (-0.28 , -0.16 respectively) and increased LF/HF (0.37, 0.16 respectively) $P < 0.05$ for all. There were no predictors of HRV in the 3–5 years group.

Conclusion: In children over 5 years our results demonstrate that the determinants of autonomic dysfunction in children and adolescents with OSA are age and sleep stage dependant. In the children over 5 years, increased waist circumference relative to neck or height, predicted changes in HRV suggestive of increased sympathetic activity during NREM sleep.

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COMBINED EFFECTS OF CHILDHOOD OBESITY AND OBSTRUCTIVE SLEEP APNOEA ON BLOOD PRESSURE

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Background: Being overweight in childhood is associated with major co-morbidities, including obstructive sleep apnoea (OSA), which affects up to 50% of overweight and obese children, compared to 5% of the general population. Both OSA and obesity are associated with elevated blood pressure. In this study we aimed to examine the separate and combined effects of OSA and obesity on blood pressure (BP) and heart rate (HR) in children.

Methods: Children aged 8–18 years were recruited from the Melbourne Children's Sleep Centre. 16 were obese (defined as ≥ 95 th percentile with a BMI z-score ≥ 1.65) and 22 were healthy weight. 23 non-snoring healthy weight children were recruited from the community as controls. All children underwent overnight polysomnography. OSA was defined as an obstructive apnoea hypopnoea index (OAHl) > 1 event/h.

Analysis: Data were compared between the three groups with either One Way ANOVA and Newman Keuls posthoc testing or Kruskal-Wallis One Way ANOVA on Ranks with Dunn's post testing if not normally distributed.

Results: BMI z-score was not different between the control and healthy weight OSA groups and both groups were lower than the obese OSA group ($P < 0.001$). OAHl was not different between the

two OSA groups. HR was higher during N3 in the obese OSA group (77 ± 2 bpm) compared to the control (68 ± 3 bpm, $P < 0.05$) group. Awake systolic BP was significantly higher in the obese OSA group (123 ± 2 mmHg) compared to both the control (116 ± 2 mmHg) and healthy weight OSA (116 ± 2 mmHg) groups ($P < 0.05$). BP in N3 tended to be higher in the obese OSA group ($P = 0.058$).

Discussion: This study has provided preliminary evidence that obesity in childhood has an independent effect on the cardiovascular effects of OSA during both wakefulness and sleep. Treatment of OSA is associated with improvements in cardiovascular health, thus routinely screening for OSA in the growing number of obese children will likely have significant benefits.

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CLINICAL CHARACTERISTICS AND POST-OPERATIVE COURSE OF SEVERE OBSTRUCTIVE SLEEP APNOEA IN UNDER 3'S

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Background: Adenotonsillectomy (T&A) is standard therapy for childhood obstructive sleep apnoea (OSA). Children under 3 years of age are at increased risk of respiratory complications after T&A, and so surgery may be deferred until the child is older. We aimed to describe the demographic characteristics, treatment and post-operative course of very young children diagnosed with severe OSA to inform treatment decisions in this age group.

Methods: Children aged 6 months–3 years without co-morbidities undergoing polysomnography (PSG) for suspected OSA in 2014–2015 were identified. Records of those with severe OSA (obstructive apnoea hypopnoea index (OAHI) >10 events/h) were examined for demographic factors (including Socio-Economic Indexes for Areas (SEIFA) score based on postcode), growth, treatment and outcome.

Results: Of 143 children aged 6 months–3 years having PSG in the 2 years, 20 (14%) had severe OSA (mean age 27 months; 20% female; median OAHI 19 events/h, range 10–150 events/h). Prevalence of severe OSA was not different from that in children of all age groups (17.6%, $P = 0.27$). These 20 children represented 11% of all otherwise healthy children with severe OSA diagnosed in the same time period (34% female, $P = 0.32$ for difference in gender proportion from the study group). Average weight for age centile was 52%. Average SEIFA score was 983 (decile 4 in Victoria, with expected mean 5). Treatment details were available for 19/20 children: 15 T&A, 2 tonsillectomy and 2 adenoidectomy. None received CPAP. Details of post-operative course are available for 14 children to date: 4 spent 1 night in ICU (planned) of whom 2 had desaturation episodes. Three other children had a single episode of fever and one had a minor haemorrhage not requiring intervention. Three children (16%) stayed in hospital for longer than one night (maximum 3 nights). Length of stay and rate of respiratory complications were not different from our previous published experience with a larger cohort of children of all ages with severe OSA.

Discussion: Severe OSA is not more or less common in children under 3 years of age compared to older children and the post-operative course is also comparable. Therefore, T&A for severe OSA should not be delayed in this age group. We are collecting further data on satisfaction with and outcomes of treatment.

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EFFECTS OF SLEEP DISORDERED BREATHING SEVERITY ON CEREBRAL OXYGENATION IN CHILDREN

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Introduction: Sleep disordered breathing (SDB) is a common paediatric sleep disorder ranging in severity from primary snoring (PS) to obstructive sleep apnoea (OSA). Children with PS by definition do not experience clinically significant desaturation or sleep fragmentation, whereas OSA is characterised by repetitive hypoxia, hypercarbia and sleep fragmentation. Both hypoxia and sleep disruption are thought to impact neurocognitive development. Near-infrared spectroscopy measures tissue oxygenation index (TOI) which represents cerebral oxygenation. To date there have been few studies examining the effects of SDB on TOI in children and they have not distinguished between severities of OSA. The aim of this study was to determine the effect of SDB severity on TOI in children.

Methods: 107 children aged 3–12 years underwent overnight polysomnography and were classified as having PS (obstructive apnoea hypopnoea index (OAHI) ≤ 1 event per hour; $n = 26$), mild OSA (>1 OAHI ≤ 5 events per hour; $n = 22$), moderate/severe OSA (MS) OSA (OAHI >5 events per hour; $n = 26$) or non-snoring controls recruited from the community ($n = 33$). One-way analysis of variance (ANOVA) with Bonferroni post hoc testing was used to compare severity groups in each sleep state. Pearson correlations were performed to assess the relationship between OAHI and TOI during wake, N1, N2, N3, REM and total sleep for the cohort as a whole. Results presented as mean \pm SEM.

Results: During wake, TOI was significantly lower in controls ($72.4 \pm 0.6\%$) compared to PS ($75.0 \pm 0.7\%$) and MS OSA ($75.0 \pm 0.5\%$), $P < 0.05$ for both. Though not reaching statistical significance, all severities of SDB had elevated TOI compared to controls during the different sleep states. When the entire cohort was analysed, there was no correlation between OAHI and TOI in any sleep state.

Discussion: Our study has demonstrated that children with SDB have elevated cerebral oxygenation compared to healthy non-snoring controls during wake. This may be due to a protective mechanism influenced by other physiological parameters such as elevated blood pressure, which is evident in children with SDB, acting to conserve cerebral oxygenation levels.

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OUTCOMES OF ADENOIDECTOMY IN CHILDREN; 1 YEAR FOLLOW UP

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Introduction: Adenoidectomy alone is one of the most common paediatric surgeries. In Australia there were 12,952 adenoidectomies performed without tonsillectomy in the year 2011, and with shifting

trends the primary indication for surgery is becoming increasingly for airway obstruction, including obstructed breathing during sleep. The aim of this study was to investigate symptoms, including snore, witnessed apnoea and quality of life for children before and after adenoidectomy alone.

Methods: The OSA18 questionnaire and Adenoid Symptom Checklist were performed before surgery and after surgery at one month, three month and one year follow up. The OSA18 is a validated questionnaire investigating the impact that OSA has on QOL with 18 questions each answered on a 7 point likert scale. The questionnaire results in a total score ranging from 18–126 which then fits into one of three severity categories; <60 OSA has little impact on QOL, 60 = 80 moderate impact, >80 large impact. The Adenoid Symptom Checklist has 19 questions pertaining to sleep and ENT symptoms.

Results: 132 families were invited to participate, 112 were recruited and 35 were withdrawn, mainly lost to follow up. Of the 77 participants 36% ($n = 28$) were female, with a mean age at time of surgery of 4.6 years (range: 13.4 years–4 months). The mean OSA18 total score before surgery was 58.5 (max 101 - min 20) which decreased 41.0% one month after surgery to 34.5 (max 74 - min 18), and was maintained at three months 32.8 (max 71 - min 18), and one year follow up 33.8 (max 98 - min 18) ($P \leq 0.001$). The occurrence of all sleep related symptoms had significant improvement after surgery at one month, three month, and one year follow up; Snore ($P \leq 0.001$), Witnessed apnoea ($P \leq 0.001$) and Restless sleep ($P \leq 0.001$). The occurrence of ENT related symptoms had significant improvement at one month, three months and one year follow up; Chronic mouth breathing ($P \leq 0.001$), Rhinorrhoea ($P \leq 0.001$), Nasal congestion ($P \leq 0.001$), Hyponasal speech ($P \leq 0.001$), Cough ($P \leq 0.001$) and Hearing problems ($P \leq 0.001$). At one year follow up there had been 80% decrease in medication use for nasal problems ($P \leq 0.001$).

Discussion: This study concludes that adenoidectomy alone is successful from a parental perspective with significant improvement in OSA related symptoms of snore, witnessed apnoea and QOL.

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DEVELOPING BEST PRACTICE FOR BI-LEVEL POSITIVE AIRWAY PRESSURE TITRATIONS IN PAEDIATRIC PATIENTS WHEN USING MACHINES WITH VOLUME-ASSURED PRESSURE SUPPORT

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Introduction: To discuss effective titration techniques for bi-level positive airway pressure (BPAP) studies on paediatric patients when using the volume assured pressure support (VAPS) settings, outlining the advantages and disadvantages when using these types of machines.

Methods: Current titration methods in a paediatric sleep laboratory are outlined, including initial assessment, initiation process, overnight titration procedures, and follow up management of patients. Detailed assessment of changes to titration procedures when using these settings vs. when doing a more conventional BPAP titration. Outline of staff development and education to ensure effective and consistent titrations.

Observations regarding the effectiveness of using the VAPS settings to alleviate targeted conditions.

Results: Most patients have variable pressure requirements overnight. Using the VAPS feature allows for varying pressure delivery

and has demonstrated an increase in patient comfort and greater confidence from staff when titrating overnight.

Patient compliance has been similar to that of patients using traditional BPAP. However, effectiveness in controlling nocturnal hypoventilation and other conditions has observed to be improved.

Discussion: The paucity of literature with regards to titrating children using these machines limits the ability for paediatric sleep units to readily develop policies and procedures for staff when utilising these newer technologies.

Our sleep laboratory has seen potential benefits when using machines with the volume assured pressure support settings on children and are aiming to develop a gold standard for titrating complex patients when using these settings.

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BI-LEVEL POSITIVE AIRWAY PRESSURE SUPPORT (BPAP) WITH AVERAGE VOLUME ASSURED PRESSURE SUPPORT (AVAPS) TO SUCCESSFULLY MANAGE PAEDIATRIC SLEEP-RELATED RESPIRATORY INSUFFICIENCY

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Background: Average volume assured pressure support (AVAPS) is a feature on Bi-level positive airway pressure (BPAP) machines which delivers a consistent pre-set target volume by automatically adjusting the pressure support within a pre-determined range. Therefore, varying pressure requirements within a period of sleep can be provided.

We present a case series of 12 paediatric patients with nocturnal hypoventilation who were better managed on BPAP with the AVAPS feature than with conventional BPAP.

Methods: All patients had a diagnostic polysomnogram (PSG), a PSG on conventional BPAP and a PSG on AVAPS. Data from the studies as well as clinical information was collected. Statistical analysis was done using SPSS.

Results: Age range: 4 months to 17 years; gender: 2 female, 10 male; medical diagnoses- myopathies, cerebral palsy, brainstem tumours, chromosomal abnormalities, congenital central hypoventilation syndrome and tracheostomies.

Comparing AVAPS to conventional BPAP- mean TcCO₂ decreased by 9.25 mmHg (95% CI 4.54–13.96), mean baseline SaO₂ improved by 3.2% (95% CI 1.54–4.79) and mean SaO₂ nadir improved by 8.75% (95% CI 3.59–13.91). Mean sleep efficiency improved by 7.1% (95% CI 3.52–10.81). All results were statistically significant- $P < 0.05$.

Conclusion: With AVAPS, our patients received an appropriate tidal volume with each breath, but without using a fixed high pressure throughout the night. The automatically adjusting setting allowed lower pressures to be given with an increased IPAP only when required. Patient comfort was also enhanced.

These cases highlight that AVAPS is a useful feature of BPAP machines which can be used in paediatric patients with nocturnal hypoventilation. Further studies are warranted to elaborate on the potential benefits of AVAPS.

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SUPPORTING THE USE OF OVERNIGHT TREND OXIMETRY IN INFANTS AND CHILDREN AT REGIONAL CENTRES ACROSS QUEENSLAND; A STATE-WIDE SERVICE PROFILE

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Introduction: The Respiratory & Sleep Medicine service at our centre regularly receives consults, requesting review of inpatient overnight trend oximetry reports, undertaken at regional centres to aid clinical management. Most of these are performed in infants with Chronic Neonatal Lung Disease (CNLD), to assess the need for home supplemental oxygen prior to discharge. The specialist consult involves review of clinical information and interpretation of overnight trend oximetry results (provided by email/fax). An on going management plan is then recommended. This service provides remote support to regional units, aiming to reduce inpatient tertiary transfer. This study aims to quantify the extent of this present activity and develop a standard Statewide process for this consultation.

Methods: Information regarding all external trend oximetry reports referred to our unit for consultations were collected prospectively over a 6-month period. This included referrer details, patient demographics, clinical history, trend oximetry results, recommended management and overall clinical outcome.

Results: 53 oximetry reports (25 = female) were referred over the first 3 months of this study. Mean gestation at birth was 29.4 weeks (24–40 weeks). Mean age (uncorrected) at time of oximetry was 4.7 months (2 days–2.4 years). 40 of the oximetries (75.5%) were undertaken on infants with CNLD. Specialists confirmed adequate oxygenation for 21 patients (40%), recommended commencement ($n = 3$) or an increase in oxygen therapy ($n = 15$) in a total of patients 18 (34%). A wean of oxygen therapy was advised in 2 patients (4%) and alternative management was suggested in 2 patients (4%). Transfer to the tertiary centre for sleep study was only recommended in 1 patient (2%). The interpretation and plan recommended was not clearly documented in 9 patients (17%).

Discussion: Specialist advice is sought on trend oximetry reports for a significant number of regional patients. Using remote consultation appears to reduce the need for tertiary transfer enabling patients to be managed regionally. This process needs to be developed further with a standardised process and clear recording of consultation advice. Provision of education to regional clinicians regarding the interpretation of trend oximetry data could add further benefit, reserving specialist involvement for only selected high-risk patients.

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24 – HOURS OXYGEN SATURATION RECORDINGS AT DISCHARGE IN PRETERM INFANTS – A MEASURE OF INTERMITTENT HYPOXIA

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Introduction: There is limited literature documenting intermittent hypoxia (IH) at preterm infant discharge using new generation oximeters. The aims of this study were to: 1. Determine IH in preterm infants at neonatal discharge by documenting the 3% desaturation

index (DSI) and 4%DSI from a 24-h oximetry recording. 2. Compare overnight 12-h to 24-h recordings.

Methods: Infants born < 37 weeks gestational age (GA) and admitted to the Wellington NICU were approached. Masimo Rad – 8 oximeters were used and set to sleep mode with a 2 sec averaging time. 24-h oximetry recordings were performed as near as possible to discharge. Data were downloaded using Profox software and analysed using the automatic edit function with no manual editing. For infants < 32 weeks GA recordings were repeated 1 month post discharge.

Results: 41 infants had a 24-h pulse oximetry recording. For 38 there were sufficient data recorded for analysis. There were 17 (44.7%) males. Median GA at birth was 32.5 weeks (range 24–36). Post-menstrual age at time of study varied from 35 to 42 completed weeks. The median mean SpO₂ was 97.9% (IQR 97.2–98.8), median DSI3% 77.4 events/h (IQR 52.5–103.1) and median DSI4% 51 events/h (IQR 31.1–73.7). For 12 infants who had a repeat study at 4 weeks post discharge the median DSI4% decreased from 57.9 events/h to 25.5 events/h ($P = 0.008$). 24-h oximetry reports were clinically similar to 12-h recordings.

Conclusion: The prevalence of IH is high in preterm infants at neonatal discharge but in this small pilot study appeared to decrease in very preterm infants four weeks post discharge. A 12-h overnight recording is likely to be sufficient for clinical decision-making.

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INCIDENCE OF ANTIDEPRESSANT USE IN A POPULATION OF DIAGNOSTIC SLEEP STUDY PATIENTS AT MONASH LUNG AND SLEEP

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Introduction: It is known that there exists a higher incidence of depression in clinical and community samples of people with obstructive sleep apnoea (OSA), however the exact relationship remains unclear. Many symptoms of both depression and OSA overlap, which can lead to an underdiagnosis of OSA in depressed patients or an increased likelihood of OSA patients being prescribed antidepressant medication. Longitudinal studies have shown CPAP treatment to lessen symptoms of depression, however depression has also been associated with poor compliance to medical therapies. With such a dynamic relationship between depression and OSA, it is important to understand magnitude of the issue in order to maximise outcomes. The study aimed to assess the incidence of antidepressant use amongst patients referred for a diagnostic sleep study at Monash Lung & Sleep. It was expected that a significant proportion of patients would be taking antidepressant medication at the time of their diagnostic sleep study.

Methods: Antidepressant medication names were identified via MIMS under the MIMS class antidepressant. The resulting list was checked against medications registered in the sleep study database for Monash Lung & Sleep patients undergoing a diagnostic sleep study since 2015. Patients were divided into two groups, dependant on whether they were taking antidepressant medication at the time of their diagnostic study. The two groups were described.

Results: Of the 2051 patient's sampled, 441 (21.5%) reported antidepressant use concurrent with their diagnostic study. Results of further analysis and descriptive statistics are pending.

Discussion: The findings indicate that a considerable portion of diagnostic patients at Monash Lung & Sleep are concurrently

treated with antidepressant medication. Antidepressant use is an indirect measure of the prevalence of depression within the sample, with only cases previously judged worthy of pharmaceutical intervention accounted for. To better understand the prevalence of depression in the sample, symptoms of depression should be assessed at the time of the sleep study. It is further suggested that depression symptoms and CPAP compliance be assessed longitudinally.

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INCIDENCE OF OSA IN PATIENTS SCHEDULED FOR BARIATRIC SURGERY IN A SOUTH EAST ASIAN COHORT

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Background: Obesity is a risk factor for Obstructive Sleep Apnea (OSA). Studies done in western populations showed that 60–70% patients undergoing bariatric surgery have significant OSA, but there is no data from Asian populations. Perioperative continuous positive airway pressure (CPAP) therapy for OSA patients has been shown to be associated with reduced perioperative complications. Polysomnography is routine for pre bariatric surgery in our tertiary institution, and we report on the local incidence and severity of OSA in this cohort.

Methods: Demographic, clinical and polysomnographic data were retrospectively collected from a cohort of pre-bariatric surgery patients whom underwent overnight polysomnography from Dec 2011 to Dec 2015. Mild, moderate and severe OSA was defined as an AHI ≥ 5 , ≥ 15 and ≥ 30 /h, respectively.

Results: 76 patients were included. Only 3 patients did not have OSA. The incidence of mild, moderate and severe OSA was 16%, 20% and 60% respectively. The incidences of extremely severe OSA, i.e. AHI >60 is 26/76% and AHI >90 is 14/76%.

Discussion: The incidence of mod-severe OSA in our local South East Asian (SEA) pre bariatric surgery cohort is higher than previously reported at 80% of the screened population. These patients would benefit from perioperative continuous positive airway pressure therapy. PSG prior to bariatric surgery should be mandatory in the SEA population.

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TIME ANALYSIS OF SNORING AND ITS IMPACT ON DEVELOPMENT OF OTHER COMORBIDITIES

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Background: There are strong physiological links between snoring, hypertension, diabetes and cardiovascular disease. These conditions are thought to be linked physiologically with obesity and lifestyle factors the main contributors. The aim of this study was to identify if there is a timeline from age of snoring onset to the development of hypertension, type 2 diabetes mellitus and/or heart disease.

Methods: The study included all referrals to the sleep service at the Alfred Hospital with snoring as the primary feature of the referral. These patients were then asked to complete a questionnaire, which asked questions to obtain further details regarding their snoring history. Additional questions included whether the diagnosis of hypertension, diabetes and cardiovascular disease (in the form of

atrial fibrillation, ischaemic heart disease or congestive cardiac failure) had previously been made and at what age.

Results: As of 3rd June 2016, 266 patients had been included in the study with the mean age of the study population was 55 (± 15) years and 68% male. The mean age of onset of snoring for the male group was 32 (± 16) years compared with 40 (± 17) years for women. Of the entire 266 patients, 43% reported a diagnosis of hypertension, 26% had type 2 diabetes mellitus and 23% had a form of heart disease. 8% of patients had all four comorbidities ('Quadrella'). The mean age of those with all four comorbidities was 68 years with 75% of these patients male. In the group with all four comorbidities, the mean age at onset of snoring was 39 (± 20) years; hypertension onset was at 43 (± 12) years, type 2 diabetes mellitus at 52 (± 10) years and any heart disease at 54 (± 15) years.

Intended outcome and impact: There appears to be a sequential timeline link between the onset of snoring and the subsequent onset of hypertension, type 2 diabetes mellitus and heart disease in this study despite the small sample size. The development of this timeline link and subsequent progression from snoring to the other comorbidities may play a future role in determining whether medical intervention for those who have snoring is required to prevent the development of these comorbidities.

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A COMMUNITY SURVEY OF PARTNER-REPORTED HABITUAL LOUD SNORING

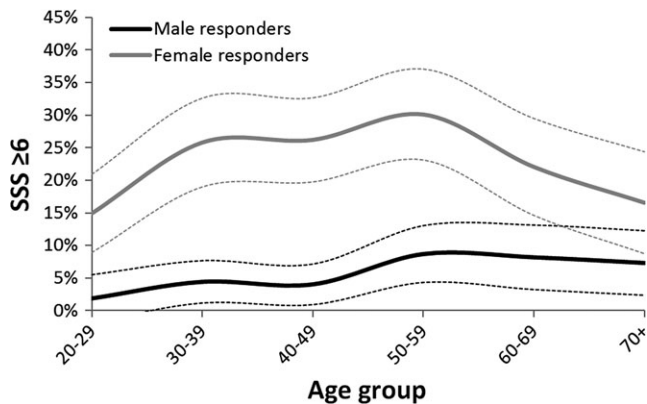
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Introduction: Obstructive sleep apnoea is remarkably prevalent in the community. Less well characterised is the community prevalence of snoring, which is a significant problem for partners of habitual loud snorers, and a frequent source of referrals to specialist sleep and ENT services. The aim of this study was to examine the community prevalence of partner-reported habitual loud snoring.

Methods: The study was part of the 2015 South Australian Health Omnibus survey, using random stratified sampling and face-to-face interviews to assess health characteristics in South Australians aged 15 years and over. In addition to demographic data, survey respondents were asked about snoring and, if they had a bed partner or room-mate, to complete the Snoring Scale Score (SSS), a 0–9 point scale assessing the frequency (nights per week), duration (within night) and loudness of their partner's snoring. A snoring scale score of ≥ 6 reflects partner snoring on every/most nights, all or most of each night, with loud/very loud snoring audible from another room through a closed door. Prevalence estimates ($\pm 95\%$ CI) were weighted to reflect ABS Estimated Resident Population figures according to age and gender.

Results: There were 3005 participants. 49.2% (46.5–51.9%) of males vs. 28.4% (26.0–30.8%) of females ≥ 20 years self-reported that their own snoring had ever bothered others. 73.9% (71.6–76.2%) of responders aged 30–59 reported having a bed-partner/room-mate. Females reported habitual loud snoring (SSS ≥ 6) in their partner more frequently than did males (Figure), particularly in 30–59 year age groups: 27.4% (23.5–31.2%) vs. 5.7% (3.7–7.7%) respectively.



Conclusion: Habitual loud/very loud snoring is a remarkably common problem, particularly for females aged 30–59.

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EFFECTS OF RENAL SYMPATHETIC DENERVATION ON SLEEP APNOEA SEVERITY AND METABOLIC INDICES IN PATIENTS WITH RESISTANT HYPERTENSION AND SLEEP APNOEA: A PROSPECTIVE BEFORE-AND-AFTER STUDY

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Background: Catheter-based renal sympathetic denervation is a percutaneous technique for lowering blood pressure in treatment-resistant hypertension. Obstructive sleep apnoea is comorbid with resistant hypertension in at least two-thirds of patients. These patients invariably have dysmetabolic features and added cardiovascular risk. Pilot studies have suggested improved sleep apnoea severity and metabolic control following renal sympathetic denervation.

Methods: We prospectively evaluated the effect of renal sympathetic denervation in a cohort of patients ($n = 20$) with obstructive sleep apnoea and treatment resistant hypertension. Patients with resistant hypertension (≥ 3 drugs at maximal dose, including diuretic) and an apnea-hypopnea index ≥ 15 events/h underwent renal sympathetic denervation. Patients were naïve to both continuous positive airway pressure and insulin at enrolment and were precluded from these therapies during the study period.

Results: At baseline, the mean apnea-hypopnea index was 21.3 (5.3) events/h and at 6 months post renal denervation the mean apnea-hypopnea index was 20.5 (6.7) events/h, with a reduction of 0.9 events/h (95% CI -0.7 – 1.6 , $P = 0.39$). Reductions in minimum SaO₂ (-2.7%), mean SaO₂ (-0.45%) and frequency of desaturation below 90% (-17.3) were not statistically significant. Glucose measurements measured at 2 hrs following tolerance testing reduced by 1.14 mM (95% CI 0.22 – 2.06 , $P = 0.03$). There were no significant changes in fasting glucose, HbA_{1c}, insulin resistance, beta-cell function, cholesterol or triglyceride levels.

Conclusion: Our data show that in patients with resistant hypertension and obstructive sleep apnea, catheter-based renal sympathetic denervation did not result in significant improvement in sleep apnoea severity. Apart from modest increments in glucose tolerance, there were no significant improvements in other markers of carbohydrate and lipid metabolism.

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IMPACT OF THE TREATMENT EFFECT OF CONTINUOUS POSITIVE AIRWAY PRESSURE BETWEEN YOUNG-OLD AND VERY OLD OBSTRUCTIVE SLEEP APNEA SYNDROME PATIENTS

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Introduction: Several studies showed continuous positive airway pressure (CPAP) is effective for improvement of old obstructive sleep apnea (OSA) syndrome patients' excessive daytime sleepiness (ESD). But few report compared with both young-old and very old OSA patients' treatment effect with CPAP. We proceeded this study to clarify this problem and predictive factors were influenced with effect of CPAP therapy.

Methods: Subjects were out-patients with snoring, EDS or cardiovascular disease. They were undergone Type two PSG, and diagnosed OSA. The patients were prescribed CPAP. Three to six months after CPAP therapy, they were checked apnea-hypopnea index (AHI) using the recording data in CPAP apparatus.

Then, the subjects were separated into two groups between ≥ 80 y/o and < 80 y/o. We analyzed retrospectively the treatment effect (AHI to 5 events/h and $> 50\%/h$ reduction in baseline AHI) between two groups. And whether age, pretreatment AHI (≥ 30 events/h), gender, body mass index (BMI ≥ 30 kg/m²), and EDS were influenced with the treatment effect.

Results: Subjects were 149 out-patients from May, 2013 to July 2015. ≥ 80 y/o group (18 patients) and < 80 y/o group (131 patients) were analyzed with logistic regression analysis. In the analyze of CPAP treatment effect, no difference between both groups ($P = 0.542$). Pretreatment AHI ($P = 0.046$) and gender ($P = 0.033$) were influenced with the treatment effect.

Conclusion: In this study showed CPAP therapy was equally effective between young-old and very old OSA patients. We concluded that CPAP therapy should be recommended to very old OSA patients as well as young-old population.

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HEART RATE VARIABILITY OUTCOMES OF CONTINUOUS POSITIVE AIRWAY PRESSURE VS. ORAL APPLIANCE TREATMENT FOR OBSTRUCTIVE SLEEP APNOEA

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Background: Obstructive sleep apnoea (OSA) is a risk factor for cardiovascular disease. Changes in the autonomic nervous system are thought to contribute to this risk. Heart rate variability (HRV) is a simple, non-invasive measurement that reflects the relationship between the sympathetic and parasympathetic nervous systems, and has been shown to correlate with cardiovascular mortality and morbidity. The aim of this study is to retrospectively analyse data from a randomised crossover trial¹ which assessed health

outcomes of Continuous Positive Airway Pressure (CPAP) vs. mandibular advancement splint (MAS) for OSA, to compare differences in measurements of HRV at baseline and after each intervention.

Methods: Patients had 1 month each of optimal CPAP and MAS treatment following acclimatisation to both therapies. ECG tracings (lead II) will be extracted from sleep studies performed at baseline and after intervention with CPAP and MAS. These will be analysed for measures of HRV in the time and frequency domains, both over the whole recording and also comparing samples from wakefulness, non-REM sleep and REM sleep.

Progress to date: The sleep studies have been identified, and data extraction is currently under way.

Intended outcome and impact: This study will assess the impact of MAS and CPAP on HRV in patients with OSA. This will add to our knowledge of the comparative effects of MAS vs. CPAP on health outcomes, and cardiovascular risk in particular.

¹Phillips CL, Grunstein RR, Darendeliler MA, Mihailidou AS, Srinivasan VK, Yee BJ, Marks GB, Cistulli PA. Health outcomes of continuous positive airway pressure vs. oral appliance treatment for obstructive sleep apnea: a randomized controlled trial. *Am J Respir Crit Care Med*. 2013 Apr 15;187 (8):879–887.

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UPTAKE AND BENEFITS OF POSITIVE AIRWAY THERAPY IN THE ELDERLY

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Introduction/Aim: The prevalence of sleep disordered breathing (SDB) increases with age, but there is limited evidence of the benefit of positive airway pressure (PAP) therapy in the elderly. Our aim was to assess the characteristics of an elderly population referred for a diagnostic sleep study, including their symptoms and willingness to have PAP if SDB was detected. We wished to determine how many patients would then proceed with PAP, and whether this benefits them.

Methods: Structured interview and questionnaires performed on elderly population aged >75 years, who were referred to Concord Hospital Sleep Laboratory for a diagnostic sleep study (DSS) from January to September 2015. Information extracted included demographic data, co-morbidities, Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI). The results of the DSS were recorded and subjects were contacted 6 months later to assess their uptake of PAP, and any benefit from this.

Results: 23 patients were recruited (15 males). The mean age was 80 (± 3) years, and most were obese (mean BMI 32 ± 6.8 kg/m²). Their baseline mean ESS was 8.5 (normal <11) and mean PSQI was 7.8 (normal <5). 13 patients (57%) had severe obstructive sleep apnoea (OSA) (RDI ≥ 30), 4 (17%) had OSA/hypoventilation, and 6 (26%) had mild-moderate OSA (RDI < 30). At 6 months, 8 of the 17 patients (47%) with severe OSA and/or hypoventilation were on PAP therapy (5 on continuous PAP, 3 on Bi-level PAP). All these patients reported good compliance and subjective improvement in symptoms. There was significant improvement in mean ESS (12 to 5; $P = 0.018$) and PSQI (8 to 4; $P = 0.017$) on PAP therapy.

Conclusion: Severe sleep disordered breathing is common in the elderly. This small cohort highlights the challenges in treating these patients with PAP. However, those who accepted PAP demonstrated a symptomatic improvement. Further study is required, including the investigation of strategies to assist PAP uptake in the elderly.

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EVALUATION OF AUTO-CPAP FOR COMMENCEMENT AND TITRATION OF CPAP IN PAEDIATRIC PATIENTS

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Introduction: Recently auto-CPAP (continuous positive airway pressure) machines have been used as a means of titrating CPAP pressures in patients with obstructive sleep apnoea (OSAS) however their utility in paediatric patients still requires evaluation.

Aim: To determine the tolerance and titration efficacy of auto-CPAP in paediatric patients with OSAS.

Methods: A retrospective audit of medical records of all children commenced on Resmed S9 auto-CPAP between Jan 2009–July 2015 was performed. Information regarding severity of OSAS, CPAP utilisation, and correlation between auto-CPAP determined pressures and CPAP titration studies was evaluated.

Results: 74 patients were commenced on auto-CPAP, 37 patients (57%) tolerated ongoing CPAP use and of these 70.3% of patients had >4 h of average usage per night. 35 patients (47.3%) ceased CPAP due to poor tolerance, and 3 patients ceased due to improvement in OSAS. Comparing those that tolerated ongoing CPAP and those that did not there were no significant differences in OAH or obesity. The number of hours that CPAP was used per night at most recent or final review correlated with the number of hours used at the first follow up following CPAP commencement ($r = 0.398$, $P = 0.003$), and strengthened at 2nd follow up ($r = 0.622$, $P < 0.001$) and 3rd follow up visits ($r = 0.525$, $P = 0.008$). Top 95th percentile pressure on auto-CPAP was used to determine a fixed CPAP pressure and 57% of patients were trialled on fixed pressure CPAP machines with 74.47% of these patients continuing to tolerate fixed pressure CPAP. 16 patients underwent CPAP titration studies and recommended pressures were similar to auto-CPAP determined pressure but an exact match was rare (mean difference -2.4 , range -5.8 to $+5$). 2 patients were commenced on BiPAP immediately following CPAP titration.

Discussion: Auto-CPAP is particularly useful in determining which paediatric patients will tolerate ongoing use of CPAP. Early good CPAP usage predicts later patient adherence. Top 95th percentile pressures determined by auto-CPAP machines are a good indicator of required CPAP pressure in paediatric patients but do not substitute an eventual need for CPAP titration studies.

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AN AUDIT OF THE RESPIRATORY WARD-BASED NON-INVASIVE VENTILATION (NIV) IN A TERTIARY CARE CENTRE

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Introduction: Non-invasive ventilation (NIV) has become the standard of care for patients admitted with acute type II respiratory failure with respiratory acidosis. Quality assurance within NIV services help to preserve best clinical practice. This audit compares the compliance of the current practices of ward NIV in a tertiary centre to the standard recommended practice from the British Thoracic Society (BTS) Guidelines and with a historical cohort within the service.

Methods: The audit included patients who received ward NIV for acute type II respiratory failure from 1st February 2015 to 1st Feb 2016. The audit aimed to study the compliance of the NIV service to the recommended patient selection, monitoring of physiological markers, outcomes of treatment and reported documented escalation plans for patients according to the BTS guidelines.

Progress to date: A total of 180 patients are expected to be included in the audited period. 44 patients received NIV in the audited period to date. The indications for NIV varied, including acute exacerbation of COPD (AECOPD) (34.09%), obesity hypoventilation syndrome (13.63%), post-operative respiratory failure (11.36%), neuromuscular disease (7.82%), acute pulmonary oedema (APO) (4.55%), combination AECOPD and APO (15.91%) and other (6.82%). The population was elderly (mean age 72.95 ± 12.91 years) with an even gender distribution (47.72% female). The mean \pm SD pre-NIV pH was 7.30 ± 0.08 and PCO_2 was 72.67 ± 20.04 mmHg, which improved to 7.33 ± 0.07 and 65.45 ± 17.56 mmHg and 7.33 ± 0.05 and 65.10 ± 19.19 mmHg at the 1 and 4-h mark respectively. 56.81 % of the 1 and 4-h arterial blood gasses (ABGs) were taken in a timely manner, a similar notation to the historical cohort, with no statistically significant difference comparing ABGs taken during- and outside of- regular work hours. 77.27% of patients were successfully weaned off NIV. 75% of patients had documented escalation plans.

Intended outcome and impact: NIV management on the respiratory ward of our institution is at par with the current international standards. This audit serves as a quality assurance tool and to help guide future improvements for the unit.

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EXPLORING THE ASSOCIATION BETWEEN SLEEPINESS AND MOOD DISORDER IN PATIENTS WITH EXCESSIVE DAYTIME SLEEPINESS

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Background: Excessive daytime sleepiness (EDS) is a common and debilitating symptom with a multitude of causes. Patient reported symptoms can be difficult to quantify and differentiate. The association between objective sleepiness (mean sleep latency) and depression/anxiety has never been reported. This study aims to examine the association between objective and subjective measures of sleepiness and mood disorders.

Methods: A retrospective multicentre study at two tertiary centres in Melbourne with ethics approval obtained at both sites. Adults with an MSLT in conjunction with a Hospital Anxiety and Depression Score (HADS) and Epworth Sleepiness Scale (ESS) were identified over a 3 year period. A HADS score detects depression (HADS-D ≥ 8) and anxiety (HADS-A ≥ 11) and is validated in a sleep clinic population. Data collected included demographics, medical and sleep study information. Prevalence of mood disorders in the MSLT population was compared to an obstructive sleep apnoea (OSA) clinic population. Correlation analysis between measures of sleepiness (MSLT and ESS) and mood scores was performed. Categorical variables were compared using Chi-squared test with two-sided *p*-values (significant if <0.05).

Results: 220 patients were included in the analysis. Mean age was 41 ± 15.7 years, mean body mass index 28.6kg/m^2 , 30% had a HADS-A score consistent with anxiety and 43% a HADS-D score consistent with depression. Mean results for the entire cohort: ESS 13.7, mean sleep latency 11.5 minutes, HADS-A 8.2 and HADS-D 7. There was no significant correlation between mean sleep latency and either HADS-A (-0.006 , $p = 0.93$) or HADS-D score (0.002 , $p = 0.98$). There was a weak correlation between ESS and; mean sleep latency (-0.25 , $p < 0.01$), HADS-A (0.15 , $p = 0.03$) and HADS-D (0.2 , $p = 0.004$). There was no significant association between diagnosis of hypersomnia disorders and presence of either anxiety ($p = 0.86$) or depression ($p = 0.72$). Prevalence of depression and anxiety was comparable to published local data examining HADS scores in an OSA population.

Conclusion: Mood disorders were common in the MSLT population. Correlation was found between subjective measures of sleepiness and mood disorders. No correlation was found between objective measures of sleepiness and mood disorders. Routine screening for mood disorders in patients with hypersomnolence should be considered.

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ASSESSMENT OF UPPER AIRWAY DILATOR FUNCTION BEFORE AND AFTER JAW PROTRUSION

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Background: The response to treatment of sleep apnea by mandibular advancement is difficult to predict, with clinical failure reported in up to half of patients. Identification of those likely to respond to use of a Mandibular device remains a research priority. During normal tidal breathing, upper airway patency is maintained by both static and dynamic activity of the pharynx. MRI and nasal endoscopy studies of sleep apnea patients show that mandibular protrusion results in a change in the static shape of the upper airway, due to an increase in antero-posterior dimension, with or without lateral widening. Electrophysiological and dynamic MRI scanning of the airway of sleep apnea patients also suggests that motor failure of dilatory muscles may be important in the pathophysiology of the condition. Altered motor function of airway muscles may be integral to the pathophysiology of sleep apnea and also impact on the response to mandibular advancement devices in patients with otherwise similar anatomy. Considering the emerging focus on the dynamic function of the upper airway, our study examines the feasibility of nasal endoscopic assessment of the capacity of airway dilator muscles to increase pharyngeal calibre in awake supine sleep apnea patients.

Methods: Cohort: Adult sleep apnea patients being referred for a mandibular device. Awake video nasal endoscopy was performed using local anaesthetic in the supine position. Video was taken of the velo and oropharynx while the patient performed three maximal inspirations from normal tidal exhalation through the nasal airway. The manoeuvre was repeated during maximal comfortable jaw protrusion. Minimal and maximal airway dimensions, and a number of linear and area geometric parameters were established by computer analysis of frames extracted from the recording. These were assessed for changes induced by the manoeuvre in both the normal and protruded states.

Progress to date: Methods and patient recruitment have been established.

Intended outcome and impact: This study will show the feasibility of a simple nasal endoscopic technique for assessment of the ability of airway dilator muscles to increase airway calibre, allowing clinical assessment of upper airway function, which may be useful in the identification of sleep apnea patients likely to respond to Mandibular Advancement.

Mandibular advancement achieves effective control of Obstructive Sleep Apnea in 50 to 70% of patients. The clinical identification of patients who are unlikely to respond to use of a Mandibular advancement splint remains a high research priority. Ref 1.

MRI scanning of the upper airway during mandibular protrusion show three characteristic anatomic responses: anterior movement >2 mm of the posterior tongue en bloc, anterior movement >2 mm of the oropharyngeal but not nasopharyngeal region and thirdly, minimal anterior movement of either region.

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IMPACT OF ANTHROPOMETRIC CHANGES ON CPAP REQUIREMENT IN RE-TITRATION STUDIES

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Introduction: Repeat in-laboratory continuous positive airway pressure (CPAP) titration studies are often requested for patients with obstructive sleep apnoea (OSA) to reassess treatment efficacy, with indications including persisting daytime sleepiness, weight change or suspected inadequate or excessive pressure. Major weight loss after bariatric surgery has been shown to reduce the severity of OSA, however there is limited data to predict the effect of more modest changes in weight or other parameters on pressure requirement.

Methods: Retrospective review of clinical and polysomnographic records of all patients who underwent reassessment CPAP titration study with our service during 2013–2015. Patients were included if they had a diagnosis of OSA and a previous in-laboratory CPAP titration study. Exclusion criteria included central or mixed sleep apnoea, hypercapnoea or use of bilevel non-invasive ventilation or supplemental oxygen.

Results: 231 patients (156 male, 75 female) were identified with mean age 63.6 years (SD 12.7), weight 95.7 kg (SD 19.4), BMI 33.1 (SD 6.31) and Epworth Sleepiness Scale (ESS) 8.7 (SD 5.1). The mean time since the prior CPAP titration was 41.7 months (SD 23.9). A change in recommended pressure was associated with a change in weight ($P < 0.001$), BMI ($P = 0.001$) or neck circumference ($P = 0.040$), but not with change in ESS ($P = 0.138$) or time since previous study ($P = 0.141$). If the prior CPAP titration was not 'optimal' by AASM criteria, there was no significant association between changes in pressure and weight ($P = 0.082$) or BMI ($P = 0.284$). Change in interface between the studies did not significantly affect the association between pressure and weight changes. Of the 49 patients who gained at least 5 kg in weight, 55% had an increased CPAP requirement yet 31% required a lower pressure. Of the 40 patients who lost 5 kg or more, recommended pressure decreased in 55% but increased in 28%.

Discussion: Change in anthropometric variables was associated with a change in titrated pressure. However, paradoxical effects were seen in a significant minority of patients, suggesting other factors may be relevant.

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A CASE PRESENTATION OF PERRY'S SYNDROME: AN UNUSUAL CAUSE OF CENTRAL HYPOVENTILATION

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Background: Perry syndrome is a rare autosomal dominant condition characterised by parkinsonism, central hypoventilation, psychiatric symptoms and unexplained weight loss. The gene involved is a mutation in dynactin 1 (DCTN1) on chromosome 2p13.1. Only sixteen families worldwide have been described. Death is primarily caused by respiratory failure or suicide with a life expectancy of 5 years. We describe a case of Perry syndrome who recently presented to our centre.

Methods: A 55 year-old man was admitted with Type II respiratory failure of unknown origin in the context of 30 kg weight loss, apathy and depression over the preceding two years. He was noted to have periodic breathing at rest with apnoeas lasting up to a minute during wakefulness. Initially he presented with features consistent with acute hypercapnia (GCS14, slurred speech, asterix), with no abnormalities on respiratory exam and an PaCO₂ of 67.9 mmHg. He had a flat affect, with decreased facial expression but no overt Parkinsonism. Treatment with non-invasive ventilation (NIV) was initiated with significant improvement. His family history was reviewed including previous publications regarding his brother's diagnosis of Perry syndrome. He is currently stable on nocturnal NIV with resolution of his hypercapnoea and hypersomnolence (Epworth sleepiness scale 7). Genetic testing confirmed the patient was heterozygous for the c.233A>G(p.Tyr78Cys) mutation in exon 2 of the DCTN1 gene. A literature review was also performed and diaphragmatic pacing has been considered.

Progress to date: Completed.

Intended outcome and impact: To highlight and describe an unusual cause of central hypoventilation and discuss the diagnostic approach and treatment options for respiratory failure in this rare familial neurodegenerative disease. Additionally to describe the family pedigree, genetic testing implications and future management of this condition for his children and grandchildren.

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A PATIENT WITH PULMONARY EMBOLISM AND STROKE- IS SLEEP APNOEA THE CULPRIT?

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Introduction: Asymptomatic patent foramen ovale (PFO) is reported in up to 72% of patients with obstructive sleep apnoea (OSA). The right to left shunt (RLS) generated from a PFO could be potentiated by transient increased pulmonary pressures recorded in OSA. We report on a case of untreated OSA potentiating paradoxical embolism through a PFO.

Case report: A 68- year- old man presented to the hospital with dyspnoea over 2 weeks duration and sudden left arm weakness. A CT angiography of the head showed incidental pulmonary embolism, but no established cerebral infarct. A bedside echocardiogram

revealed right heart strain but no other abnormalities. The patient developed sudden dense right hemiparesis with repeat CT angiogram demonstrating left MCA occlusion. Subsequent investigations revealed multiple pulmonary embolism and extensive right saphenous deep vein thromboses. There was no evidence of malignancy and prothrombotic screen was negative. The patient gave a history suggestive of OSA and he was noted to have apnoeic spells in the ward. A sleep study showed severe obstructive sleep apnoea with a total apnoea/hypopnoea index (AHI) of 47.5/h. The patient was commenced on CPAP with improvement of AHI. An Echocardiogram with a bubble study was repeated post initiation of CPAP proving PFO with no further evidence of right heart strain.

Results: Paradoxical strokes have been described from peripheral embolism transitioning through PFOs, relating to RLS across PFOs. In studies on patients with OSA syndrome and PFOs, RLS developed with obstructive apnoeas longer than 17 sec. The risk of paradoxical cerebrovascular events was thought to increase proportionally to the respiratory disturbance index of these patients. Conversely, CPAP treatment has shown to reduce RLS in patients with known concurrent OSA and PFOs.

Discussion/Conclusion: The severe untreated OSA, pulmonary embolism, altered right heart haemodynamics and co-existing PFO were likely potentiating factors for a paradoxical embolism and subsequent stroke in this patient. His treatment with CPAP could decrease the risk of further paradoxical events by reducing RLS and altering right heart pressures.

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THE RECOMMENDED CPAP PRESSURES FROM IN-LABORATORY TITRATION STUDIES FOR PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNOEA INCREASE SIGNIFICANTLY OVER A 12 MONTH PERIOD OF CPAP THERAPY

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Background: Following a diagnosis of Obstructive Sleep Apnoea (OSA), a Continuous Positive Airway Pressure (CPAP) titration study is the gold standard method to manually titrate positive airway pressure and determine the optimal pressure for maintaining upper airway patency. There are limited data regarding the change in CPAP pressure requirements over time. In patients diagnosed with severe OSA, this study aims to identify if there are significant changes in CPAP pressure at 6 and 12 months, and potential factors influencing changing CPAP pressure requirements.

Methods: 49 patients (age 59.2 ± 9.4 years; 34 Male, 15 Female; Body Mass Index (BMI) 36.6 ± 9.5 kg/m²) newly diagnosed with severe OSA underwent in-laboratory CPAP titration, with repeat CPAP titration studies at 6 and 12 months after the initial titration. Recorded patient data at 0, 6 and 12 months included Epworth Sleepiness Score (ESS), Apnoea Hypopnoea Index (AHI), BMI, and waist and neck circumference. For each CPAP study, we recorded final CPAP pressure, sleep posture, sleep stages, total sleep time and mask type. Data were analysed using ANOVA and post-hoc Tukey's test.

Progress: Compared with the baseline (0) study, there was a significant increase in CPAP at both the 6 month and the 12 month

studies (0 months: 12.3 ± 2.7 cm H₂O; 6 months: 13.5 ± 2.8 cm H₂O; 12 months: 14.0 ± 3.3 cm H₂O; $P < 0.0001$, for 0 vs. 6 and 12, ANOVA). The subjects' ESS decreased significantly from baseline (0) at both 6 months and at 12 months (0: 10.0 ± 4.6 au; 6: 7.4 ± 4.7 au; 12: 6.0 ± 3.6 au; $P < 0.0005$, for 0 vs. 6 and 12). There was no difference between 6 and 12 months in terms of CPAP pressure or ESS. No significant changes over 12 months in any other measured variable were recorded.

Intended Outcome: We conclude that in subjects treated with CPAP for severe OSA, CPAP requirements increase over a 6–12 month period, in association with a significant reduction in subjective sleepiness. However, there are no associated changes in other anthropometric or polysomnographic variables. Possible causes for the increase in CPAP include a true increase in pressure requirements, subtherapeutic initial titration CPAP, or differences in follow up CPAP titration protocol. We speculate that patients with severe OSA may benefit from a review of CPAP pressure requirements after 12 months of CPAP.

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EFFECTS OF ANTIDEPRESSANTS ON POLYSOMNOGRAPHIC PARAMETERS IN OBSTRUCTIVE SLEEP APNOEA PATIENTS

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Introduction/Aim: Most antidepressants prolong REM latency and reduce amount of REM sleep. A small number of studies demonstrated significant effects of antidepressants on sleep of Obstructive sleep apnoea (OSA) patients. We studied the physiological changes associated with long term use of selective serotonin reuptake inhibitors (SSRI, a common class of antidepressants) in sleep in OSA patients.

Methods: We recruited 5 OSA subjects on SSRI and 5 age matched control subjects who were not on antidepressants. All subjects were males. We reviewed the Polysomnographic (PSG) parameters, including total sleep time (TST), apnoea hypopnoea index (AHI), amount of REM sleep and slow wave sleep (SWS), REM latency, and arousal index (AI). Data was analysed using non-parametric tests.

Results: Mean (\pm standard deviation) age for the SSRI group was 57 ± 16 years old and 51 ± 14 years old for control group ($P = 0.35$). The control group had a lower BMI 28 ± 0.71 kg/m² compared to the SSRI group 34 ± 2.2 kg/m² ($P = 0.01$). The AHI for the SSRI group and control group were 31 ± 16 and 35 ± 18 events per hour respectively ($P = 0.83$). There were non-significant trends for the SSRI users to have less TST (290 ± 117 vs. 379 ± 54 min, $P = 0.12$), REM sleep (12 ± 7 vs. 19 ± 6 % TST, $P = 0.21$) and SWS (7 ± 8 vs. 12 ± 9 % TST, $P = 0.39$). The REM sleep latency for the SSRI group was 188 ± 140 min, compared to 125 ± 36 min ($P = 0.35$) for the control group. The AI were similar between the 2 groups (28 ± 21 vs. 33 ± 24 events per hour, $P = 0.83$).

Conclusion: In this small cohort of patients, long term antidepressant use in OSA patients was there was considerable inter-individual variation in sleep parameters PSG. Larger numbers of patients are required to confirm the significance of observed trends in altered sleep architecture. There was no large difference in AHI. The clinical significance of the changes requires further investigation.

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EFFICACY OF DAYTIME SLEEP STUDIES IN ASSESSMENT OF HYPERSOMNOLENCE; AN AUDIT OF DAYTIME SLEEP STUDIES PERFORMED AT A TERTIARY CARE HOSPITAL

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Background: Daytime hypersomnolence is subjectively assessed using Epworth sleepiness score (ESS); which provides average sleep propensity over 8 different real life situations. Daytime sleep studies (MSLT/MWT) are routinely performed to get an objective assessment of hypersomnolence but applicability and generalizability of these results is difficult as they quantify situational sleep propensity under one controlled environment only. There is little evidence to support collinearity between the two methods.

Aim: To review demographic profile of patients being investigated for excessive daytime sleepiness in our sleep lab and to analyse key factors that may impact on results of MSLT/MWT.

Methods: This study will present a retrospective analysis of all the daytime sleep studies performed at our lab for investigation of excessive daytime sleepiness from January 2015 to March 2016. Local data was extracted from sleep lab database.

Results: Multiple endpoints for analysis include association of Mean sleep latency (MSL) with Epworth sleepiness score (ESS), Total sleep time (TST), AHI and CPAP treatment pressures on overnight sleep study.

Conclusion: A detailed analysis of daytime sleep studies results will be presented. MSLT/MWT results do aid in our clinical decision making but one needs to understand the limitations of these investigations.

Disclosures: None.

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DEMOGRAPHIC AND ANTHROPOMETRIC ASSOCIATIONS WITH SLEEP-DISORDERED BREATHING

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Background: There is growing interest risk factors for obstructive sleep apnoea aside from obesity.

Aim: To describe the demographics of attendees at a teaching hospital-associated sleep laboratory, and to elucidate any association between demographic factors and sleep-disordered breathing in this cohort.

Methods: Audit of consecutive attendees of the sleep laboratory during the first quarter of 2014 with respect to demographic data (country of birth, social disadvantage as measured by the 2011 Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)), anthropometry (BMI, neck circumference) and sleep study characteristics.

Results: The sleep laboratory provided 367 services during the audit period. 62% of patients resided in an area in the lowest (i.e. more disadvantaged) half of the IRSAD, and 186 (55%) patients had follow-up appointments scheduled in the private health system. 143 (42%) of patients were born outside of Australia/New Zealand, of which 64 were born in Europe, 21 Asia, 16 the United Kingdom, 12 South America, 11 the Middle East, 7 South Asia, 6 Oceania 4 Africa (2 patients did not list a country of birth).

The overall prevalence of severe obstructive sleep apnoea (AHI > 30) in patients who underwent a diagnostic study was 62%.

In univariate analysis, male gender, BMI > 30 and neck circumference were associated with severe sleep apnoea. Patients with private physician follow-up had a lower prevalence of at least moderate (AHI > 15) but not severe (AHI > 30) obstructive sleep apnoea. Country of birth as Australia, New Zealand or UK was associated with a lower, and South Asian country of birth a higher, prevalence of severe OSA in univariate analysis, but this did not persist following correction for age, gender and BMI.

In multivariate analysis following correction for age, gender and BMI, the Epworth Sleepiness Score and IRSAD were associated with AHI. No association was found between AHI and private follow-up, country of birth or age.

Conclusion: The association between IRSAD and OSA may suggest a role for socioeconomic disadvantage, and warrants confirmation in larger cohort studies.

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HOW THE SLEEP 'PERFECT STORM' IMPACTS ON ADOLESCENTS

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The critical role that sleep plays in adolescence is increasingly well documented for a range of areas including brain maturation, learning, emotional wellbeing and physical health. Insufficient sleep, daytime sleepiness and circadian misalignment in adolescence have been variously shown to contribute to reduced quality of life and productivity, greater risk of depression and obesity, higher rates of drowsy driving crashes and illness and may increase incidents of anti-social behaviours, aggression, substance abuse and self-harm. This presentation will provide an overview of findings and an update of key evidence of the important role of sleep in adolescent development; it will also argue that the 'perfect storm' metaphor applies to sleep patterns of adolescents in the sense that developmental trajectories of biopsychosocial factors conspire to limit the quantity of sleep for many adolescents who live in industrial societies in the 21st century.

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DO WE SLEEP TO REWIRE THE BRAIN?

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Sleep function remains controversial for several reasons. The minimal amount of brain tissue required for sleep to manifest remains controversial as does the issue of when sleep first appears in evolution. Sleep measurement is indirect; no single parameter is always indicative of sleep. The measures one uses to define sleep influence how individuals frame the issue of sleep function, e.g. whole animal (behavior, metabolic, or EMG measures) or small neuronal/glial network (single cell or small network electrical activity measures). At higher levels of tissue organization, several functions of sleep are experimentally demonstrable. Thus, during sleep whole body metabolic rate is lower than basal waking metabolic rate; this fact directly demonstrates that sleep serves a caloric function. Cognitive behavioral measures indicate that sleep serves to restore cognitive function decline associated with prolonged wakefulness. An extensive literature supports the idea that sleep serves a host-

defense function, e.g. improves recuperation from infectious challenge. These sleep functions are generally accepted, but their disparate mechanisms suggest that they may be opportunistic functions rather than the primordial function for sleep. At the whole brain level two newer theories propose that sleep replenishes brain energy stores and that sleep serves a glymphatic function; both are great ideas but lack convincing experimental support due to technical limitations. At the small neuronal/glia circuit and synaptic level, sleep is posited to stabilize brain connectivity and preserve synaptic plasticity. Connectivity and synaptic efficacy change with cell activity, e.g. afferent input, and are influenced by sleep and sleep loss. Activity-dependent molecules, e.g. neurotrophins, cytokines, adenosine, NO, mechanistically alter brain microcircuits. Most of these molecules, in fact all currently studied, also play a key role in sleep mechanisms. Small neuronal networks, e.g. cortical columns, in vitro co-cultures of neurons and glia, oscillate between wake-like and sleep-like states as defined by electrical properties used to characterize sleep at the whole brain level, e.g. amplitude of evoked response potentials, delta wave synchronization and power, and burstiness of action potentials. Over days during in vitro network development, these parameters manifest suggesting that sleep is a small network emergent property, as opposed to an inherent cell property. Accepting this idea, logically sleep should occur in any organism with a neuronal network, but not in organisms lacking neuronal networks. Further, sleep is initiated at a local network level and sleep mechanisms are one in the same as plasticity mechanisms. Sleep's primordial function may thus deal with network connectivity.

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IMPACT OF MULTI-NIGHT SLEEP RESTRICTION ON ADOLESCENTS' ATTENTION: A NETWORK-BASED ANALYSIS OF MRI DATA DURING THE PSYCHOMOTOR VIGILANCE TEST

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Introduction: Adolescents often experience chronic sleep restriction (SR) on school nights. Little is known about how brain function is altered during attention breakdown, especially in the context on adolescent SR. Here we report on a network-based neuroimaging analysis of a vigilance task in which we compare responses based on performance (lapse vs. normal) and sleep condition (SR vs. healthy sleep duration; HS).

Methods: Thirty-three typically-developing 14–16-year-old adolescents underwent a 3-week within-subjects protocol: a baseline week followed by two 5-night experimental conditions of 6.5 hrs vs. 10 hrs in bed per night, in counterbalanced order. Each adolescent underwent fMRI at the end of each experimental condition while completing a variant on the Psychomotor Vigilance Test. Imaging data were analysed using event-related independent component analysis (eICA) for two different response types (lapse = reaction time >500 ms, normal = RT 100–400 ms). We selected a subset of ICs for relevance, fitting a 3rd-order polynomial to each time series and extracting the timing and intensity of peak activations for each subject, then entering these into a bootstrapped within-subject ANOVA (comparing lapse vs. normal and SR vs. HS). Finally, median ANOVA coefficients for each subject were pooled and tested for significance.

Results and Discussion: We identified 7 ICs that appeared relevant to distinct elements of the attention, sensory, or motor aspects of PVT performance. Lapses were marked by subtly unusual brain responses in several networks. Lapses seemed to require a more dramatic recovery from “default mode” brain states, and greater activation of a network involved in appraising salience. Attention networks were also subtly sluggish to respond during lapses. With some exceptions, these effects were the same across HS and SR. Sleep restriction may make lapses more likely, but minimally change what the brain is doing during each lapse.

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COGNITIVE PERFORMANCE AND SLEEP SPINDLES IN ADOLESCENTS: A REVIEW AND DATA FROM A SLEEP RESTRICTION PROTOCOL

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Objectives: Sleep spindles have been linked to cognitive performance in adults, however the relationship between spindles and cognition in adolescents is under-studied. A systematic review identified 13 studies published between February 2009 – June 2015, using samples with ages ranging from 8–21 years. The studies show strong relationships between various spindle characteristics and cognitive areas of fluid intelligence and working memory. Adolescence is a time of high pressure to perform academically, combated by changes to sleep habits and typically sleep loss. The relationship between sleep spindles and cognition was therefore examined under the context of sleep restriction.

Methods: 34 adolescents aged 15–17 years attended a sleep laboratory for 10 days and received 3 separate ‘doses’ of sleep: 5 h, 7.5 h or 10 h. Adolescents had 2 baseline nights of 10 hrs of sleep, followed by 5 consecutive nights of restricted sleep to mimic an adolescent's potential self-restriction of sleep during the school week. Adolescents then had 2 nights of recovery sleep (10 hrs).

Results: Preliminary analyses of $n = 8$ participants in the 5 hr sleep restriction condition indicate a significant reduction in the number of spindles during sleep restriction as well as a reduction in spindle density (number of spindles per minute of stage 2 sleep). Working memory (Operation Span Task) was strongly correlated with spindle density during sleep restriction, however did not reach significance with this sample size ($r = 0.54$, $P = 0.17$). Fluid intelligence (Letter Sets and Number Series Task) was also strongly correlated with spindle density during restriction, however also did not reach significance with this sample size ($r = 0.70$, $P = 0.05$). Fluid intelligence was strongly correlated with total number of spindles at recovery ($r = 0.8$, $P = 0.02$).

Conclusions: The preliminary results replicate past findings of correlations between sleep spindle activity and cognitive performance. They furthermore indicate that sleep restriction leads to a reduction in brain wave patterns which are linked to cognitive performance.

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TREATING OSA TO IMPROVE AF MANAGEMENT - WHAT IS THE EVIDENCE?

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Atrial fibrillation (AF) affects at least a quarter of a million Australians and accounts for an estimated \$1.8 billion in healthcare costs. Obstructive sleep apnoea (OSA) is highly prevalent in AF with some studies suggesting that 40–80% of patients with AF have OSA. Numerous observational studies suggest that OSA is an independent risk factor for AF and AF treatment failure. Studies also show that treatment of OSA may reduce arrhythmia recurrence but to date there are no large randomised controlled trials that have directly addressed this question. This presentation will examine the evidence that treatment of OSA improves AF management. We aim to stimulate discussion over the merits of whether randomised controlled trial evidence is needed and the outcomes that evidence should be based upon before OSA treatment becomes a routine component of AF management.

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IDENTIFYING AND TREATING OSA IN THE PERI-OPERATIVE SETTING: MITIGATING PATIENT RISK OR LOGISTIC BURDEN

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Obstructive sleep apnoea is highly prevalent among patients undergoing major surgery. As many as 40% have or are identified as high risk for OSA in this population. Most of this disease burden remains unrecognized in the standard clinical context. Observational studies suggest OSA is a risk factor for a number of post-operative complications including delirium, chest sepsis, myocardial ischaemia, pulmonary embolism, unplanned admission to the ICU and reintubation. Narcotic use and excessive intra/post-operative fluid replacement may exacerbate existing OSA or contribute to emergent OSA in the post-operative setting.

Although an association between high risk OSA and postoperative complications is demonstrated the causal relationship is yet to be established. Limited data on the use of CPAP in the postoperative setting suggests it may have a protective benefit from postoperative complications. This presentation will overview the existing evidence of the risk related to untreated or undiagnosed OSA in patients undergoing major surgery.

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PULSE OXIMETRY: THE RIGHT TOOL IN THE RIGHT HANDS

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Pulse oximetry can be applied in many different settings (1). Oxygen saturation (SpO₂) obtained from a pulse oximeter is routinely recorded during full PSG and limited channel monitoring, and is a component in the definition of sleep related respiratory events. As with any physiological measurement, there are factors which may influence the accuracy of pulse oximetry which need to be recognized. These factors include the site of interface with the patient, the

type of oximeter used, the settings within the oximeter, how data is recorded onto another device, algorithms employed, display of data and statistics reported. Not all of these will be covered in this presentation; however, there will be discussion of some issues, such as averaging time, sampling rate and display characteristics which can significantly impact on outputs and thus diagnosis. These variables can be manipulated by the measurement scientist, and thus, an understanding of the performance characteristics of an oximeter with its associated recording and analysis, is crucial to the correct diagnosis of patients with sleep disordered breathing

1. Clinical Use of pulse oximetry: Official guidelines from the Thoracic Society of Australia and New Zealand. *Respirology* 2014 Jan; 19 (1):38–46.

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IMPLICATIONS OF PERIPHERAL CLOCK DISRUPTION: LESSONS FROM OSTEOARTHRITIS

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Clocks are present within most cells in the body. Those present in tissues other than the suprachiasmatic nucleus (SCN) are termed “peripheral” clocks. Peripheral clocks are partly regulated by the SCN clock. They are also responsive to changes in the local tissue environment. Peripheral clocks have an important role in providing tissue-specific regulation of cell behaviour. They ensure the temporal separation of conflicting cell processes and enable co-ordination of reliant processes. Peripheral clocks also have a role in controlling the cellular life cycle and are involved in the regulation of cell differentiation and aging. Recently we found that the peripheral clock is altered in osteoarthritis, one of the most common degenerative conditions affecting humans. Mimicking the change in clock function in vitro causes cells to adopt phenotypic characteristics reminiscent of the disease state indicating clock disruption may contribute to disease development. There is mounting evidence indicating that peripheral clock disruption is associated with the development of a number of other pathologies including diabetes and cancer.

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BRAIN MOLECULAR RHYTHMS; SLEEP CONSEQUENCES IN HEALTH AND DISEASE

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There are many well-known bi-directional interactions between circadian rhythms and sleep; e.g. cell activity and sleep interact to affect the magnitude of cortical EEG delta power and gene expression differentially across the 24 h day. Here the focus is on rhythms of sleep molecular mechanisms including. 1) How sleep regulatory substances (SRS) vary with the time of day; e.g. brain interleukin-1 (IL1) and tumor necrosis factor (TNF) peak at the onset of the sleep period in mice. 2) How SRS mutations have time-of-day effects on sleep phenotypes; e.g. mice lacking the IL1 receptor have less NREMS and REMS during the night. 3) Time-of-day-dependent outcomes of sleep deprivation; e.g. an IL1 receptor accessory protein mutant mouse sleeps less after sleep deprivation performed during ZT 10–20 while it sleeps more after sleep deprivation performed at ZT 22–8; a cafeteria diet; e.g. the effects on NREMS of a cafeteria diet occur mostly during the light hours in rats, and infectious challenge; e.g. low doses of influenza

virus enhance night time sleep disproportionately more than daytime sleep. 4) The effects of continuous light or continuous dark on sleep outcomes following infectious challenge; e.g. sleep responses to *Candida albicans* are substantial higher in continuous light than continuous dark and both are different from mice on a 12:12 h L: D cycle. We conclude the molecular mechanisms for sleep are extensively coupled to the circadian rhythm molecular mechanisms.

Supported by the National Institutes of Health (USA) grants NS25378 and HD36520.

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PREVIOUS AND CURRENT RESEARCH AT THE NEW ZEALAND BRAIN RESEARCH INSTITUTE: IMPACT OF SLEEP RESTRICTION AND OBSTRUCTIVE SLEEP APNOEA ON CEREBRAL PERFUSION

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Over the past 15 years, a number of studies have been undertaken at the New Zealand Brain Research Institute variously investigating functional MRI or cerebral blood flow associated with obstructive sleep apnoea, microsleeps, or drowsiness in normally-rested or sleep-restricted participants. The results of two previous studies will be presented: (1) Cerebral perfusion differences between drowsy and non-drowsy individuals after acute sleep restriction and (2) Decreased regional cerebral perfusion in moderate-severe obstructive sleep apnoea during wakefulness. The current status of two ongoing studies will also be discussed: (1) Can early treatment prevent sleep apnoea-related brain damage? and (2) Efficacy of stimulants for preventing microsleeps in people with acute sleep restriction.

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WHAT ARE WE AIMING FOR? SUCCESSES, FAILURES AND PROMISE OF HOME SLEEP MONITORING

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This presentation illustrates and clarifies key benchmarks for home sleep monitoring, with the goal of promoting audience members' ability to critically appraise existing and new sleep monitors. Practical considerations include cost, portability, patient tolerance/acceptability, the data transfer process, and end-user experience. Statistical considerations include reliability, sensitivity and specificity relative to a "gold standard", representative coverage of the construct being measured (content validity) and, given that gold standards often have their own limitations, conformity to conceptual expectations (construct validity). Although technological progress is rapid, home sleep monitors tend to make important trade-offs in these benchmarks. This is inherent in the measurement enterprise and drives innovation. However, problems emerge when potential users are left in the dark due to companies failing to fully test their products, to allow or promote

independent testing, to disclose technical findings, or to make a good faith effort to translate those technical findings into lay terms.

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VALIDATION OF PHOTOPLETHYSMOGRAPHY BASED SLEEP STAGING COMPARED WITH POLYSOMNOGRAPHY IN HEALTHY MIDDLE AGED ADULTS

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Introduction: Overnight polysomnographic (PSG) studies are invaluable in the assessment and diagnosis of many sleep disorders. However, the costs associated with this highly specialized and labor-intensive procedure makes it less suitable for long-term monitoring. Recent years saw an explosion in the availability of wearable devices which claim to be able to track sleep patterns during the night. Although well-suited for long-term home sleep monitoring, the performance of most of these devices remains unpublished.

Methods: Using a wrist-worn PPG to analyze heart rate variability and an accelerometer to measure body movements, sleep stages and statistics are automatically computed based on overnight recordings. Sleep/wake, 3-class (wake/NREM/REM) and 4-class (wake/N1 + N2/N3/REM) classifiers were trained on a data set of 135 simultaneously recorded PSG and PPG recordings of 101 healthy subjects, and validated on 80 recordings of 51 healthy middle-aged adults (28 females, mean age 51.8 ± 7.3 years).

Results: Regarding the epoch-per-epoch agreement between PPG- and PSG-sleep stages, the sleep/wake classifier obtained a Cohen's kappa coefficient of agreement of 0.55 ± 0.14 and accuracy of $91.5 \pm 5.1\%$, the 3-class classifier, a kappa of 0.46 ± 0.15 and accuracy of $72.9 \pm 8.3\%$, and the 4-class classifier, a kappa of 0.42 ± 0.12 and accuracy of $59.3 \pm 8.5\%$. Regarding the bias and standard deviation of the error between PPG- and PSG-sleep statistics, the method obtained, for total sleep time, 13.40 ± 31.74 min, for sleep efficiency $2.90 \pm 6.82\%$, for total wake time, -13.40 ± 31.74 min, for wake after sleep onset, -3.19 ± 25.28 min, for time in N1 + N2, -28.33 ± 42.22 min, for time in N3, 0.26 ± 36.32 min, and for time in REM, 41.47 ± 33.62 min.

Discussion: Although the performance is not yet at a level where this method can replace gold-standard PSG in the clinic, the moderate epoch-per-epoch agreement, and in particular, the good agreement in terms of sleep statistics makes this inexpensive and comfortable monitoring procedure a good complement to PSG, in particular for long-term monitoring at home. It can also provide an improvement over traditional actigraphy where only sleep and wake states are assessed. Further validation is needed in other age groups and clinical populations before it can be fully deployed in clinical practice.

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SLEEP AND CARDIOVASCULAR CONTROL BEFORE BIRTH L. BENNET

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When we think about sleep and its effects on our adult health, we seldom think that our problems might have started in fetal life. Yet, it is

during fetal life that the foundation of our sleep architecture is laid down and research suggests that impaired fetal sleep development may programme for later adult disease. Fetal sleep-like states evolve from a desynchronous state to cycling between rapid-eye movement (REM) and non-REM patterns and it is debated as to whether the fetus is ever awake. Fetal cardiovascular function matures as a function of growth and autonomic nervous system development, but it is also modulated by sleep cycling and fetal behaviour. We now know that fetal activity including sleep, is regulated by circadian clocks, entrained by mothers eating and light exposure at least late in gestation. Little is known about the control of these rhythms earlier in life and their impact on cardiovascular or other physiological development. Modern day life, with our over-exposure to light, stress, and western diets, challenges our circadian rhythms and this is associated with poor sleep and risk for illness. Pregnancy is already associated with poor sleep quality, and these life-style factors compound the issue. New research suggests that impaired maternal circadian rhythms and inadequate sleep are associated with impaired fetal development and increased risk for adult diseases such as hypertension. This talk will discuss how fetal sleep evolves, its relationship to fetal development and the role of circadian rhythms.

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CARDIOVASCULAR CONSEQUENCES OF SLEEP DISORDERED BREATHING IN INFANTS AND CHILDREN

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During childhood sleep is at a life time maximum. Sleep is essential for normal development and is particularly important in childhood when infants spend over 70% of each 24 h asleep and children around 50%. During infancy infants are also most vulnerable to respiratory disruptions due to immature cardiorespiratory control. Preterm infants frequently exhibit apnoeas termed apnoea or prematurity and an immature breathing pattern termed periodic breathing. Apnoea of prematurity is usually resolved by term equivalent age, however periodic breathing can continue over the first 6 months after term equivalent age. Periodic breathing has been considered benign as the apnoeas are short, however we have shown that it is associated with significant reductions in cerebral oxygenation. Whether these repetitive falls in cerebral oxygenation contribute to the adverse neurological outcomes frequently observed in ex-preterm children is yet to be ascertained.

In older children sleep disordered breathing is very common and it is estimated that these affect around 35% of all children. As in adults sleep disordered breathing has significant effects on the cardiovascular system with primary school aged children exhibiting elevated blood pressure or 10–15 mmHg together with increased sympathetic activity as measured by heart rate variability. The effects on the cardiovascular system are milder in younger children with elevated blood pressure only being observed in those with moderate to severe disease in REM sleep. These findings raise the question – should we be identifying and treating sleep disordered breathing earlier in children. These physiological studies provide important evidence which will influence treatment of these conditions in children to improve long term outcomes.

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SLEEP, HYPOXIA, AROUSAL AND CARDIOVASCULAR CONTROL: MECHANISTIC INSIGHTS FROM RODENTS USING OPTOGENETICS

P. BURKE

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Obstructive sleep apnoea causes significant intermittent arterial hypoxemia and hypercapnia, and leads to cardiorespiratory stimulation and arousal from sleep. These adjustments in breathing, circulation and vigilance are initiated by feedback by O_2/CO_2 chemoreceptors such as the carotid body, and by airway mechano-, thermal and pressure sensors. Brainstem neuronal networks receive and integrate this respiratory afferent information, and activate physiological and behavioural effectors via a sequence of central neuronal connections that remain poorly defined. Identifying these key intermediate neuronal circuits, such as the circuitry responsible for the arousal by carotid body activation, is vitally important. So too is defining the endogenous factors and mechanisms that modulate the information flow along these circuits that shape neural gain (ie ventilatory response) and adaptive behaviour (ie arousal threshold). My talk will focus on recent efforts using optogenetic methodologies to test the contribution of specific brainstem pathways in rodents for the hypoxic or hypercapnic-induced cardiorespiratory stimulation and arousal from sleep. I will also present evidence that increased endogenous adenosine tone, via sleep deprivation or mild CNS hypoxia, suppresses brainstem circuits triggering arousal. This metabolic neuromodulator may underlie the increased arousal threshold seen in obstructive sleep apnoea.

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MANAGING DEPRESSION IN THE SLEEP CLINIC

C. GRAY

New Farm Clinic, Brisbane, Australia

In this presentation psychiatrist Dr Curt Gray will take the participants through diagnostic issues with respect to depression as it may present in a sleep clinic and considerations regarding “sub-typing” different forms of depression, key issues of concern such as suicidality and other comorbidities, pointers to a better response to somatic treatments, and available treatment modalities. Recommendations about referral to a mental health practitioner will be discussed.

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AN INVESTIGATION OF THE LONGITUDINAL RELATIONSHIP BETWEEN SLEEP AND DEPRESSED MOOD IN DEVELOPING TEENS

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Introduction: The prospective, bidirectional relationship between sleep disturbance and depressed mood was assessed in a school-based sample of adolescents.

Methods: One-hundred and thirty eight Australian adolescents (mean age Time 1 = 15.69, SD = 0.92; 64% male) completed

questionnaires to assess sleep parameters and depressed mood, on two occasions over 1-year.

Results: Cross-sectional associations were observed between depressed mood and sleep duration, as well as wakefulness in bed. Prospective analyses revealed depressed mood predicted less total sleep time on school nights and a longer latency to sleep onset on weekends 1-year later. There was no prospective support for sleep predicting later depressed mood.

Discussion: Contrary to prediction, our results suggest in this case that depressed mood may act as a precursor to poor sleep rather than the converse.

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WHAT IS THE IMPACT OF SOCIAL SUPPORT ON THE RELATIONSHIP BETWEEN CHILD SLEEP DISTURBANCE AND POSTNATAL DEPRESSION?

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Aims: To determine the extent to which the social support that caregivers receive affects the relationship between Postnatal Depression (PND) and child sleep problems.

Methods: The sample consisted of 108 participants who were caregivers of children between 6–18 months of age. Participants completed an online survey comprised of the Edinburgh Postnatal Depression Scale, The Social Provisions Scale and The Brief Infant Sleep Questionnaire. Pearson's product-moment correlations and moderation analyses were utilised to explore relationships and moderation effects.

Results: Results showed that parents of children who were sleep disturbed had higher levels of PND and less social support. A significant negative relationship between social support and PND was found ($r = -0.539$, $P = 0.000$). Correlations between PND and nocturnal sleep ($r = -0.231$, $P = 0.016$) and nocturnal wakefulness ($r = -0.228$, $P = 0.018$) were significant. Social support was also significantly correlated with nocturnal sleep ($r = 0.329$, $P = 0.001$) and nocturnal wakefulness ($r = 0.199$, $P = 0.039$). No moderating effect of social support on the relationship between child sleep disturbance and PND was found for either sleep variables ($b = -0.014$, 95% CI $[-0.099, 0.071]$, $t = -0.33$, $P = 0.745$; $b = 0.065$, 95% CI $[-0.267, 0.396]$, $t = 0.39$, $P = 0.700$).

Discussion: Parents with high social support have lower PND scores and their children present with less sleep problems. Although a significant moderating effect of social support on the child sleep and PND relationship was not found, the significant correlations between the three variables reveal that caution must be taken when concluding there is no moderating effect.

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TIME-OF-DAY PREFERENCE IMPACTS YEAR 8 STUDENTS' SLEEP TIMING, STRESS, AND FOOD INTAKE DURING THE SCHOOL HOLIDAYS

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Introduction: The delay in circadian timing during adolescence combined with early school starts results in sleep restriction on school days, which is often somewhat offset by extended sleep on weekends and holidays. These changes to sleep may be

exacerbated for those with an evening (EP) compared to morning preference (MP). Further, research suggests that EP in adolescence is associated with changes in food consumption and stress hormones, and increased obesity risk. This study assessed differences in sleep length and timing during school time and holidays for Year 8 students. The impact of Morningness-Eveningness (M-E) on sleep timing, stress, and food intake was explored.

Methods: Nineteen adolescents aged 13–14 years ($M = 13.1 \pm 0.2$ years, 7 male) wore ActiWatches (MiniMitter, Philips) for one week prior, and one week during, the school holidays. Participants completed the M-E Scale and daily 7-point scales rating food intake and stress (compared to usual levels).

Results: Mixed model analyses specified day, day-type (school/ weekend/holidays) and M-E as fixed effects and subject as a random effect. There were no significant main or interaction effects for time in bed or total sleep time (TST: school nights = 8.7 ± 0.8 h, weekends = 9.0 ± 1.3 h, holidays = 9.1 ± 1.2 h). There was a significant main effect of day-type for sleep onset time ($P = 0.001$; school nights = 22:16 h, weekends = 23:07 h, holidays = 23:23 h) and wake time ($P < 0.001$; school nights = 6:58 h, weekends = 8:09 h, holidays = 8:47 h). There were significant M-E*Day-type interaction effects with EP showing even later sleep and wake times on weekends and holidays (compared to school days) than MP (all $P < 0.028$). There was a significant M-E*day-type interaction for stress ($P = 0.048$) and food intake ($P = 0.002$) with EP displaying higher than usual stress and food intake in the holidays (compared to school days) than MP.

Discussion: In this cohort, rather than extending sleep on weekends and holidays, it was simply delayed, suggesting that school week sleep restriction may not always be compensated for on weekends and holidays. In addition, EP, who delay sleep timing even further, may also experience greater changes in stress levels and food intake during the holidays. This combination of changes in timing, stress and food intake may help to explain why evening preference is a risk factor for higher body mass index.

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IMPLEMENTING A SCHOOL-BASED SLEEP

INTERVENTION: VOICES OF THE SCHOOL NURSES

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Introduction: Sleep problems affect up to 40% of children during the early primary school years. They are not only associated with poorer child and parent outcomes, but also an additional \$27.5 million burden on Australia's Medicare system if they occur in the first 7 years of a child's life. Therefore, delivering an evidence-based sleep intervention via an important yet under-recognised health workforce, the school nursing system, could improve child and parent outcomes and lead to reductions in healthcare costs. This study aimed to determine the (i) feasibility, acceptability and sustainability as well as (ii) intervention delivery costs of training primary school nurses to deliver a brief behavioural sleep intervention.

Methods: An embedded mixed methods design utilising quantitative and qualitative data sources was used. We invited 24 primary school nurses from the Victorian Department of Education and Training to participate. All nurses had delivered a school-based sleep

intervention as part of the *Sleep Well – Be Well* study. Nurses completed surveys pre and post training, and up to 18 months later as well as a detailed focus group.

Results: Qualitative and quantitative evidence demonstrated training school nurses to deliver a brief sleep intervention was feasible and acceptable. Competence and confidence levels were maintained 12 months after the completion of intervention delivery demonstrating sustainability for this low cost model. Other common conditions where a similar intervention may be suitable were identified by school nurses. Benefits of school nurses' participation in translational research projects were identified.

Discussion: Our findings highlight the potential for utilising school nurses directly in interventions at the health and education interface thereby reducing barriers and improving access to healthcare for children and families. Nurses identified benefits personally and for their role within the school system, but also the challenges of intervention implementation.

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WHO USES WHAT? PREDICTING PARENTS' USE OF EXTINCTION SLEEP INTERVENTIONS WITH THEIR YOUNG CHILDREN IN THE GENERAL AUSTRALIAN COMMUNITY

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Introduction: Extinction behavioural sleep interventions are often recommended to parents to improve sleep in their infants and toddlers, but not all will implement such techniques. Parents' cognitions impact what settling behaviours they use, their routines, limits and habits around bedtime. But to date research has focused on links between parent cognitions, particularly limit-setting cognitions, and children's sleep behaviours. The following research has extended this by investigating how a broader range of parents' night-waking cognitions predict their use of extinction interventions with their children, and what specific parent, child and family factors predict parents' night-waking cognitions.

Methods: Parents of a 6–18-month-old child ($n = 1344$) completed an online survey measuring use of three extinction interventions ('cry-it-out', 'controlled crying' and 'parental presence'); perceived effects of extinction on them and their child; parent night-waking cognitions, mood, efficacy, age, education, partner disagreement, and satisfaction with sleep information; and child age, fussiness, and sleep problem rating. Pathway analysis was used to construct a model to predict extinction use from perceptions, cognitions, and the various parent and child factors.

Results: Parents' perception of the impact of extinction strongly predicted use of extinction, with more positive perceptions predicting extinction use while negative perceptions predicted non-use. If extinction was perceived as positive parents' had more positive thoughts and fewer concerns about limit-setting, fewer positive thoughts about active comforting, and more negative affect about night-waking. Problematic child sleep, parent efficacy and parent satisfaction with sleep information each uniquely predicted three of the four measured cognitions. Other child and parent factors made smaller predictive contributions to specific cognitions within the model. The amount of variance predictors could explain in each dependent variable ranged from 4–54%.

Discussion: The findings indicate that there are differential effects of specific family factors and cognitions on specific sleep

management practices. The range in variance explained suggests other, unmeasured factors significantly impact upon some of parents' sleep-related cognitions and practices, which we are yet to understand.

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THE RELIABILITY OF SELF-REPORTED SLEEP PROBLEMS IN ADOLESCENTS AGED 16–19 YEARS ACCORDING TO GENDER AND ETHNICITY (ASIAN-AUSTRALIAN VS. CAUCASIAN-AUSTRALIAN)

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Introduction: The impact of ethnicity and gender on sleep problems have been relatively well explored in adults and young children but have received less attention in adolescents. A challenge however when collecting sleep estimates is the reliance on self-report and especially in adolescents where unlike younger children sleep is less likely to be under parental observation and unlike older adults they are less likely to have a bed partner to corroborate statements. This limitation can be partly addressed if confidence measures are included in questionnaire items.

Methods: As part of an omnibus survey, single item questions with a four point scale (not during the past month, <1/week, 1–2/week and ≥3/week) were used to assess the frequency of loud snoring, long pauses between breaths while asleep (i.e. 'apnoea'), leg twitching/jerking during sleep (i.e. 'PLMD'), confusional awakenings, daytime sleepiness, nightmares and sleepwalking. An additional response key, 'I don't know', was included to assess sleep problem self-awareness. Participants included 42 female Asian-Australians (exclusively Chinese background), 120 female Caucasian-Australians, 118 male Asian-Australians and 165 male Caucasian-Australians aged 16–19 years attending Year 11/12 schooling.

Results: Two between factor ANOVA (Gender by Ethnicity) analyses revealed no significant gender by ethnicity interactions: significant main effects were observed for gender on 'PLMD' ($F > M$), confusional awakenings ($F > M$) and nightmares ($F > M$); and a significant main effect of ethnicity on daytime sleepiness (Asian > Caucasian). The percentage of adolescents who reported 'I don't know' was highest for 'apnoea' (56.9%; significant post-hoc result included $M > F$ & Asian > Caucasian) followed by loud snoring (36.5%), 'PLMD' (36.0%; $M > F$), confusional awakenings (32.9%), sleepwalking (18.2%; $M > F$ & Asian > Caucasian), nightmares (6.2%; $M > F$) and daytime sleepiness (1.9%).

Conclusion: The addition of an 'I don't know' response key is recommended in future surveys. More than a third of adolescents were unable to report on apnoea, snoring, PLMD and confusional awakenings suggesting that additional measures may be needed when assessing these items. In general, the frequency of 'PLMD', confusional awakenings and nightmares were higher in female adolescents while daytime sleepiness was higher in Asian-Australian adolescents.

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A PRELIMINARY STUDY INVESTIGATING SLEEP AND EMOTIONAL MEMORY CONSOLIDATION IN SCHOOL-AGED CHILDREN

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Introduction: It is well known that sleep benefits memory consolidation in young adults. It is thought that emotional information is preferentially consolidated by sleep-related brain processes to improve recall. During childhood there are significant developmental changes to emotional information processing, memory networks, and sleep architecture. It remains unclear if children's memory consolidation benefits from sleep in a similar manner as compared to young adults. The current study explores preliminary data for a larger study investigating memory for emotional information across sleep and wake in school-aged children.

Method: A repeated-measures design was used with 11 children (5 female) aged 8–13 years ($M = 10.85$, $SD = 1.68$). Participants underwent a 2 hr daytime nap condition and an equivalent wake condition in the subsequent week. Polysomnography was used to quantify sleep in the nap. Participants were required to complete a learning task using emotionally valenced (positive, neutral, negative) stimuli, followed by recall sessions where participants needed to identify a set of learned target stimuli from a set of distractors.

Results: A significant reduction in false alarms (false positive responses) was found for the nap condition compared to wake ($P = 0.024$). Moderate to large effect sizes for hit rate performance (correct identification of targets) were found in terms of both valence ($\eta^2 = 0.103$) and the interaction of condition and valence ($\eta^2 = 0.139$). Moderate to large effects were also found for condition ($\eta^2 = 0.104$) and valence ($\eta^2 = 0.149$) for recognition accuracy (overall memory performance).

Discussion: In this pilot study, the observed effect sizes suggest that emotional information was better remembered than neutral information, particularly after sleep compared to wake. These effects appear to be largely driven by a reduction in false alarms and subsequent overall memory performance. However these effects were not statistically significant, and future analysis in a larger sample is required to verify these results and examine associated sleep neurophysiology.

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IS HISTORY OF PARASOMNIAS A CONTRAINDICATION TO SLEEP RESTRICTION THERAPIES FOR MIDDLE CHILDHOOD INSOMNIA?

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Introduction: There is a good evidence base for sleep restriction therapy for adult insomnia. Recent studies suggest sleep restriction therapies (e.g., bedtime fading) may also be effective in middle childhood. However, these techniques may be under-utilised due to lack of knowledge about possible contraindications in this population. In particular, parasomnias (e.g., sleep terrors, sleepwalking) are common in childhood and may be exacerbated by sleep deprivation.

Methods: As part of a randomized controlled trial, this study observed changes in occurrence of parasomnias during insomnia treatment using sleep restriction therapies. 42 participants (6–

13 years) who met criteria for Chronic Insomnia Disorder (as per the International Classification of Sleep Disorders, 3rd edition) were randomly allocated to one of three groups: sleep restriction (time in bed [TIB] reduced to 30 min less than baseline average total sleep time [TST]), bedtime restriction (TIB reduced to match baseline average TST), or regular sleep schedule (i.e., control; TIB scheduled to match baseline average TIB). Treatment was provided in 2 sessions over 2 weeks. Children were monitored via 7-day sleep diaries and provided verbal reports of parasomnia frequency to their sleep therapist.

Results: 19 out of 42 children reported a history of parasomnias (45% of total sample). 79% of children with a history of parasomnias reported no re-occurrence during treatment. For 3 children, parasomnia frequency during treatment was equal to baseline and treatment continued without modification. For 1 child (bedtime restriction group) the frequency of parasomnias increased, the treatment plan was immediately modified to increase TIB, and education was provided about scheduled awakenings as the recommended treatment for sleep terrors. There were no reports of onset of parasomnias in children without such history and there was no significant difference between treatment groups in reported history or re-occurrence of parasomnias ($P = 0.97$).

Discussion: History of parasomnias may not be an outright contraindication to sleep restriction therapies for insomnia in middle childhood. Results need to be replicated with a larger sample.

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THE DIRECTION OF THE RELATIONSHIP BETWEEN SYMPTOMS OF INSOMNIA AND PSYCHIATRIC DISORDERS IN ADOLESCENTS

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Introduction: This study assessed the direction of the relationship between symptoms of insomnia disorder, depression, various anxiety disorders and obsessive compulsive disorder (OCD) in adolescents after controlling for age, gender, chronotype, and outcome variable at baseline.

Methods: Data was collected in eight high schools in (omitted for blinding), at two time-points approximately 6 months apart. The study was completed by 318 and 255 high school students at baseline and follow-up, respectively, aged 12–18 ($M = 14.96$, $SD = 1.34$) in grades 7 to 11 at baseline. Hierarchical regression analyses were used to assess each relationship, the first model controlling for age, gender and chronotype, and the second controlling for outcome variable at baseline.

Results: Insomnia symptoms predicted and were predicted by symptoms of each psychiatric disorder in model 1. In model 2, insomnia symptoms predicted symptoms of depression, and vice-versa. Symptoms of insomnia also predicted symptoms of separation anxiety disorder (SAD), but not vice-versa, in model 2. Symptoms of obsessive compulsive disorder (OCD) and social phobia (SP) predicted symptoms of insomnia disorder in model 2, but not vice-versa. Insomnia symptoms were no longer related to symptoms of generalised anxiety disorder (GAD) and panic disorder (PD) in model 2.

Discussion: Symptoms of insomnia disorder are bidirectionally related to depressive symptoms independent of baseline symptoms, and unidirectionally related to symptoms of OCD and SP where OCD and SP are independent risk-factors for the development of insomnia symptoms. Preventative and treatment efforts for mental health problems in adolescents may focus on insomnia symptoms, and vice-versa.

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SLEEP PATTERNS AND QUALITY IN CHILDREN WITH CYSTIC FIBROSIS AND THE RELATIONSHIP TO DISEASE SEVERITY

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Background: Sleep disruption in adults with cystic fibrosis (CF) has been well documented, however there are limited studies of children with CF. Our aim was to measure sleep patterns and sleep quality objectively and subjectively in clinically stable children with CF and controls, and to examine the relationship between sleep and severity of disease.

Study Design: All Victorian children with CF aged 7–18 years who were free from pulmonary exacerbation were eligible, and age and gender matched healthy controls were recruited. Sleep patterns and objective sleep quality were measured in the home environment with actigraphy over 14 days. One night of SpO₂ was measured using pulse oximetry. Daytime sleepiness was evaluated by the Pediatric Daytime Sleepiness Scale (PDSS) and subjective sleep quality by the Sleep Disturbance Scale for Children (SDSC) and OSA-18. Pulmonary function testing was performed in children with CF.

Results: Eighty-seven children with CF and 55 controls were enrolled and were well matched for age, sex and body mass index. Mean (\pm SD) FEV₁ for CF patients was $78.2 \pm 19.5\%$. CF patients had significantly lower total sleep time (TST) (440 mins vs. 469 min; $P < 0.05$) and sleep efficiency (SE) (80% vs. 86%; $P < 0.05$) than controls due to more frequent awakenings and more wake after sleep onset (WASO). There was no difference in sleep latency, sleep onset time or sleep schedule variability. In children with CF, FEV₁ and SpO₂ nadir correlated positively with TST and SE and negatively with frequency of awakenings and WASO. CF patients had significantly higher total SDSC scores (45 vs. 35; $P < 0.001$), OSA-18 scores (35 vs. 24; $P < 0.001$) and PDSS scores (14 vs. 11; $P < 0.001$). There was a negative correlation between PDSS and FEV₁ ($r = -0.23$; $P < 0.05$).

Conclusions: Children with CF and stable lung disease have shorter TST and poorer SE than healthy children and less sleep than the National Sleep Foundation recommendations. Parents of children with CF commonly report sleep disturbance in their children and children with CF have a high prevalence of daytime sleepiness related to disease severity. Optimal management of children with CF should include sleep assessment as part of routine clinical review.

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THE PREVALENCE OF SLEEP DISORDERED BREATHING IN PATIENTS ADMITTED FOR VIDEO-EEG MONITORING

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Background: Sleep disordered breathing is associated with an increased risk of cardiovascular disease including stroke, hypertension, acute myocardial infarction, diabetes, and premature mortality, and affects 9–24% of the general population. Disturbances to sleep architecture can result in increased hypersomnolence, altered mood, and decreased cognition and quality of life. An underlying sleep disturbance may lower seizure threshold, decrease quality of life and cognitive functioning in this population. Therefore, we sought to assess the prevalence of sleep disordered breathing in patients admitted for long-term video-EEG monitoring using routine polysomnography.

Methods: We included 158 patients, admitted to our video-EEG monitoring unit who underwent polysomnography between February 2012 and September 2015.

Results: There was an increased prevalence of sleep disordered breathing in patients admitted for VEM monitoring with 49/158 (31%) meeting the minimum diagnostic criteria (apnea-hypopnea index ≥ 5). Patients with epilepsy had the highest prevalence of sleep-disordered breathing (33%), followed by PNES (29.5%) and those with both disorders (18.1%). There were no significant differences in cognition, and quality of life measures across these groups.

Conclusion: Routine polysomnography is a useful diagnostic tool in patients admitted for video-EEG monitoring, and may lead to correct identification of nocturnal events. Treatment of an underlying sleep disturbance may improve daytime functioning and psychiatric comorbidities, and also optimise seizure control in people with epilepsy.

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CARDIOPULMONARY FUNCTION DURING THE PERI-ICTAL STATE OF EPILEPTIC AND PSYCHOGENIC NON-EPILEPTIC SEIZURES

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Background: Sudden, unexpected death in epilepsy (SUDEP) is a significant cause of mortality in epilepsy, for which there are no known interventions. Terminal cardiopulmonary arrest often in association with an epileptic convulsive seizure is proposed to be the final mechanism of SUDEP. Psychogenic non-epileptic seizures (PNES) can superficially resemble epileptic seizures, but are not

accompanied with electrophysiological changes. Patients with PNES may also experience cardiopulmonary changes during their events, which are thought to be in relation to stress and trauma. Despite this, cardiopulmonary function is poorly understood during both epileptic seizures and PNES.

Methods: We studied 31 patients who were admitted to our video-EEG monitoring unit and routinely had a polysomnography between February 2012 and September 2015. A total of 88 events were recorded, which were classified as epileptic convulsive seizures, epileptic non-convulsive seizures, and PNES. Heart and respiratory rates, heart rate variability (HRV), and blood oxygenation using pulse oximetry were analysed for the pre-ictal, ictal and post-ictal phases of each event. Values were then averaged for each patient by seizure type.

Results: There were significant and prolonged changes to cardiac function in the epileptic convulsive seizures. Changes to maximal heart rate differed across the three event groups, being more pronounced in the epileptic convulsive seizures ($P = 0.024$). HRV showed a distinctive biphasic pattern where there was a significant increase from pre-ictal to ictal, and then a suppression from ictal to the postictal, which differed from the non-convulsive epileptic and non-epileptic psychogenic groups ($P = 0.0001$). Epileptic convulsive seizures were also associated with a characteristic pattern of hyperventilation, which differed from that of PNES ($P = 0.0002$).

Conclusion: This study demonstrates clear associations between cardiac and respiratory dysfunction in convulsive seizures that may have significant implications for the pathophysiology of SUDEP. Respiratory monitoring, or polysomnography is currently not standard practice in video-EEG monitoring, but should be considered as it may provide crucial insights into cardiorespiratory function during seizures.

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SLEEP SPINDLE ACTIVITY SIGNIFICANTLY CORRELATES WITH IMPLICIT MEMORY CONSOLIDATION IN OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Sleep spindles are distinct thalamocortical brain waves which play a putative role in sleep continuity and sleep-dependent memory consolidation. Spindle deficits, including reduced spindle activity and slower spindle frequencies have been reported in untreated patients with OSA, who may also demonstrate problems with memory. However, no studies have investigated the relationship between sleep spindles and overnight implicit memory consolidation in OSA. We examined the relationship between sleep spindle activity during overnight polysomnography and implicit memory in patients with moderate to severe OSA.

Methods: We studied 45 untreated OSA patients (age 49 ± 9 BMI 30.0 ± 4.2 , AHI 35.5 ± 22.9 , ESS 9.9 ± 4.4) who attended the sleep laboratory for overnight polysomnography. A 20-min statistical learning task was administered to participants at 7 pm (familiarization phase) during a "cover" recognition task prior to overnight polysomnography. Participants were not given instructions to remember anything during familiarisation. 24-h later and following an 8-h sleep opportunity participant's implicit learning was assessed during a surprise test phase. EEG signals recorded at electrodes sites F3-M2, F4-M1, C3-M2, C4-M1, O1-M2, O2-M1 and midline channels at Fz-M2, Cz-M1, Pz-M2, and Oz-M1 from all-night recordings were quantitatively analysed following automated artefact removal. Sigma EEG power (12–15 Hz) and slow (11–13 Hz) and fast (13–16 Hz) frequency spindle activity was derived using power spectral analysis. Associations between spindle activity in NREM sleep and implicit learning scores were examined.

Results: Lower slow and fast spindle activity at frontal and central brain regions were significantly correlated with worse overnight implicit memory consolidation (F3-M2: Slow spindle activity (SA) vs. surprise learning scores, $r = 0.37$, $P = 0.013$ & Fast SA: $r = 0.30$, $P = 0.047$; F4-M1: Slow SA: $r = 0.35$, $P = 0.022$ & Fast SA: $r = 0.34$, $P = 0.023$). Reduced EEG sigma power during NREM was also correlated with worse implicit learning scores.

Discussion: Reduced spindle activity in patients with untreated OSA is related to poorer overnight memory consolidation. Exploring links between spindle deficits and impaired memory may explain how altered sleep neurophysiology contributes to the inter-individual variability in overnight learning processes in OSA.

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SLEEP SPINDLE CHARACTERISTICS BEFORE AND AFTER SLEEP DEPRIVATION IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive Sleep Apnea (OSA) is associated with sleep disruption and impaired cognition. Sleep spindles play a pivotal role in maintaining sleep-dependent cognitive processes. We investigated the effects of sleep deprivation on spindle density & morphology during NREM sleep in OSA patients and healthy adults (HA). The relationship between sleep spindles & neurobehavioural performance after 24-h awake was explored.

Methods: Eight males with OSA (AHI 49.8 ± 24.7 /h; age 45 ± 8.5 years) & 9 healthy adults (1 F; AHI 4.5 ± 2.7 ; age 28 ± 3.6 years) underwent baseline overnight polysomnography (PSG), followed by 40-h of extended wakefulness with 2-hourly assessments of simulated driving, and followed by a recovery sleep PSG. Frontal (Fz), central (C3, Cz, C4), parietal (Pz) and occipital (Oz) EEG signals were analysed using an automated spindle detection algorithm based on a band-passing finite-impulse-response filter & Hilbert transformation. Spindle density & morphology (duration, frequency, amplitude & symmetry) during NREM sleep were compared between groups, before and after sleep deprivation. Baseline spindle densities were investigated in relation to neurobehavioural performance after 24-h awake.

Results: At baseline, OSA patients had reduced spindle density (/min) at Fz; OSA vs. HA: (1.5 vs. 2.6, $P = 0.005$) and C3 (1.7 vs. 2.6,

$P = 0.02$), and had shorter spindle durations (sec) compared to healthy adults (e.g. C3; OSA vs. HA: 0.81 vs. 0.88, $P = 0.03$). After sleep deprivation, both groups had lower fast spindle densities at central sites. Spindle amplitude and mean frequency were significantly reduced in healthy adults only. Spindle durations in OSA patients were significantly reduced in recovery sleep compared to baseline. Lower mean spindle frequency across the cortex correlated ($\rho = -0.74$ to 0.88) with worse driving performance (greater steering deviation) in healthy but not in OSA participants.

Conclusions: OSA patients have reduced spindle densities compared to healthy adults; however, these differences may be in part attributed to increasing age. Recovery sleep after extended wakefulness results in reduced spindle density and changes in morphology both in healthy adults and to a greater extent in OSA patients. Vulnerability to performance impairment after sleep deprivation in healthy adults may be predicted by sleep spindle densities.

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SLEEP SPINDLE DENSITY INCREASES WITH 6 MONTHS OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) TREATMENT AND CORRELATES WITH IMPROVED NEUROBEHAVIOURAL FUNCTION IN OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Sleep spindles are distinct thalamocortical brain waves which play a putative role in sleep continuity and sleep-dependent cognitive processes. Spindle deficits including reduced spindle activity and slower spindle frequencies are reported in untreated patients with OSA, who may also demonstrate neurobehavioural impairment. However, no studies have examined the effects of CPAP on sleep spindles and their relationship with cognitive function pre-post treatment. We investigated the effects of 6 months of CPAP on spindle characteristics and neurobehavioural performance in OSA.

Methods: We studied 162 OSA patients (age 50 ± 13 , BMI 33.4 ± 7.6 , AHI 35.0 ± 26.8 , ESS 12.1 ± 4.9) before and after 6 months of CPAP. Neurobehavioural tests assessed working memory (2-back & 3-back), sustained attention (Psychomotor Vigilance Task, PVT), visual-spatial scanning (Letter Cancellation Task, LCT) and executive function (Stroop). Attended in-lab overnight polysomnography was performed at baseline and after CPAP. EEG signals (C3/M2) from all-night recordings were analysed in a sub-set of 90 participants using an automated spindle detection algorithm based on a band-passing finite-impulse-response filter & Hilbert transformation. Slow (11–13 Hz) and fast (13–16 Hz) frequency spindle activity was also derived using power spectral analysis. Spindle density & morphology (duration, frequency, amplitude)

during stage N2 sleep were compared before and after CPAP and associations with performance were examined.

Results: Six months of CPAP significantly increased sleep spindle density (Baseline vs. CPAP: 1.65 vs. 1.84p/min, $P = 0.003$), spindle duration (0.799 sec vs. 0.809 sec, $P = 0.019$) and amplitude (11.7 vs. 13.5 $\mu V2$, $P < 0.0001$); increased slow and fast spindle activity ($P < 0.0001$); and improved neurobehavioural function across all cognitive domains. Increased spindle density and longer spindle duration were consistently and significantly correlated with better performance on PVT, LCT and Stroop tasks at baseline and after treatment, while faster spindle frequencies correlated with better working memory and increased attention after CPAP.

Discussion: This study shows significant improvements in sleep spindle deficits in OSA patients following CPAP treatment. Exploring links between spindle deficits and problems with attention/executive function may elucidate how altered sleep neurophysiology impacts on cognitive function in OSA.

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THE UTILITY OF CLINICAL VARIABLES FOR IDENTIFYING OSA PATIENTS VULNERABLE TO WORKING MEMORY IMPAIRMENT DURING EXTENDED WAKEFULNESS

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Introduction: Obstructive sleep apnea (OSA) is a prevalent condition associated with impaired performance in several cognitive domains including working memory (WM) function. Working memory is important for efficient goal directed information processing, learning and task performance. This study aimed to identify patients who are vulnerable vs. resistant to working memory impairments following extended wakefulness and to determine if clinical and polysomnography (PSG) derived variables can successfully discriminate between these patient phenotypes.

Methods: 56 patients with OSA (Age 49.4 ± 8.9 years old, BMI 31.7 ± 5.8 kg/m², AHI 38.1 ± 24.9) underwent a baseline in-laboratory overnight PSG followed by 28 h of extended wakefulness (6:00 am Saturday – 10:00 am Sunday). Working memory performance was assessed by a 2-back test at 12:30 am, 2:30 am, and 5 am and included 2 outcomes, cumulative reaction time and accuracy, which were averaged across the 3 night time tests. Analysis was performed in four steps: 1) Using the 2 working memory outcomes, cluster analysis was used to classify patients as vulnerable or resistant to working memory impairment, 2) Factor analysis was used to reduce the 2 working memory outcomes into single linear outcome variable (working memory performance factor), 3) Backward stepwise linear regression was used to identify significant predictors of working memory performance, 4) Regression adjusted predicted values from the regression model was used to test if the significant predictors could differentiate between the vulnerable and resistant OSA patients using receiver operator curve (ROC) analysis.

Results: 25 participants were identified as vulnerable and 31 as resistant. Regression analyses showed lowest O₂ saturation, ESS and total sleep time explained 44.3% of variance in working memory performance factor and could successfully discriminate between vulnerable vs. resistant OSA groups (ROC area under the curve 0.876, $P < 0.001$, sensitivity 86.6%, and specificity of 76.0% at the optimal regression model cut-off).

Discussion: This analysis shows that routinely collected variables from diagnostic PSG can identify OSA patients who are more likely to experience significantly impaired working memory performance during extended wakefulness. These findings may help clinicians to assess and identify working memory dysfunction in OSA, but further careful validation and assessment of other cognitive domains, such as vigilance, is needed.

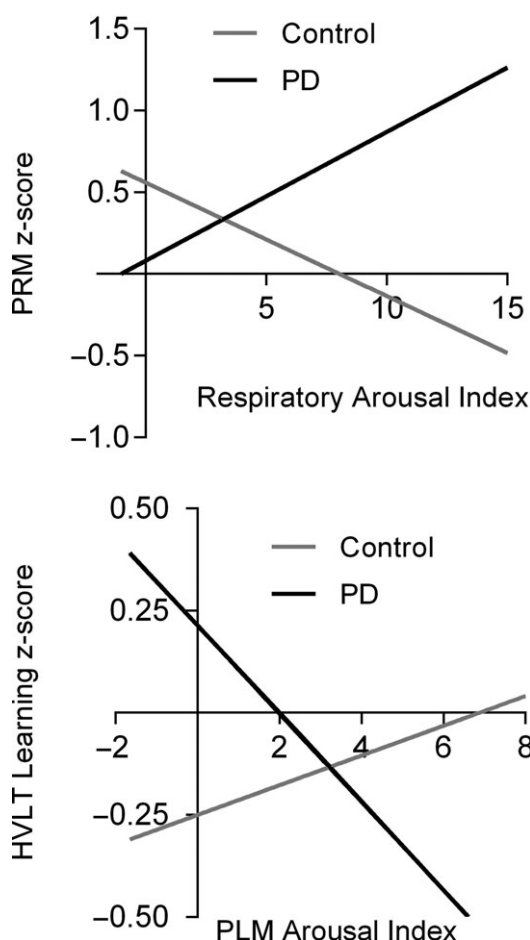
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DOES PARKINSON'S DISEASE MODERATE THE RELATIONSHIP BETWEEN DISRUPTED SLEEP AND COGNITION? A CASE-CONTROLLED POLYSOMNOGRAPHIC STUDY

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Background: Disrupted sleep and cognitive impairment, particularly in the domains of memory and executive function (EF) are common non-motor symptoms in Parkinson's Disease (PD). Given that sleep sufficient in both quality and quantity is essential for cognition, poor sleep may add to the cognitive burden of the disease. While older adults may be able to compensate for age-related sleep changes, individuals with PD may be less able to do so due to primary neuropathology.



Objective: This study aimed to clarify the effect of disrupted sleep on memory and EF in PD relative to neurologically healthy matched controls.

Method: 20 participants with PD and 20 healthy controls completed polysomnography and neuropsychological assessment. Moderated regression was used to determine whether indices of sleep quality equally predicted cognition in PD and controls.

Results: Consistently, sleep indices differentially predicted cognition in PD and controls. Metrics typically indicating *poorer* sleep (shorter sleep time, longer wake after sleep onset, more respiratory arousals) were associated with *better* cognition in PD; the inverse was true of controls. Time in N2 and REM had divergent effects: more N2 predicted poorer verbal fluency in PD and better verbal fluency in controls; more REM predicted better memory in controls only. More frequent PLM arousals were associated with poorer memory only in PD.

Conclusions: Relationships between sleep metrics and cognition are markedly different in PD and healthy controls, both in strength and direction. Nuanced analysis and interpretation of sleep data in PD is required: assumptions underlying sleep assessment may not translate easily to PD.

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TO WHAT EXTENT DO ACCEPTED PRINCIPLES OF SLEEP MEDICINE APPLY IN PARKINSON'S DISEASE?

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Background: Both cognitive impairment and sleep problems are common in Parkinson's disease (PD). Robust evidence in the sleep medicine and psychology literatures supports an association between disrupted sleep and poor cognition; in PD, evidence for this relationship is equivocal. Over the course of 2 studies, using both subjective and objective sleep data, we set out to determine whether sleep disturbance adds to the cognitive burden of PD.

Methods: Study 1: 166 patients with idiopathic PD completed the Parkinson's Disease Sleep Scale-Revised and a neuropsychological examination. The sample was split into younger (<61 years) and older-onset (>61 years) PD and multi-group path analysis was used to model the relationships between patient characteristics, sleep symptoms, and cognition in each group.

Study 2: 20 people with idiopathic PD and 20 neurologically healthy controls completed polysomnography and neuropsychological examination. Moderated regression was used to examine whether sleep indices equally predicted cognition in PD and controls.

Progress to date: Completed.

Intended outcome and impact: In both studies, the findings were unexpected. In Study 1, 'general' sleep disturbance and insomnia predicted better cognition in younger-onset PD and poorer cognition in older-onset PD. In Study 2, indices that we would interpret as indicative of poorer sleep (e.g. shorter TST, longer WASO, more respiratory arousals) consistently predicted better cognition in PD and poorer cognition in controls.

Thus, converging evidence from 2 studies, highlights the complexity of sleep in PD.

Sleep in PD is heterogeneous. Single measures such as WASO and sleep quality on questionnaires treat sleep as homogeneous. It may matter less that sleep is disrupted, than why sleep is disrupted. We need a model that takes care of heterogeneity, in explaining how sleep dysfunction evolves over time, in which patients, and with what consequences.

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OUTCOME OF OBSTRUCTIVE SLEEP APNOEA IN CHILDREN WITH DOWN'S SYNDROME

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Introduction: Children with Down Syndrome are at increased risk for OSA due to their anatomical and neuromuscular abnormalities. We describe the treatments undertaken for children with Down Syndrome and the efficacy of the treatment.

Methods: This retrospective study reviewed clinical data from children with Down Syndrome who underwent sleep studies between January 2013 and December 2015. Patient records were accessed to review the clinical recommendations and treatment outcomes.

Results: Data was available on 65 children with Down syndrome. The population distribution was 15% age <1 year; 46.3% age 1–4 year and 37.6% age ≥5 years.

Parameter	N (%)	Pre-mean	Pre-median (range)	Post-mean	Post-median (range)
AHI					
No Treatment	21 (32.3%)	5.9	5.2 (0.1–16.7)	4.8	2.4 (0.4–14.7)
CPAP	18 (27.6%)	34.4	15.3 (4.9–168.2)	19.8	11.7 (0.4–121.1)
Surgery	20 (30.76%)	14.2	14.1 (2.3–35.1)	17.0	15.1 (0.9–52.1)
T/A's + CPAP	6 (9.2%)	10.1	7.9 (1.8–22.8)	13.3	11.9 (1.2–30.4)

Pre- = pre-treatment, Post- = post-treatment.

Amongst those for whom long term CPAP was recommended, only 46% tolerated the therapy while 38.4% did not. Usage time for poor compliance ranged from 1–5 months.

Discussion: In Down syndrome, OSA is common and treatment rates are high. We found no difference in treatment distribution amongst different age groups. Adenotonsillectomy was often followed by a requirement for further treatment. While CPAP treatment was effective, only 50% of patients showed ongoing compliance with this therapy. Detection and management of OSA in Down Syndrome must be closely monitored to determine if OSA is effectively managed.

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A CROSS-SECTIONAL ANALYSIS OF DAY VS. NIGHT RESPIRATORY PARAMETERS DURING EARLY ADOLESCENCE IN CYSTIC FIBROSIS

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Introduction: Respiratory failure remains the major cause of death in adolescents with cystic fibrosis. Overnight polysomnography (PSG) may help identify respiratory deterioration in young patients with cystic fibrosis.

Methods: A prospective cohort study of 46 patients with CF, aged 8–12 years, from a specialist clinic in a tertiary paediatric hospital. Daytime pulmonary function, shuttle test exercise testing and overnight PSG were studied.

Results: Of 81 children aged 8–12 years, 46 (57%) agreed to participate. FEV₁ (% predicted, mean 74.6%) was normal in 23 (50%), mildly abnormal in 12 (26.1%), moderately abnormal in 10 (21.7%) and severely abnormal in 1 (2.2%). Amongst sleep study parameters, FEV₁ (% predicted) showed significant correlation with the respiratory rate (RR) in slow wave sleep (SWS), CO₂ change in REM, baseline SaO₂, and the arousal index (hr⁻¹). Backward, stepwise linear regression modelling for FEV₁ (% predicted) included the entire group with a wide spectrum of clinical severity. From sleep, variables remaining in the multivariate model for FEV₁ ($F = 16.81$, $P = 0.000$) were the RR in SWS (min⁻¹) and the CO₂ change in REM ($P = 0.003$, and 0.014 , respectively). When daytime tests were included, the variables remaining were RR in SWS and BMI_{sd}s ($F = 18.70$, $P = 0.000$).

Conclusions: Respiratory abnormalities on overnight sleep studies included elevated respiratory rates and mild CO₂ retention in REM sleep and these incorporated into a model correlating with FEV₁ (% predicted). Thus, mild mechanical impairment of ventilation is evident on overnight sleep studies in children with cystic fibrosis although the significance of this finding will require further investigation.

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THE EFFECT OF ATORVASTATIN, ESCITALOPRAM, AND PREGABALIN ON POLYSOMNOGRAPHY PARAMETERS

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Introduction: There are limited data on the effect of different medications on polysomnography (PSG) parameters of patients referred to a sleep clinic. The variety of comorbidities associated with such a cohort may further affect the relationship between medications and PSG parameters. The aim of this study is to describe differences in PSG parameters associated with the use of common medications.

Methods: Three commonly prescribed medications were selected as representatives of their respective drug classes: Atorvastatin (HMG-CoA reductase inhibitors), Escitalopram (SSRI), and Pregabalin (GABA analogue). Demographic data (age, sex, height, weight, BMI) and PSG variables of patients on these medications undergoing PSG between August 2014 and February 2016 were extracted from the PSG database (NeXus, Compumedics, Australia) of a tertiary sleep centre. PSG variables included: Arousal index (AI), Periodic limb movement index (PLMI), Central apnoea index (CAI), Apnoea

hypopnoea index (AHI), Sleep efficiency, Sleep onset latency. Patients on more than one study medication were excluded, other non-study medications may have been taken. Various regression analyses were performed.

Results: 79 patients had Atorvastatin, 47 Escitalopram and 36 Pregabalin. CAI was higher ($P < 0.05$) in patients taking Pregabalin, after adjusting for AHI. Patients on Atorvastatin had less CAI than those on Escitalopram. Sleep efficiency was lower ($P < 0.05$) in patients taking Atorvastatin compared to Pregabalin. Non-significant trends were noted with increased AI and PLMI with Atorvastatin, decreased stage 1 sleep with Pregabalin and increased sleep onset and REM latency with Escitalopram.

Discussion: There are significant differences in various sleep parameters (CAI, Sleep efficiency, AI, and PLMI) between patients taking Atorvastatin, Escitalopram, and Pregabalin. Further analysis of differences in PSG parameters between medications and medication classes is planned.

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EFFECT OF INCREASING CEREBRAL BLOOD FLOW ON SLEEP ARCHITECTURE AT HIGH ALTITUDE

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Background: There is an almost universal prevalence of central sleep apnoea (CSA) during sleep at high altitude. Where, sleep architecture is fragmented by increased arousals and greater proportions of lighter sleep. Previous work has shown that pharmacologically increasing cerebral blood flow (CBF) reduces CSA severity; however, whether this alters sleep architecture is unknown. The aim of this study was to examine whether increases in CBF at high altitude affected sleep architecture and improved sleep quality.

Methods: At 5050 m, 11 subjects underwent full polysomnography (PSG) monitored sleep following either iv acetazolamide (Az) (10 mg/kg) combined with dobutamine (Dob) (2–5 µg/kg/min) or placebo injections i.v (order randomized). Duplex ultrasound of volumetric blood flow in the internal carotid and vertebral arteries was used to estimate global CBF prior to sleep.

Results: CBF increased by $37 \pm 15\%$ following Az/dob compared to placebo ($P < 0.001$). CSA index fell from 136 ± 47 to 49 ± 37 events/h of sleep ($P < 0.001$). The Arousal Index fell from $68 \pm 47/h$ to $22 \pm 10/h$ ($P < 0.01$) with similar sleep efficiency $70\% \pm 14\%$ when compared to placebo $65 \pm 16\%$ (NS). The percentage of time spent in light sleep was less with Az/dob compared to placebo (Non-REM stage 1: $11 \pm 6\%$ vs. 19 ± 10 ; $P = 0.03$) and there was a trend for more non-REM stage 3 sleep ($21 \pm 12\%$ vs. 13 ± 11 ; $P = 0.06$). The percentage of non-REM stage 2 was similar between conditions ($62 \pm 12\%$ vs. $58 \pm 12\%$, Az/dob and placebo, respectively; $P = 0.23$), as was REM sleep ($6 \pm 6\%$ vs. $10 \pm 8\%$; $P = 0.27$). All non-REM sleep stages saw a reduction in CSA events ($P < 0.05$), whereas events during REM sleep were similar between conditions ($P = 0.60$).

Conclusion: Increasing CBF reduced the severity of CSA at high altitude, resulting in less fragmented sleep due to fewer arousals and consequently less time spent in light sleep.

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AGE, GENDER AND OSA ASSOCIATED CHANGES ON POLYSOMNOGRAPHIC MEASURES OF SLEEP QUALITY IN A SLEEP LABORATORY SETTING

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Introduction: Previous research has established age and gender associated changes in Polysomnographic (PSG) measures of sleep quality in the sleep laboratory environment, but failed to account for the relationship between age, gender and Obstructive Sleep Apnoea (OSA). Consequently, this study aimed to investigate whether age and gender associated changes on PSG measures of sleep quality are only associated indirectly through their relationship with OSA.

Methods: A sample of 254 sleep physician referred patients were used including 165 males (age: $M = 50.1 \pm 31.6$ years; BMI: $M = 30.9 \pm 12.2$; AHI = 26.3 ± 44.4 ; ESS = 7.5 ± 9.0) and 89 females (age: $M = 52.4 \pm 31.0$ years; BMI: $M = 34.0 \pm 19.2$; AHI = 17.3 ± 40.3 ; ESS = 7.8 ± 9.6). Attended diagnostic PSG studies from three sleep laboratories were included. Exclusion criteria: patients with sleep disorders other than OSA, patients with significant physical illness or mental impairment and patients who reported current alcohol abuse or use of psychoactive medications. Hierarchical regression model with AHI included at stage 2

Stage 1				Stage 2			
	Age	Sex	R ²		Age	Sex	AHI
Age	1			Age	1		
Sex	0.07	1		Sex	0.07	1	
SOL	0.10	0.17**	0.04**	AHI	0.30***	-0.14*	1
REM LAT	0.11	0.08	0.02	SOL	0.09	0.17**	0.03
SE	-0.39***	0.01	0.15***	REM LAT	0.05	0.11	0.18**
TST	-0.33***	-0.03	0.11***	SE	-0.33***	-0.02	-0.20**
REM	-0.18**	-0.04	0.03*	TST	-0.27***	-0.06	-0.19**
SWS	-0.12	0.24***	0.07***	REM	-0.08	-0.10	-0.29***
N2	0.07	-0.08	0.01	SWS	-0.04	0.21**	-0.21**
N1	0.19**	-0.17**	0.06***	N2	0.02	-0.05	0.16*
				N1	0.09	-0.12	0.31***

Note: *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, $N = 254$.

Discussion: Age, gender and OSA severity were all determinants of PSG measures of sleep quality. Importantly, AHI was found to be a mediator for N1 and REM proportions, demonstrating that they do not change with age when AHI is controlled. These findings may facilitate clinical interpretation of sleep architecture demonstrated on PSG in clinical cohorts. This research also provides evidence that a more complex predictive model may be required to properly delineate age related changes in sleep quality.

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THE UTILITY OF AUTOMATIC SLEEP ANALYSIS IN VERIFYING TOTAL SLEEP TIME PRIOR TO AN MSLT

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Purpose: The Multiple Sleep Latency Test (MSLT) is routinely used for the diagnosis of central disorders of hypersomnolence. Standard protocol requires the MSLT to commence 1.5–3 h after their polysomnography (PSG) after having achieved a total sleep time (TST) of at least 6 h during the prior PSG. It is also recommended to allow the patient to wake spontaneously. On occasion, the scientist scheduled to record the MSLT has arrived to find that the patient has woken early and the PSG has ended. Thus the scientist needs to quickly determine if 6 h of TST have been recorded on the PSG while ensuring that the MSLT commenced within the 1.5–3 h window. A quick way to verify this 6-h TST requirement could be to use automated sleep analysis. The aim of this study was therefore to determine the suitability of automated sleep analysis to verify that the 6 h TST requirement has been met.

Methods: A retrospective review of 49 patients undertaking Type 1 polysomnography (PSG) on the evening prior to their scheduled MSLT was conducted. Overnight PSGs were recorded using the Compumedics Profusion system and scored in accordance with the 2012 American Academy of Sleep Medicine (AASM) Manual for the Scoring of Sleep and Associated Events. Each PSG was scored both manually and using the Compumedics automated sleep staging algorithm.

Results: Total sleep time for the manually scored (TST_{Man}) and automatically analysed (TST_{Auto}) PSGs were not significantly different (403.2 ± 7.6 min vs. 398.1 ± 9.0 min for TST_{Man} and TST_{Auto} respectively, $P = 0.67$). Bland-Altman test demonstrated a slight bias of 5.1 ± 33.4 min towards TST_{Man} ($P = 0.29$). The automatic algorithms ability to detect >6 h of TST had sensitivity and specificity of 92% and 83% respectively. The receiver operating characteristic (ROC) area under the curve was 0.97 (95% CI: 0.92–1.00) for the discrimination threshold of 6 h TST ($P < 0.0001$). The positive and negative likelihood ratios of the automatic analysis algorithm in detecting a TST greater than 6 h were 5.5 and 0.1 respectively.

Conclusions: The automatic sleep analysis algorithm can be a useful tool when there is a need to quickly determining the TST prior to commencement of the MSLT.

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MICROSLEEP ASSESSMENT ENHANCES INTERPRETATION OF MAINTENANCE OF WAKEFULNESS TESTING

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Introduction: Brief episodes of sleep (microsleeps) may dangerously impact alertness, particularly whilst driving. In sleep centres,

the maintenance of wakefulness test (MWT) is the gold-standard test used to objectively evaluate daytime wakefulness and assess driver safety. It measures mean sleep latency over 4 trials (>50% sleep in an epoch), however, microsleeps prior to sleep onset are not included in the assessment. This study aimed to determine the value of assessing microsleep data prior to sleep onset in the MWT.

Methods: All patients attending for MWT over a 12 month period were included in the study ($n = 20$). Patients underwent a full night polysomnography prior to MWT the following day. MWT consisted of 4×40 min trials at 2 hourly intervals throughout the day. Microsleeps were scored as 3–15 sec of sleep in an epoch. Data are presented as mean \pm SD and were compared using paired and unpaired t-tests.

Results: 18 patients (90%) experienced a microsleep prior to sleep onset in at least one MWT trial and 9 (45%) patients experienced a microsleep in all trials. Mean time to first microsleep was significantly shorter than the mean time to sleep onset (16 ± 12 vs. 22 ± 12 min, $P < 0.05$). Although only 3 MWT patients had a mean sleep latency <8 min demonstrating abnormal ability to maintain wakefulness (AASM), 7 patients met this criteria based on microsleep latency. There was a trend for an increased number of microsleeps prior to sleep onset in the patients with microsleep latency <8 min compared to those with longer microsleep latencies (7.3 ± 7.2 vs. 3.0 ± 3.2 ; $P = 0.09$). In addition, average microsleep duration was significantly longer in the patients with microsleep latency <8 min (7.5 ± 2.7 vs. 5.1 ± 1.3 sec; $P = 0.03$). Time of day did not significantly influence average microsleep number or duration. Interestingly, 5 of the 6 patients with a history of a recent motor vehicle accident had >3 microsleeps prior to sleep onset.

Discussion: The occurrence of microsleeps prior to sleep onset is common. Although microsleep data is routinely recorded it is currently overlooked in MWT studies. The inclusion of microsleep data, in addition to mean sleep latency, may ensure a better insight into an individual's ability to maintain wakefulness. More research is needed to establish whether microsleeps prior to sleep onset during MWT predict increased crash risk.

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CLASSIFICATION OF HYPOPNEAS ACCORDING TO THE AASM 2012 RESPIRATORY EVENT CRITERIA

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Purpose: In 2012 the American Academy of Sleep Medicine (AASM) updated the "Manual for the Scoring of Sleep and Associated Events." This update not only changed the criteria for scoring a hypopnea, but also provided rules for the classification of hypopneas. Hypopneas can be classified as obstructive if any of the following features appears during the event: (a) snoring, (b) inspiratory flattening of the nasal pressure trace or (c) thoracoabdominal paradox. If none of these 3 features are present during the event, then the hypopnea is regarded as central in nature. The prevalence of obstructive and central hypopneas according to these criteria has yet to be examined.

Methods: A retrospective review of 40 consecutive patients undertaking Type 1 polysomnography (PSG) for the suspicion of OSA was conducted. PSGs were recorded according to the AASM Manual and scored using the 2012 AASM recommended hypopnea criteria (AASM_{2012Rec}). Patients were excluded if they were taking opioid medications or had a history of cardiac failure. Hypopnea events were classified as either obstructive or central. Obstructive hypopneas were further sub-classified according to the presence/absence of each feature during each hypopnea (snoring, inspiratory flattening and thoracoabdominal paradox).

Results: A total of 4209 hypopnea events were examined. Obstructive hypopneas were more common than central hypopneas (83% vs. 17%). Obstructive and central hypopneas were both predominantly associated with NREM sleep (80% and 91% of hypopneas were found in NREM for obstructive and central hypopneas respectively). Obstructive hypopneas were significantly longer in duration than central hypopneas (median [IQR]: 23.1 sec [16.8, 31.9] vs. 16.2 sec [12.7, 22.5], $P < 0.0001$). More than half of the obstructive and central hypopneas were associated with SpO₂ desaturations (64% and 60% for obstructive and central hypopneas respectively). The most common obstructive hypopneas were those with both snoring and inspiratory nasal flattening present during the event (44.2% of all obstructive hypopneas).

Conclusions: In an OSA population, there would appear to be little benefit in classifying hypopneas since most hypopneas appeared to be obstructive in nature.

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THE OXYGEN DESATURATION INDEX: SHOULD WE TAKE THEIR WORD FOR IT?

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Background: The oxygen desaturation index (ODI) is described as the number of 3% (or greater) desaturations per hour of total sleep time. The ODI, or measures of AHI with hypopnea rules requiring a 4% desaturation have been found to be associated with cardiac comorbidities. Recently results of the European Sleep Apnoea Database were reported that showed the ODI4% (but not AHI) was independently associated with hypertension. An advantage of the ODI is that the calculation of the ODI is automated which reduces interrater reliability issues and ensures any calculation is repeatable. However, the ODI is typically calculated by proprietary software, where the method of calculation is unknown. The AIM of this study was to develop and test a well described ODI algorithm against the Compumedics Profusion 3 software derived values.

Method: An open method for calculating the ODI was devised, described and tested on a data set of 17 patients. Data was first calculated by the Compumedics Profusion 3 software for the full night at ODI3% and ODI 4%. SpO₂ data was then exported and analysed with the open algorithm.

Results: Individual and group results differed significantly. The Compumedics ODIs were typically larger than the open algorithm derived ODIs. A mean difference of 13.7 was observed ($P < 0.01$).

Discussion: Difference are likely due to different approaches for the identification of desaturations and the description of "baseline". The Compumedics software appears to identify desaturations based on the highest point immediately preceding the desaturation and the

lowest point during the desaturation. The open algorithm defines baseline using a 10 min sliding window with desaturations described as any point which drops 3% or more below the baseline.

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CAN OXIMETRY BE USED IN SLEEP CLINICS TO REDUCE THE COST OF OBSTRUCTIVE SLEEP APNEA DIAGNOSIS WITHOUT COMPROMISING ACCURACY?

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Introduction: A recent Australian multicentre randomised controlled trial (LIFT-OSA) of patients referred to sleep clinics with suspected obstructive sleep apnea (OSA) found comparable patient outcomes and physician confidence when patients were diagnosed using Level 3 vs. Level 1 sleep studies, but inferior outcomes using level 4 (oximetry). The present study was undertaken to see whether oximetry could be used *in conjunction* with PSG to reduce diagnostic costs, while maintaining high diagnostic accuracy.

Methods: Analyses were conducted using results from 402 participants enrolled in the LIFT-OSA study. Participants had at least 2 symptoms of snoring, witnessed-apneas and/or excessive daytime sleepiness and completed an in-laboratory PSG. A receiver operating characteristic (ROC) curve was constructed using a 3% oxygen desaturation index (ODI) to determine the overall diagnostic accuracy of oximetry for moderate-severe OSA (defined as PSG apnea-hypopnea index ≥ 20 /h). Optimal upper ("rule-in") and lower ("rule-out") ODI cut points were developed to have OSA "ruled-in" and "ruled-out" with high precision and minimise patients in the indeterminate range who need to proceed to PSG. A cost per patient was estimated for each rule-in rule-out ODI cut-point combination.

Results: The area under the ROC curve for oximetry was 0.95 (95% CI 0.93–0.97). An optimum oximetry high (ODI ≥ 22 events/h) and low (ODI < 10 events/h) cut-point pair was found which accurately "ruled-in" OSA in 140/402 and "ruled-out" OSA in 147/402 OSA (35% and 37% of patients respectively); gave 6 false positives and 2 false negative results; and correctly classified 97% of 287 patients. The remaining 115/402 (29%) patients who had "indeterminate" oximetry results falling between these high and low cut-points would, in this model, require PSG. Using a cost of \$150/patient for oximetry and \$588/patient for in-laboratory PSG the average per patient cost for diagnosis using this model was \$318/patient, i.e. 46% cost saving compared with the alternative of all patients proceeding directly to in-laboratory PSG.

Discussion: Oximetry used in conjunction with PSG has the potential to substantially decrease the cost of OSA diagnosis in sleep clinics, without compromising diagnostic accuracy.

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IDENTIFYING CARDIOGENIC ARTEFACT IN OESOPHAGEAL PRESSURE MEASUREMENTS IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Respiratory effort is an important factor underpinning cyclical obstruction and arousal interactions in obstructive sleep apnoea (OSA). The current 'gold standard' measure of respiratory effort derives from oesophageal pressure, which can be markedly contaminated by cardiac oscillations with overlapping frequencies leading to noisy signals and derived measurements. Adaptive filters have been described previously, but require the form of the cardiogenic noise to be known. The aim of this study was to use a new analytical method derived from respiratory mechanics to better isolate cardiac from respiratory oscillations in oesophageal pressure towards more effective cardiogenic artefact filtering.

Methods: Previously recorded airflow (mask and pneumotachograph), oesophageal pressure (Poes) and ECG signals were taken from 6 males with severe OSA (mean \pm SD age 44 ± 9 years, BMI 35 ± 5 kg/m², AHI 77 ± 29 /h) and 5 age-matched normal-weight males. Flow and volume changes during periods of stable breathing in wake without obstruction were used to estimate respiratory system resistance and elastance that best fit Poes to the respiratory system equation of motion. This expected best-fit pressure was then employed by an adaptive filter to identify and separate respiratory vs. cardiogenic artefact components of the oesophageal pressure signal.

Results: The equation of motion produced good Poes fits during wake. The estimated respiratory pressure from flow tracked the respiratory periodicity of the Poes signal. Application of the adaptive filter enabled separation of a cardiogenic noise signal in phase with the cardiac cycle, as identified from ECG, with frequency analysis identifying peaks at multiples of heart rate. The form of the cardiac waveform centred on the ECG R-wave was similar between subjects.

Discussion: This study provides a method for separating cardiac artefact from oesophageal pressure signals from which further analysis of the cardiac waveform should help to advance improved cardiogenic artefact filtering applicable during both stable and unstable periods of airflow (e.g. during cyclical airway obstruction). Cardiogenic artefact signals identified during stable wake appear to be useful as a noise source input for adaptive filtering of oesophageal pressure throughout the remainder of the night.

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OPEN ACCESS SOFTWARE TO CALCULATE RESPIRATORY CONTROL LOOP GAIN FROM STANDARD POLYSOMNOGRAM

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Introduction: We recently published a method of estimating respiratory control stability ("loop gain") using only data available in a conventional polysomnogram. However, our initial implementation

requires significant programming skills to use, and is therefore likely to be inaccessible to many clinical researchers. In this abstract we present a new implementation of the software which has a graphical interface; and is accessible to users without a strong technical background.

Software Implementation: Our software is comprised of two modules: (1) The original software written in Matlab which implements the physiological modelling and data processing; and (2) A graphical interface module written in C# which allows the user to setup and run analysis without directly programming in Matlab. This architecture was chosen to serve the dual purpose of making the software accessible more broadly to clinical researchers; while maintaining a suitable development platform to facilitate continued development of functionality of the method (i.e. to quantify other physiological traits).

Overview of Procedure: In order to use the tool, a polysomnogram (including nasal pressure catheter) is conducted as normal using commercial polysomnogram software; with sleep state, respiratory events and arousals scored according to the AASM criteria. Raw physiological data is exported from the commercial PSG software to the European data format (.edf); and scored events and hypnogram exported as text (or .xml) files. The graphical software has two key steps: (1) An import phase which allows the user to map their clinical channel and event notations to those required for the loop gain analysis; and (2) An analysis phase which allows the user to configure analysis parameters and to conduct the loop gain estimation procedure. Figures are produced for each analysis window, and numerical results are provided in spreadsheet software.

Discussion: This software is currently compatible with CompuMedics Profusion polysomnogram recordings; and updates compatible with Philips-Respironics Alice Sleepware, and Cambridge Electronic Design Spike2 recording systems will be released shortly. The software is released under an open-source licence and will be made freely available to not-for-profit researchers.

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THE RELATIONSHIP BETWEEN BETA-BLOCKERS AND OBSTRUCTIVE SLEEP APNEA

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Introduction: Beta-blockers reduce duration of Central Sleep Apnea (CSA) events. However, an association between Obstructive Sleep Apnea (OSA) and Beta-blockers has not been established. The mechanism for cessation of events in OSA differs from CSA. Increased respiratory effort, transient increases in carbon dioxide and declining oxygen saturation interact with elevated catecholamine. Beta-blockers act as a catecholamine antagonist, therefore, there is a potential for Beta-blockers to increase duration of individual respiratory events. This study aims to investigate the association between Beta-blockers and duration of individual OSA events, hypothesising an increase in the mean duration of obstructive events in patients on beta-blockers compared to those who are not.

Method: Retrospective analysis of Monash Lung and Sleep Polysomnography (PSG) database from 2015 to 2016. Participants were included if these criteria were met: Diagnostic studies, Apnea/

Hypopnea Index (AHI) >15, Age >38, percentage of Central to Obstructive Apnea <12%. Participants were then divided into two groups: those reporting Beta-blocker usage (Test), and those who do not take Beta-blockers (Control). Mean Obstructive Apnea/Hypopnea duration was compared between these groups.

Results: Preliminary analysis indicates that no significant difference was found between test and control groups, although more detailed statistical analysis is still pending.

	Mean event duration (sec)	SD	N
Test	22.4	4.7	87
Control	22.7	6.2	886

Discussion: This data-set has not demonstrated any clear association between Beta-blocker use and event duration. Further matching and sub-sets of this data will be provided, controlling for AHI, etc. This may elucidate more specific interactions, such as severity of hypoxia in OSA and its association with Beta-blockers. Controlling for hypoxia, and excluding hypopneas are potential areas for future research. Ultimately, an interaction study would be more conclusive methodology.

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A PRELIMINARY ANALYSIS OF BRIEF AROUSAL AND AWAKENING RESPONSES ASSOCIATED WITH POSTURE SHIFTS IN SLEEP, AND THE IMPACT OF SUPINE-AVOIDANCE ALARM TREATMENT

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Background: Supine-avoidance alarm devices may be useful for treating patients with positional obstructive sleep apnoea (POSA). However, little is known regarding temporal relationships between brief arousals/awakening responses and posture shifts during sleep, or the subsequent impact of supine-avoidance alarms on the time taken to return to sleep. This study aims to assess the frequency and duration of arousal and awakening responses associated with posture shifts during sleep, and to examine how quickly sleep resumes following posture shifts with and without active supine-avoidance treatment.

Method: This study is part of an ongoing trial comparing supine-avoidance vs. CPAP therapy in patients with POSA. Following a baseline full in-home sleep study (Embletta MPR) with an inactive supine-avoidance alarm device (BuzzPOD, Gorman Promed), patients were randomised to active supine-avoidance treatment vs. CPAP for 8 weeks before cross-over to the remaining treatment, with a repeat in-home sleep study at the end of each treatment. A technician blinded to supine-treatment data scored arousal and awakening responses (<15 and ≥15-sec EEG changes). All sustained (≥30 sec) posture shifts commencing from established sleep during baseline and supine-avoidance nights were assessed for arousal/awakening responses (within -30 to +3 sec), and sleep onset latency following each posture shift.

Results: From 51 patients randomised to date, data from the first 20 (65% Males, mean ± SD age 55.7 ± 13.1 years, BMI 29.4 ± 6.3 kg/m²) were available for preliminary analysis. From a total of 99 (baseline) vs. 71 (treatment) sustained posture shifts (median [IQR] 5

[3–7] vs. 2 [2–5] per patient), most [96%; 95/99 vs. 68/71] were associated with full awakening or brief arousal, followed by 4.3 ± 8.7 vs. 2.2 ± 5.6 min before sleep resumed. Fewer but residual sustained shifts to supine vs. non-supine postures on treatment (18 vs. 53, Fisher's $P = 0.034$) vs. baseline nights (41 vs. 58), and a trend for faster sleep onset after shifts to supine (mean ± SEM 0.6 ± 0.2 vs. 4.0 ± 1.2 min, $P = 0.062$) on treatment vs. baseline nights suggest residual false negative and/or alarm sleep-through events.

Conclusion: Further data and a more detailed analysis of alarm events, including those from shorter (<30 sec) attempts to shift to supine sleep are needed to clarify the impact of supine-avoidance alarm treatment on sleep posture and sleep quality in patients with POSA.

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SLEEP APNEA AND ADVERSE PREGNANCY AND BIRTH OUTCOMES

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Background: Some studies have reported significant relationships between adverse pregnancy and fetal outcomes and symptoms of Obstructive Sleep Apnea (OSA) while others have not. The use of subjective measures of OSA (questionnaires) may be, in part, responsible for the variable findings. The purpose of this study was to use objective measures of OSA in pregnancy and examine whether OSA is related to adverse birth and pregnancy outcomes.

Methods: 189 women >28 weeks singleton pregnant consented to the study and were monitored overnight for nasal pressure and oxygen saturation (ApneaLink). All data were manually scored for apnea hypopnea index (AHI) and oxygen desaturation index at 3 and 4% (ODI3%; ODI4%). Women were excluded from subsequent analyses if there was less than 60 mins of sleep.

Results: Preliminary findings from 11 women aged 28 ± 3 years (range, 23–33 years) are reported in this abstract, although analyses are ongoing. Mean AHI was 2.8 ± 3.4 events/h (range, 0.1–10 events/h); OSA (AHI ≥ 5) was present in 18% of women ($n = 2$); pre-eclampsia was identified in $n = 1$; gestational diabetes was identified in $n = 3$; and preterm birth occurred in $n = 3$. Regression analysis performed between OSA-related measures (AHI, ODI3% and ODI4%) and birth outcomes (birth weight, Apgar scores, gestational age) showed no significant relationships. OSA-related measures were not different when women were categorised as ±preterm births, ±hypertension or ±gestational diabetes, although differences in ODI4% were approaching statistical significance in the group with and without gestational diabetes ($x \pm y\%$ vs. $a \pm b\%$, respectively, $P = 0.08$).

Conclusion: These preliminary analyses of pregnant women showed no significant relationships between adverse birth outcome and OSA-related measures including AHI, ODI3% and ODI4%, although there was a tendency for greater oxygen desaturation (at the 4% level) in women with gestational diabetes. Given the small sample size these analyses are limited by low statistical power and high chance of a type II error (false negative). This limitation will be overcome with ongoing analyses in a larger number of participants.

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PREVALENCE OF DIABETES MELLITUS IN PATIENTS UNDERGOING EVALUATION FOR OBSTRUCTIVE SLEEP APNEA AT THE GOLD COAST UNIVERSITY HOSPITAL

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Introduction: There is a strong association between obstructive sleep apnea (OSA) and diabetes mellitus (DM) extending beyond the shared relationship with obesity. The prevalence of DM in OSA is as high as 40% in previous cross sectional studies but there is a paucity of data for OSA patients in the Gold Coast area.

Aim: The aim of the study is to assess the prevalence of DM in patients with OSA in the outpatient setting and compare this data with other population studies.

Methods: A retrospective study of patients who presented for a diagnostic polysomnogram (PSG) over a period of 12 months (1st January 2014 – 31 Dec 2014) was analysed to obtain the prevalence of T2DM in patients with OSA. Data was analysed using Microsoft Excel, using an unpaired Students t- test, and significance taken as $P < 0.05$.

Results: During the study period, 243 patients had undergone PSGs. Mean age (\pm SD) of the patients was 59 (\pm 14) years age and 40% of the patients were male. Based on the PSGs, 8% of patients had an apnea-hypopnea index (AHI) <5 (normal), 19% had an AHI 5–15 (mild); 26% had an AHI 16–30, and 46% had an AHI >30 . A documented diagnosis of DM was noted in 26% of patients. The prevalence of DM was higher with increasing severity of OSA (5% in normal, 15% in mild OSA; 42% in mod OSA and 47% in severe OSA). Increasing age, body mass index (BMI), total AHI, REM AHI were associated with a diagnosis of DM ($P < 0.05$) but only multi-variable analysis only age, BMI and REM AHI were associated with DM.

Conclusion: Our results are consistent with recent literature that the prevalence of DM in patients with moderate and severe OSA patients is high. Our results provide us with an opportunity to ensure that patients presenting to our clinic for evaluation of OSA should be screened for DM, particularly those with REM OSA in addition to traditional high risk groups (age and BMI) to enable earlier diagnosis and effective management of T2DM.

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IMPACT OF ETHNICITY ON SLEEP PHENOTYPE: A COMPARISON BETWEEN CHINESE AND CAUCASIAN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Chinese populations have a comparable prevalence of obstructive sleep apnoea (OSA) compared to their Western counterparts, but are notably much less obese. Therefore, Chinese may have a different OSA phenotype that is less dependent on obesity. The aim of this study was to compare the differences in OSA by sleep state, position, respiratory event type and oxygenation between Chinese and Caucasian individuals.

Methods: A retrospective cross-sectional study was conducted. Adult subjects of Chinese and Caucasian descent with moderate to severe OSA (apnoea-hypopnoea index (AHI) ≥ 20 events/h), were included in the study ($n = 90$). Subjects were matched by age, gender and AHI. Data were analysed to identify differences between the two groups

with respect to body mass index (BMI), event type, degree of hypoxia as well as the effect of sleep state and body position on events. The secondary outcome was to analyse differences in the prevalence of metabolic risk factors. Data presented are mean \pm SEM.

Results: Despite equivalent AHIs (Chinese 47.3 ± 3.4 , Caucasian 47.0 ± 3.5 events/h; $P = 0.61$), Chinese subjects were significantly less obese compared to Caucasian subjects (BMI: 27.7 ± 0.6 vs. 35.7 ± 1.4 kg/m², $P < 0.001$). They had less frequent hypopnoeas (26.5 ± 2.8 vs. 34.7 ± 3.4 events/h, $P = 0.02$) and more frequent apnoeas (21.4 ± 3.1 vs. 15.1 ± 3.0 events/h, $P = 0.01$). In particular, Chinese subjects exhibited a trend toward more frequent apnoea whilst supine (23.4 ± 3.0 vs. 13.4 ± 4.1 events/h, $P = 0.14$) with similar frequency of apnoea whilst non-supine (10.0 ± 2.8 vs. 9.6 ± 2.9 events/h, $P = 0.93$). No significant independent effect of sleep state was identified. Both apnoeas and hypopnoeas were longer in the Chinese group compared to Caucasian subjects (apnoea duration 25.1 ± 1.2 sec vs. 19.3 ± 1.3 sec, $P = 0.001$; hypopnoea duration 25.3 ± 1.0 sec vs. 22.9 ± 1.0 sec, $P = 0.03$). Despite a longer duration, these events were associated with a lesser degree of hypoxia (%time below SpO₂ 90%: $14.6 \pm 2.5\%$ vs. $25.0 \pm 3.7\%$, $P = 0.01$) and a trend towards fewer metabolic risk factors in the Chinese group (composite of diabetes, hypertension, cardiovascular and cerebrovascular disease: 36.4 vs. 55.6% , $P = 0.11$).

Conclusion: Chinese individuals with OSA have a unique sleep phenotype, when compared to Caucasians of equivalent disease severity. Despite a lower BMI, OSA in Chinese individuals is characterised by more prominent apnoeas, likely exacerbated in the supine position, which are associated with less hypoxia. We speculate that the pathophysiology of OSA in Chinese individuals is therefore related to craniofacial features and that reduced obesity in this population lessens the hypoxic insult.

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DIFFERENCES IN RESPIRATORY AROUSAL THRESHOLD IN CAUCASIANS AND CHINESE PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Ethnic differences in OSA phenotype may not be limited to obesity and craniofacial factors. Relative importance of the underlying pathophysiological mechanisms of OSA remains unknown with race. The aims of the study were to (1) Compare the proportion of Caucasians and Chinese patients with a low predicted respiratory arousal threshold (ArTH) and (2) Determine the influence

of anatomical compromise on the proportions of patients with a low predicted respiratory ArTH.

Methods: Inter-ethnic comparison was conducted between cohorts of Caucasian and Chinese patients referred for the investigation of OSA in specialist sleep disorders clinics. Polysomnography and craniofacial photography were performed. A low respiratory ArTH was determined by an ArTH score of 2 or above (one point for each of the following: AHI <30/h, nadir SaO₂ > 82.5%, fractions of hypopnoeas >58.3%). Photographic face width measurement was used to stratify subjects into the degree of anatomical compromise.

Results: Caucasian ($n = 163$) and Chinese subjects ($n = 185$) with a range of OSA severity and normal were analysed. The proportion of both Caucasians and Chinese patients with a low predicted ArTH was reduced with increasing OSA severity. There was a substantially lower proportion of Chinese patients with severe OSA (AHI ≥ 30) who had a low predicted ArTH (2.6% vs. 17.1%, $P = 0.02$). This difference remained significant when moderate-severe OSA patients (AHI ≥ 15) were compared (28.4% vs. 48.8%, $P = 0.004$). The proportion of moderate-severe OSA Caucasian patients with a low predicted ArTH was significantly less in those with more anatomical compromise (36.6% vs. 61.0%, $P < 0.05$) whereas there was no difference in Chinese patients (25.5% vs. 31.5%, $P = 0.5$).

Discussion: In contrast to Caucasians, a low respiratory arousal threshold does not appear to be a common mechanism of OSA in Chinese patients. Specifically, Chinese patients infrequently exhibit polysomnographic evidence of a low arousal threshold. Caucasians with less severe anatomical compromise show signs of a lower arousal threshold, an association which is absent in Chinese patients. Our data provide novel evidence that OSA mechanisms vary across racial groups. This warrants further investigation and may have implications for personalised therapies for OSA.

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BED PARTNER APNOEA ANXIETY – HIGH IN CHEYNE-STOKES RESPIRATION AND OBSTRUCTIVE SLEEP APNOEA

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Bed partners are a long-suffering, under-researched population whose observations form an essential part of the clinical assessment of sleep breathing disorders. Concern regarding key symptoms (snoring, restlessness, apnoea) in different sleep breathing disorder types has not been systematically studied.

Aim: To compare bed partner concerns, sleep disruption before and after treatment. We hypothesized that apnoea anxiety would be highest in Cheyne-Stokes Respiration (CSR) partners c.f. simple snorers and obstructive sleep apnoea (OSA).

Method: Consecutive partners of patients referred for polysomnography (psg) or treatment over 6 months (Aug 2015 – Feb 2016) completed an in-house questionnaire including Generalised Anxiety Disorder (GAD7), Epworth Sleepiness Score (ESS), sleep quality, level of concern regarding snoring, apnoea and restlessness (Likert scale). Patient psg scored accepted criteria - OSA (AHI > 10/h), Snoring without OSA (AHI ≤ 10/h). CSR partners were prospectively and retrospectively recruited. Repeated measures 4 weeks post treatment were compared using SPSS.

Results: Of 73 couples screen, 30 formed study group comprising 16 OSA, 9 snorers, and 5 CSR. Most (19/30) were strong proponent for

referral. Partners of patients with OSA were equally concerned about snoring & apnoea c.f. CSR partner's who were primarily concerned about apnoea. In OSA CPAP improved bed partner sleep (pre- 58.1 ± 26.5 and post 29.1 ± 20.1 , $P = 0.004$), reduced concern re/snoring (pre- 66.9 ± 21.4 , post 11.5 ± 12.3 , $P < 0.001$), apnoea (pre- 59.9 ± 26.4 , post 14.2 ± 13.1 , $P < 0.001$), restlessness (pre 60.2 ± 6.1 , post 27.3 ± 5.7 , $P = 0.001$) & anxiety (baseline GADS-7 4.5 ± 4.1 , post 2.9 ± 2.9 , $P = 0.150$). Partners ESS reduced, but not significantly (pre 5.3 ± 3.8 , post 3.8 ± 2.3 , $P = 0.143$). Partners of CSR patients had higher concern re/apnoea (75.9 ± 26.7) than OSA (59.9 ± 26.4) & snorers (46.9 ± 30.8). Treatment of CSR reduced anxiety (ns trend).

Conclusions: Bed partners are impacted by a range of adverse factors, particularly in the setting of OSA and CSR. Successful treatment improves sleep quality, anxiety concern re/loud snoring, apnoea & restlessness. Sleep apnoea anxiety trended to be greatest in those diagnosed with CSR, moderate in those diagnosed with OSA and lowest in simple snorers. These measures should be included when evaluating disease burden and treatment response.

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AN AUDIT OF A COMMUNITY SLEEP ASSESSMENT SERVICE – WAIT-TIMES AND OUTCOMES

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Introduction: Prior to 2007, increasing demand for sleep services, plus an inability to adequately triage severity, led to long delays in assessment and accessing CPAP for patients with sleep apnoea.

Methods: We established a Community Sleep Assessment Service based in trained Approved Provider General Practices, using a standardised assessment tool, and overnight oximetry. All cases were then discussed at a multi-disciplinary meeting (MDM), with 4 outcomes: (1) severe OSA treated with CPAP; (2) more complex sleep study required; (3) sleep physician appointment; (4) no or mild/moderate sleep apnoea, for GP management (including private CPAP). This presentation represents an audit of the timelines and outcomes for this service.

Results: Assessment numbers steadily increased, up to 1400 in 2015. Prior to 2007, ~400 assessments were undertaken a year. A total of 6530 assessments have been undertaken. Median time from referral to assessment was 28 days, and time from referral to MDM was 48 days. After first MDM, 23% of cases were assessed as having severe OSA. More complex sleep studies, mostly flow-based studies, were required in 49% of patients, identifying a further 13% with severe OSA. A total of 37% of assessed patients had OSA severe enough to qualify for hospital funded treatment. Median time from referral to CPAP for “at risk” patients with severe OSA (e.g. commercial drivers) was 49 days, while patients with severe OSA but not “at risk” waited 261 days from referral to CPAP. 10% of patients required Level 1 or 2 polysomnography, and 4% saw a sleep specialist. 56% of patients were sent back to be ‘managed by their GP’. Of these patients, 38% had an ODI of less than 5.0, i.e. no significant SDB. The median ODI of the other 62% of patients defined by the MDM as having mild or moderate SDB was 11.0.

Discussion: Establishment of a community sleep assessment service and sleep MDM has led to significantly more assessments, with short waiting times from referral to treatment, especially in high risk patients

with severe OSA. Most patients can be assessed without complex sleep studies or face to face review by a sleep specialist.

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THE EFFECT OF AGE ON COMORBIDITY BURDEN AND INFLAMMATION IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Evidence from some population studies suggests that older men may be less susceptible to quality of life and mortality impacts of obstructive sleep apnea (OSA). To examine this further, we determined comorbidities and inflammatory markers associated with undiagnosed OSA in men aged <70 years and ≥70.

Methods: In a population-based study of men aged ≥40 years, men without a prior OSA diagnosis ($n = 837$) underwent full in-home polysomnography [mean age (SD): 61.0 (10.9)]. Clinic assessment included anthropometry, diabetes, hypertension, inflammatory markers, and validated questionnaires assessed lower urinary tract symptoms, depression, and daytime sleepiness by the Epworth Sleepiness Scale (ESS). Logistic regression analyses identified adjusted relationships of comorbidities with OSA severity categories.

Results: In men aged < 70 years, both mild OSA [$n = 169$, odds ratio (OR) = 1.6, 95% confidence interval (CI) = 1.1–2.4] and moderate-severe OSA ($n = 160$, OR = 1.8, 95% CI = 1.1–2.9) were significantly associated with hypertension. Mild OSA also showed a borderline association with depression (OR = 1.7, 95% CI = 1.0–2.9). Moderate to severe OSA was also significantly associated with obesity (OR = 3.9, 95% CI = 1.9–7.9), and workforce non-participation in models including interleukin-6 (IL-6) or C-reactive protein (CRP). IL-6 and CRP showed no adjusted association with moderate to severe OSA. In men aged ≥70 years, mild OSA ($n = 55$) was significantly associated with diabetes (OR = 2.52, 95% CI = 1.12–5.65) while moderate to severe OSA ($n = 59$) showed positive associations with obesity (OR = 2.86, 95% CI = 0.89–9.20, $P = 0.078$), nocturia (OR = 2.19, 95% CI = 0.95–5.00, $P = 0.06$) and depression (OR = 3.10, 95% CI = 0.81–11.8, $P = 0.098$) which did not achieve statistical significance.

An ESS > 10 was not associated with OSA severity in young or older men.

Discussion: Cross-sectional associations of undiagnosed OSA and comorbidities varied by age. Screening men <70 years with hypertension may identify OSA that will benefit from treatment. In older men, OSA contributes to comorbidities however further longitudinal studies to examine these age-related associations are required.

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THE INTER-BREATH TRANSITION PERIOD DECREASES WITH INCREASING UPPER-AIRWAY RESISTANCE

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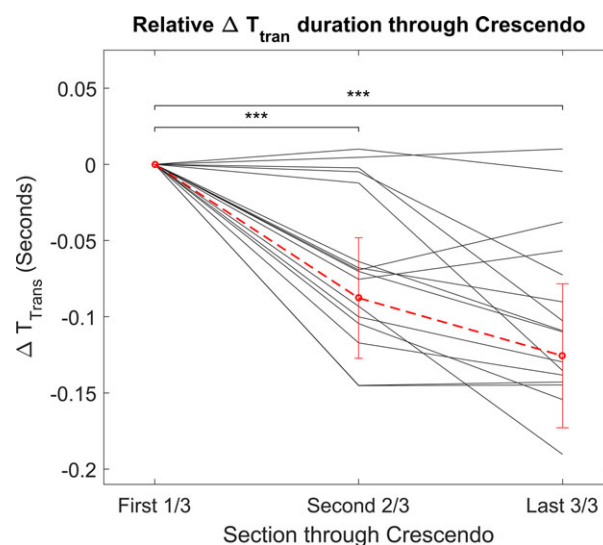
Introduction: Short pauses or “transition periods” between the expiratory and inspiratory periods of subsequent breaths are

commonly observed during sleep. However, the role that these transition periods play in the regulation of ventilation during physiological challenges such as increased upper-airway resistance in patients with obstructive sleep apnoea (OSA) has not been investigated. We hypothesised that in order to maintain eupnoeic ventilation during periods of high upper-airway resistance, the transition period reduces to accommodate an increased inspiratory period.

Methods: 20 participants underwent full polysomnogram recordings with the addition of an epiglottic catheter. “Crescendo” events (characterised by progressive increase in resistance identified by increasing epiglottic pressure swings over ≥5 breaths without an increase in peak inspiratory flow) were manually scored during apnoea-free non-REM sleep. Each breath was computationally segmented into inspiratory (the shortest period to achieve 95% of inspiratory volume), expiratory (the shortest period to achieve 95% of expiratory volume), and inter-breath transition period (T_{tran} , the period between expiratory and subsequent inspiratory periods). Crescendo events were then computationally separated into thirds, and the average transition period calculated for each section.

Results: 133 Crescendo events were identified in 15 patients (AHI 11.8 ± 9.5 events/h). The mean T_{tran} reduced between the first and second 1/3, and between the first and last 1/3 (mean \pm SD: 0.67 ± 0.21 vs. 0.60 ± 0.22 sec, $P < 0.001$; and 0.67 ± 0.21 vs. 0.57 ± 0.23 sec, $P < 0.001$). This was reflected in the relative change in T_{tran} (ΔT_{tran} , Figure 1).

Discussion: T_{tran} decreased with increased upper-airway resistance. A long baseline T_{tran} may therefore indicate a capacity to compensate for increases in upper-airway resistance. Changes in T_{tran} may be a useful surrogate for identifying high resistance breathing not otherwise identifiable in routine polysomnograms.



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PARADOXICAL EFFECTS OF THE WAKE MAINTENANCE ZONE ON WAKING PERFORMANCE AND SLEEP

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Introduction: High circadian wake drive in the early evening “wake maintenance zone” (WMZ) counteracts performance impairment from high homeostatic sleep pressure during sleep deprivation. However, whether and how high circadian drive in the WMZ interferes with sleep is not clear. We investigated the effects of the WMZ on sleep and waking performance using data from two laboratory studies of simulated shiftwork.

Methods and Results: *Study 1-Sleep.* 15 healthy males (18–29 years) completed one of three shift schedules, each involving 4 days with a total of 6.5 h time in bed daily: A) 2 days of nighttime sleep opportunities (00:30–07:00 and 22:30–05:00), then a sleep opportunity starting in the WMZ (18:30–01:00), and then a nap during the WMZ (19:00–21:00) followed by a nighttime sleep opportunity (03:00–07:30); B) split sleep opportunities daily (21:00–23:00 and 04:00–08:30); or C) one sleep opportunity daily (22:30–05:00). Mixed-effects ANOVA showed an effect of schedule on total sleep time (TST; $F = 3.88$, $P < 0.05$) but not on sleep latency ($F = 1.63$, $P = 0.21$). TST was reduced when sleep started during the WMZ, but only when there was no prior sleep loss, suggesting that high homeostatic sleep pressure from prior sleep loss can override high circadian wake drive during the WMZ.

Study 2-Performance. 13 healthy adults (22–34 years) completed one of two shift schedules: a nightshift schedule involving 3 days with daytime sleep (10:00–18:00), or a dayshift schedule involving 3 days with nighttime sleep (22:00–06:00). This was followed by 24 h wakefulness beginning at 18:00 or 06:00, respectively. Psychomotor vigilance task (PVT) performance was measured every 2 h during wakefulness. Mixed-effects ANOVA showed an effect of time awake ($F = 4.46$, $P < 0.001$) and an interaction of schedule by time awake ($F = 5.18$, $P < 0.001$) on PVT lapses (RT > 500 ms). After almost 24 h wakefulness following the nightshift, performance returned to near baseline levels during the WMZ, suggesting that high circadian wake drive in the WMZ can override high homeostatic sleep drive.

Discussion: Our results suggest a paradox, with high homeostatic sleep drive being counteracted by high circadian wake drive in the WMZ for waking performance but not for sleep maintenance. This indicates that homeostatic and circadian regulation may be fundamentally differently for waking function than for sleep.

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EATING VS. NOT EATING AT NIGHT DIFFERENTIALLY AFFECTS PERFORMANCE DURING THE NIGHTSHIFT

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Introduction: Shiftworkers experience impaired performance at night, however it is unknown whether their eating patterns during the night shift will influence performance. Therefore, the aim of this study was to examine the effect of eating vs. not eating during the night shift on performance.

Methods: Healthy young males were allocated to a night eating ($n = 5$; age 23.2 ± 5.5 years; BMI 22.2 ± 1.2 kg/m²) or no eating at night condition ($n = 5$; age 26.2 ± 6.4 years; BMI 23.2 ± 1.3 kg/m²). The protocol included an 8 h night-time baseline sleep, followed by 4 consecutive nights of simulated night shift (day sleep; 10:00 h–16:00 h), and an 8 h night-time sleep. During simulated night shift, meals were provided at ≈ 0700 h, 1900 h and 0130 h (night eating); or ≈ 0700 h, 0930 h, 1410 h and 1900 h (no eating at night). Meal composition was strictly controlled throughout the study. During the simulated night shift participants completed a Karolinska Sleepiness Scale (KSS), Digit Symbol Substitution Task (DSST) and a 10 min Psychomotor Vigilance Task (PVT) at 1830 h, 2130 h, 2400 h and 0400 h. Mixed effect ANOVAs specified fixed effects of condition, day, and time and their interactions, and a random effect of subject ID on the intercept.

Results: For KSS, there was a significant effect of time ($P < 0.001$), with higher sleepiness at 0400 h compared to 1830 h, 2130 h, and 2400 h ($P < 0.001$). For DSST, there were significant effects of day ($P = 0.003$), with performance improved across days, and time ($P < 0.001$), with performance at 0400 h significantly worse than at other times ($P < 0.001$). For both conditions PVT lapses were significantly higher at 0400 h, but this effect was stronger in the eating at night condition. For PVT errors there was a significant condition*time interaction ($P = 0.009$), with performance significantly worse at 0400 h compared to 1830 h, 2130 h, and 2400 h in the eating at night condition ($P < 0.001$), but not in the no eating at night condition.

Discussion: Performance was worse in the early morning hours. However, restricting food intake at night limited this impairment. Thus, altering meal timing and/or reducing meal size may be a countermeasure for maintaining performance across the night shift.

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GLUCOSE METABOLISM DURING SLEEP FOLLOWING SEVEN NIGHTS OF EIGHT OR 6 H OF TIME IN BED

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Introduction: Restricting sleep duration to below 6 h per night for consecutive nights results in impaired glucose tolerance during glucose challenge tests. However the influence of such sleep restriction on glucose metabolism *during* sleep is less well understood. A laboratory study was conducted to investigate the effect of multiple nights of sleep restriction on glucose metabolism during sleep.

Methods: Seven male participants lived in a sleep laboratory for eight nights. Participants had a 9-h baseline sleep opportunity (2300 h to 0800 h) followed by either 8 h time in bed per night from 0000 h to 0800 h ($N = 3$; mean age \pm SD: 20.3 ± 4.0) or 6 h time in bed per night from 0200 h to 0800 h ($N = 4$, mean age \pm SD: 21.5 ± 3.8). Interstitial glucose concentrations were measured continuously using glucose monitors.

Results: For each participant, area under the curve was measured from 0200 h to 0800 h during the final sleep opportunity in each condition and expressed relative to baseline. Area under the curve for glucose concentrations was not different between the two groups [$t(5) = -1.83$, $P = 0.125$].

Discussion: Restricting sleep from 8 h to 6 h per night did not affect glucose concentrations during sleep. There are several possible explanations for this. First, the system for regulating glucose during sleep may be more robust than the system for regulating glucose concentrations during a glucose challenge administered in the day time. Second, reducing sleep opportunities to 6 h per night may not be sufficient to impair glucose metabolism during sleep. Finally, at the time of abstract submission, the sample size of our group was small (seven participants) and may have reduced statistical power. At the time of the conference, this data set will have increased to 19 participants.

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MIGRAINES, HEADACHES AND DEPRESSIVE SYMPTOMS IN NARCOLEPSY: INVESTIGATION OF DIFFERENCES IN THOSE WITH AND WITHOUT CATAPLEXY

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People with narcolepsy experience poorer general health and wellbeing than the general population. The presence/absence of cataplexy may be a critically important factor, as those with narcolepsy with cataplexy have been found to have low or non-detectable levels of the neuropeptide hypocretin, which is involved in sleep and wakefulness. Those without cataplexy (with or without narcolepsy) typically have normal hypocretin levels. The specific role of hypocretin is currently not well understood.

The present study aimed to examine whether the people with narcolepsy *with cataplexy* report more migraines, headaches and lower levels of general health and wellbeing than people with narcolepsy *without cataplexy* and healthy controls. A total of 508 adult participants were recruited, which made up the four age-matched groups: participants with narcolepsy *without cataplexy* (77), a narcolepsy *with cataplexy* (131), a idiopathic hypersomnia (136)

and a control group (164). A number of questionnaires were used to collect the required data relating to migraines, headaches and general health and wellbeing.

Results indicated that all three groups with sleep disorders experienced more migraines and headaches than the controls. However, unexpectedly, those with narcolepsy with cataplexy did not experience more migraines and headaches than those with narcolepsy without cataplexy. Results also indicated that people experiencing migraines and headaches expressed higher levels of symptoms associated with depression, anxiety and stress. In addition, both healthy controls and people with narcolepsy without cataplexy suffering from migraines reported more depressive symptoms than the other groups.

These findings could suggest that the level of hypocretin may not be the only factor that exacerbates these symptoms, but possibly the number of hypocretin producing cells within the brain (Thannickal, Nienhuis, & Siegel, 2009). Also, there may be a common underlying factor among people with narcolepsy with and without cataplexy and people who suffer from migraines and headaches. Having a clear understanding of what these groups commonly share and the potential role of hypocretin in narcolepsy could provide knowledge to aid in the development of better treatments for people with narcolepsy and possibly for people without narcolepsy. Ultimately, this could help improve the quality of life for people with and without narcolepsy.

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A COLLABORATIVE APPROACH FOR IMPROVING INSOMNIA MANAGEMENT IN GENERAL PRACTICE SETTING

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Introduction: Insomnia, with many serious health consequences associated with it, is a commonly presenting complaint in general practices. Our study aimed to explore General Practitioner's (GPs) current insomnia management strategies and their views on introducing practice pharmacists in general practices as specialised sleep health service providers.

Methods: Qualitative methods were used for this exploratory study. In a purposive convenience sampling method, professional networks of research team members and snowballing techniques were used for recruiting participants. Semi-structured interviews were conducted using an interview guide. This guide included questions focused on GP's approaches for managing insomnia as well as their perceptions about collaborative sleep health services. Data collected from audio-taped interviews conducted was transcribed verbatim and transcripts were analysed using a framework analysis approach.

Results: Twenty-four interviews were conducted with GPs from demographically diverse practices. Factors that influenced GPs treatment recommendations included - presence of other coexisting health issues, severity of insomnia and its impact on patient and patient's health condition. While some of the GPs appeared to be unfamiliar with behavioral therapies, most of them reported a lack of skills and time to provide the evidence-based behavioral treatments. The majority of the GPs demonstrated a positive attitude to a collaborative sleep health service and stated that a practice pharmacist could play a significant role in managing insomnia in general practices.

Discussion: The findings of this study support the fact that management of insomnia in general practices is suboptimal. Given that GPs are very time pressured, a team based approach with practice pharmacists or practice nurses can be beneficial for delivering optimally effective and evidence-based insomnia services in general practices.

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WHILE YOU WERE SLEEPWALKING: THE SCIENCE OF SOMNAMBULISM

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Sleepwalking has long held a fascination—the strange nocturnal wanderings of people who are actually asleep. It most prominently comes to the attention of the general public when sleepwalking is used as a defence for murder or when a sleepwalker is seriously injured. Sleepwalking is a relatively common occurrence in both children and adults. This presentation will highlight the recent advances in the science of sleepwalking. It will present the results of two of our cross-sectional studies of sleepwalking in Australian children and adolescents. Results from our recent meta-analytic reviews of the prevalence of sleepwalking, interventions for sleepwalking and medication-induced sleepwalking will also be presented. A theoretical model of violence during sleepwalking will be discussed as well as clinical guidelines for managing sleepwalking based on the current science.

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THE BEAT UP ON HEART RATE VARIABILITY IN INSOMNIA PATIENTS: A CRITICAL LITERATURE REVIEW

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Introduction: Heart rate variability is an objective biomarker that provides insight into autonomic nervous system dynamics. Physiological hyperarousal is frequently posited to contribute to the development, maintenance and 24-h systemic sequelae of insomnia. However, there is conflicting evidence regarding the presence of heart rate variability impairment in insomnia patients.

Methods: Web-based databases were used to systematically search the literature for studies that compared the heart rate variability of insomnia patients to controls or reported the heart rate variability of insomnia patients before and after an intervention.

Results: The database search yielded 555 records (CINAHL 9, EMBASE 182, Google Scholar 21, PubMed 60, Scopus 140, Web of Science 143). After removal of duplicates, 275 publications remained. 22 met the inclusion criteria. Of these 5 research studies compared insomnia patients before and after an intervention. We were limited in our ability to synthesise outcome measures and perform meta-analyses due to considerable differences in patient and control selection, sample sizes, study protocols, measurement and processing techniques and outcome reporting. Furthermore, the risk of bias was deemed to be high in the majority of studies.

Discussion: We cannot confirm that heart rate variability is reliably impaired in insomnia patients nor deduce if or how insomnia

interventions alter heart rate variability and autonomic dysfunction. Large longitudinal studies of insomnia patients and controls that incorporate 24-h recordings are required to elucidate the precise nature of heart rate variability in insomnia patients. In order to validate the cardiovascular disease predictive power of heart rate variability, a specific study design would be required, such as a nested case-control study within a larger cardiovascular disease cohort study. Given the inability to adequately draw conclusions from existing research, the development of an agreed method for the measurement and analysis of heart rate variability during sleep is imperative.

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EXCESSIVE DAYTIME SLEEPINESS, BUT NOT OBJECTIVE SLEEP MEASURES, IS INDEPENDENTLY ASSOCIATED WITH SELF-REPORTED ERECTILE DYSFUNCTION IN A COMMUNITY-DWELLING COHORT OF MEN

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Background: Recent reviews have suggested a role for sleep disorders in the development of erectile dysfunction (ED). The available evidence is limited by a reliance on clinical/patient samples, self-reported sleep function, and inadequate adjustment for shared confounders. This study aimed to determine whether there is an independent association between OSA (and other sleep indices) and ED.

Methods: Data were drawn from a randomly-selected, community-dwelling cohort of men aged ≥ 40 years at recruitment (2002–5). Of these, $n = 734$ men with no prior OSA diagnosis who underwent full in-home polysomnography (Embletta X100; 2010–11) and had complete ED measures (Global Impotence Rating) were selected for the analytic sample (mean age (SD): 60.8 (10.9)). Uni-, age-, and multi-adjusted regression models of ED were fitted against PSG measures and sleep quality (PSQI) & excessive daytime sleepiness (EDS; Epworth sleepiness scale), along with related covariates including anthropometry, blood pressure, serum lipids, sex steroids and estradiol, inflammation, lifestyle factors, chronic conditions, and medication usage.

Results: Of the men examined, 24.7% ($n = 181$) had ED, most notably in men aged over 65 years ($P < 0.001$). In unadjusted models, men with ED were more likely to have higher AHI (per SD increase) (OR: 1.25; 95% CI 1.06–1.47) (in both REM (1.20; 1.02–1.41) & non-REM (1.24; 1.05–1.46) sleep), moderate/severe OSA (1.54; 1.06–2.23), higher wake after sleep onset (1.79; 1.51–2.12), lower total sleep time (0.69; 0.58–0.83), poorer sleep quality (1.40; 1.00–1.98) and excessive daytime sleepiness (1.63; 1.01–2.62). There was no significant association observed for oxygen desat. index ($>3\%$) (per SD increase or >16 sec) or arousal index. After adjusting for age (linear), only poor sleep quality (1.64; 1.08–2.50) and EDS (2.60; 1.45–4.64) were associated with ED. In final multiple-adjusted models, only EDS was found to associate with ED (2.09; 1.01–4.29) (*model also adjusted for age, waist circumf., physical activity, testosterone, cardiovasc. disease, depression, diabetes, voiding LUTS, sedative medications*).

Conclusion: Self-reported erectile dysfunction in middle-aged to elderly men appears highly dependent on the presence of a variety of biopsychosocial factors, including daytime sleepiness. Associations with objective sleep measures appears highly age-dependent.

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UNDERSTANDING WHY PATIENTS PRESENT FOR SLEEP-RELATED PRIMARY HEALTHCARE: A MULTICENTRE RETROSPECTIVE ANALYSIS OF 747 AUSTRALIAN PATIENTS FROM 2013 TO 2015

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Introduction: Understanding why patients seek sleep-related primary healthcare, as the gateway to further medical treatment, may help provide insight into better management, a reduction in the delay of diagnosis or lack of diagnosis and potentially aid future training strategies and improve treatment adherence. The aim of this study is to report the reasons why patients seek Sleep-related primary healthcare from General Practitioners

Methods: A retrospective clinical audit of electronic health records completed by 747 patients across seven General Practice clinics in Queensland and New South Wales, Australia from April 2013 to January 2015. The main primary outcome measure was the reason for presenting to a sleep-trained General Practitioner.

Results: The most common combination of reasons for a patient presenting to the GP were due to snoring and having symptoms of nocturnal disordered breathing ($n = 146$, 20.7%) followed by snoring alone ($n = 106$, 15.1%), snoring and excessive daytime tiredness ($n = 106$, 15.1%), excessive daytime tiredness alone ($n = 87$, 12.4%) and snoring and having issues with a partner or family member due to snoring ($n = 76$, 10.8%). By individual reason, 490 (69.7%) patients reported snoring as being at least one reason for presenting, followed by symptoms of nocturnal disordered breathing ($n = 272$, 38.7%), excessive tiredness ($n = 266$, 37.8%) and sleeping in a separate bedroom or having issues with a partner or family members due to snoring ($n = 92$, 13.1%).

Discussion: Patients seek sleep-related primary healthcare due to symptoms consistent with obstructive sleep apnoea and insomnia. A large proportion of patients present with multiple symptoms or issues, suggesting that patients wait until these symptoms have an increased burden before seeking help. As untreated sleep health problems have adverse effects, there is a need for further education by GPs and other health professionals about OSA risk factors and the importance of early intervention.

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PSYCHOMETRIC SLEEP MEASURES AT POST-THERAPY FOLLOW-UP IN MELANOMA, BREAST AND ENDOMETRIAL CANCER COHORTS: PRELIMINARY DATA

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Introduction: Cancer patients often report disturbed sleep, while some specific sleep disorders, such as obstructive sleep apnoea

(OSA), have been associated with increased cancer risk and tumour aggressiveness. We assessed sleep quality perception and OSA risk in three post-therapy cancer patient sub-groups (melanoma, breast and endometrial cancer).

Methods: Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) and STOP-BANG (OSA risk) questionnaires were administered to consecutive patients attending post-therapy cancer clinics (~1.5–12 months) at Westmead Hospital (melanoma, $n = 23$; breast, $n = 49$; and endometrial cancer, $n = 25$). Data were compared using a Kruskal-Wallis H test. $P < 0.05$ was considered significant.

Results: The group was predominantly female (male: female 12:85), older (age: 63.3 ± 11.4 years; mean \pm SD) and moderately obese (BMI: 29.9 ± 6.6 kg/m²). The PSQI score was 8.1 ± 3.9 au; ESS: 5.9 ± 4.8 au; and STOP-BANG: 2.8 ± 1.5 au. For PSQI, 75% of subjects scored >5 au, (Melanoma: 68%; Breast: 88%, Endometrial: 60%) while 53% of subjects scored ≥ 3 au on STOP-BANG (Melanoma: 78%; Breast: 30%, Endometrial: 76%). ESS scores were not significantly different between sub-groups; however, there were statistically significant between sub-group differences in STOP-BANG and PSQI scores as follows:

	PSQI $\chi^2(2) = 7.9$, $P = 0.02$ Score (au)	STOP-BANG $\chi^2(2) = 19.8$, $P < 0.001$ Score (au)
Endometrial Cancer	6.7 ± 3.8	3.2 ± 1.6
Breast Cancer	9.2 ± 3.7	2.2 ± 1.1
Melanoma	7.1 ± 4.2	3.74 ± 1.5

Conclusion: Poor quality sleep was common in post-treatment cancer patients (particularly those with breast cancer), while endometrial and melanoma patients were at highest risk for OSA. Sleep disturbance is a potentially treatable condition afflicting cancer patients. Larger studies are needed to establish the prevalence of specific sleep disorders in specific cancer cohorts and to define relationships between sleep disturbance and clinical outcomes.

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TIME FOR TRANSLATIONAL MOLECULAR CHRONOBIOLOGY IN PARKINSON'S DISEASE

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Parkinson's disease (PD) is a common neurodegenerative condition where patients frequently experience sleep/wake disturbances. Previous studies have attempted to investigate circadian disruption using actigraphy and melatonin secretion but currently no work has explored the impact of the disease on the circadian clock as measured through the profile of mRNA regulated by clock genes (e.g. Bmal1).

In this study we will evaluate the clock function in PD patients and age matched healthy controls by collecting oral mucosa samples along with saliva every 4 h during a 24 h period. Oral mucosa samples are used to determine the circadian oscillation profile of mRNA clock genes in their habitual synchronized condition. By contrast, saliva can be used to measure melatonin levels and an actigraphy assessment over two weeks can be used to derive

circadian locomotor behaviour. In addition, we will study the clock properties of each individual in vitro using human fibroblasts. Fibroblasts are obtained from 2 mm skin biopsies in both patients and controls. These fibroblasts are infected with a Bmal1::luciferase lentivirus allowing the study of the functionality of the individual's molecular clock. The significance of studying the circadian clock in vitro is that cells are isolated from any synchronizing hormones, medication, light and metabolic signals that were once present in the in vivo context.

Combining these measurements we aim to elucidate whether specific chronotypes may be associated with neurodegeneration and in future could be used to evaluate circadian phenotypes in healthy older individuals who are at risk for developing neurodegeneration (e.g. those with a strong family history). This work will create the basis for developing a research program that will unravel the complexity of the circadian clock in different disorders integrating molecular chronobiology and sleep research in a multidisciplinary clinical setting.

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CAN POSTURAL BALANCE BE USED AS AN INDICATOR OF SLEEP-RELATED FATIGUE?

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Rationale: Fatigue continues to be a significant hazard in occupational settings with far reaching health, economic and social consequences. It has been suggested that tests of postural balance are a valid indicator of sleep-related fatigue and thus, they could be used as an objective measure to assess fitness for duty. Past studies have typically used small samples, minimal trials and total sleep deprivation protocols which have produced mixed results. Therefore, the purpose of this study was to find clarity amongst these contradictory findings, using a sleep restriction protocol that is more representative of the western population.

Method: Eighteen male participants aged 18–30 years spent nine consecutive nights within a sleep laboratory. Seven nights were sleep restricted to five, 7 or 9 h by extending bedtimes to 23:00, 01:00 or 03:00 h and maintaining wake times of 08:00 h. Participants were tested daily at 14:00, 17:00, and 20:00 h. Standing still on a force platform with eyes open and focussing on a mark three meters ahead at eye level, participants stood first with both legs, then their right leg and left leg, each for 30 sec.

Results: A mixed model regression analysis will be used to test for main effects of sleep dose (between-subjects factor) and experimental day (within-subjects factor), and for sleep dose x experimental day interactions. The variable of 'Participant ID' will also be entered as a random effect into the analysis to account for within-subject variability. Any significant main and interaction effects will be explored through post hoc analyses.

Conclusion: This study will help clarify the discrepancies in past research, as it uses multiple trials over consecutive days within a sleep-restriction protocol that resembles the experience of the wider population. Results will reveal if postural balance is indeed a viable indicator of sleep-related fatigue. If so, balance tests may take on a wide variety of applications including the provision of objective data for use within fatigue risk management systems in the workplace. Therefore, a quick and simple balance test may have the potential to help reduce the risk of error and injury in occupational settings.

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FLOW CYTOMETRIC ENUMERATION OF BACTERIAL AND VIRUS-LIKE PARTICLE POPULATIONS IN THE HUMAN ORAL CAVITY PRE AND POST SLEEP

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Within the oral cavity are various ecological niches which provide unique surfaces for the colonisation of distinct microbial communities. Such surfaces include the tongue, throat, palate, gingivae and teeth. Although there is increasing genomic sequence data to show how these niches differ, the overall concentrations of bacteria and viruses at these locations still remains unclear.

Here, we examined the spatial distribution of the paediatric oral microbiota of 10 healthy volunteers using flow cytometry as a tool to enumerate populations of bacteria and virus-like particles (VLPs). The highest concentrations of bacteria were found at the back of the tongue with an average of $2.90 \pm 0.76 \times 10^7$ bacteria mL⁻¹ before sleep and $1.35 \pm 0.20 \times 10^8$ bacteria mL⁻¹ after sleep. The back of the throat had the highest percentage increase in VLPs with $5.68 \pm 1.86 \times 10^6$ VLPs mL⁻¹ before sleep and $5.96 \pm 2.30 \times 10^7$ VLP mL⁻¹ after sleep. These increases in bacterial and VLP concentrations were found to be significantly different from one another ($P < 0.05$), as were all other sampled locations. These detectable differences in bacterial and VLP concentrations in the oral cavity further demonstrates that the oral cavity is a heterogeneous environment with unique niches that change over time.

Through understanding the changes in microbial abundances within these niches, we can further our understanding of the healthy paediatric oral microbiome, and determine in the future, how shifts in these abundances relate to various health conditions.

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ANALYSIS OF MALLAMPATI ASSESSMENT PROTOCOL AND METHODOLOGY

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Introduction: Originally, the Mallampati Score was developed to help predict the ease of endotracheal intubation. More recently, this score has been used as a predictive tool for obstructive sleep apnoea and (in conjunction with other cephalometric images) for orthodontic evaluation to assess suitability for mandibular advancement splint therapy. While the Mallampati Scores themselves are clearly described (Class 1 to Class 4) and based upon the degree to which the uvula, faucial pillars and soft palate are visible during direct examination of the open mouth, the exact technique used varies between authors and sites, viz with or without phonation and/or tongue protrusion. Moreover, there is even less information regarding how reference images are taken. There is currently no standard practice regarding the field of depth, the perspective and angle of image acquisition. The aim of the present study was to examine and devise a specific set of practice parameters and recommendations to ensure consistency across sites for these techniques and image acquisitions.

Methods: The current protocols for the Mallampati Score and the capture of other cephalometric images in SleepSA at North Eastern Community Hospital were compared with those of The Dental Practice in Adelaide and assessed for consistency, accuracy and ease of interpretation.

Results and Conclusions: The analysis, currently underway highlighted the importance of consistent and specific procedures regarding the capture of cephalometric images. Unless very strict procedures were followed, the images varied greatly and could result in differing Mallampati Scores in the same patient, depending upon factors including the angle at which the photo was taken as well as both the direction and amount of lighting used. It was recognised that Mallampati images should be taken with the tongue out but without phonation. Additionally, a custom 'photo booth' is recommended to maintain consistency in field depth, angle tilt and lighting during photography.

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LONG-TERM NON-INVASIVE VENTILATION (NIV) SUPPORT IN CHILDREN <5 YEARS OF AGE

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Introduction: The use of Long-term NIV support in children has increased rapidly over the past decade. The aim of this study was to describe the population of children less than 5 years of age requiring home NIV support under the care of our service.

Methods: A retrospective clinical audit of children receiving NIV was conducted over a 1 year period from January 2015 – January 2016. Data was obtained from clinical bookings, information systems and chart review. A clinical database search was conducted for all paediatric patients on NIV who were initiated at less than 5 years of age. Initial review identified 36 children for inclusion. Criteria for exclusion were Invasive ventilation patients and those patients ceased NIV therapy.

Results: 145 children received NIV Support, of which 36 children met age criteria. Of those, 16 children required CPAP and 20 children required BiPAP. Clinical audit identified that, Children and families have multiple interactions over the course of their treatment with Sleep Doctors, Sleep Clinic Nurses and Sleep Study Nurses. There are a number of children that are supported through Outreach Clinics due to distance from a Tertiary Paediatric hospital. Nasal masks were well utilised and adherence data obtained. Primary diagnosis of Obstructive Sleep Apnoea (OSA) or Hypoventilation was also associated with Secondary Diagnosis or Comorbidities.

Discussion: This study is a starting point from which to consider future prospective studies evaluating Parent's or Carer experience of NIV Initiation in hospital and the months following at home and to understand the long-term impact on families caring for a child less than 5 years of age requiring long-term home NIV support, measuring Quality of Life (QOL) data and Identifying improvement in our service for young children on NIV and families.

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EFFECTS OF AGE ON CEREBRAL OXYGENATION IN CHILDREN WITH SLEEP DISORDERED BREATHING

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Introduction: Up to 35% of children have sleep disordered breathing (SDB) and the prevalence peaks in the preschool years. SDB is associated with adverse behavioural and neurocognitive outcomes which are milder in pre-school children compared to school aged children. It has been hypothesised that the repetitive episodes of hypoxia experienced during SDB underpin these deficits. To date there have been limited studies in children which have directly measured cerebral oxygenation. Near-infrared spectroscopy measures cerebral tissue oxygenation index (TOI) which represents cerebral oxygenation. The aim of this study was to determine the effects of age on TOI during wake and sleep in children.

Methods: Children aged 3–12 years referred for clinical assessment of suspected SDB ($n = 74$) and non-snoring controls recruited from the community ($n = 33$) underwent overnight polysomnography and their obstructive apnoea hypopnoea index (OAH) was calculated. Simple linear regression determined if age was predictive of TOI in wake and sleep. One-way analysis of variance (ANOVA) with Bonferroni post hoc testing was used to compare TOI in each sleep state. Results presented as mean \pm SEM.

Results: There were no differences in TOI during sleep between children with SDB and controls. Overall, age was a determinant for the change in TOI during the following: N1 (STD β , 0.25; model r^2 , 0.06), N2 (STD β , 0.33; model r^2 , 0.11), N3 (STD β , 0.36; model r^2 , 0.13), REM (STD β , 0.27; model r^2 , 0.07) and total sleep (STD β , 0.30; model r^2 , 0.09), $P < 0.01$ for all. Age was not a significant determinant for changes in TOI during wake. TOI was significantly higher during REM ($74.8 \pm 0.35\%$) compared to N2 ($73.1 \pm 0.35\%$) and N3 ($72.9 \pm 0.37\%$), $P < 0.05$ for both.

Discussion: Cerebral oxygenation increases with age during sleep in children with SDB and in non-snoring controls. Therefore, our data suggest that normal cerebral growth may play an important role in regulating the influence of SDB on cerebral oxygenation in children. Additionally, we found that cerebral oxygenation is elevated in REM vs. NREM sleep. REM is associated with increased cerebral activity which may provide an explanation for the increased demand for cerebral oxygenation and hence the increased REM TOI.

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PAEDIATRIC POLYSOMNOGRAPHY AT WELLSLEEP-CREATING A CHILD FRIENDLY ENVIRONMENT IN AN ADULT SLEEP LABORATORY

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Background: Paediatric polysomnography (PSG) is the preferred method to investigate sleep apnoea in children, to evaluate cardiorespiratory function in the context of chronic lung disease or neuromuscular disease, and to investigate atypical cases of parasomnias. However, paediatric PSG can be challenging as children may have a limited ability to cooperate with the setup, and may have trouble sleeping in a strange environment particularly if they have developmental disabilities (Beck & Marcus, 2009).

To improve the diagnostic quality of the polysomnogram, WellSleep employs a number of techniques to help create a more child friendly atmosphere. This begins with preparation at the initial clinic consultation where an informative brochure with pictures is used to explain the process. For anxious children a visit to WellSleep for a tour of the room can be very helpful in easing anxiety. At booking, enquiry is made about the child's interests that are then incorporated into the decor of the room, including wall stickers, soft toys, animal bedcovers, and computer printouts. Paediatric patients are admitted to WellSleep at 5 pm to provide extra time to acclimatise.

Methods: Thirty two consecutive paediatric admissions were reviewed for setup times and technical adequacy. Reason for diagnosis, age and developmental status were also considered.

Results: A review of set up time ranges, depending on the age/mental age of the child indicates it usually takes between 40–75 min to attach all sensors. However, sometimes the least tolerated sensors such as the nasal cannula are placed after the child falls asleep. The success of the study in terms of adequate sleep times and sensor reliability are high.

Conclusion: Paediatric studies can be performed in a primarily adult lab with the right attitude, training and techniques.

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TYPE 2 PSG MAY NOT BE APPROPRIATE FOR CLASSIFYING OSA PATIENTS AS POSITIONAL

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Purpose: Positional OSA (pOSA) is a topic of renewed interest. The categorisation of pOSA is dependent on the relationship between the supine and non-supine Apnea-Hypopnea Index (AHI). A supine: non-supine AHI ratio of 2:1 is often used to classify patients with supine predominant OSA (spOSA) while supine: non-supine AHI ratio of 2:1 with the non-supine AHI <5/h is used to classify patients with supine independent OSA (siOSA). The reliability of recording body position is thus very important for pOSA classification. Type 1 PSG has the benefit of sleep technicians in attendance to correct poor or incorrect signals whereas the Type 2 PSG occurs in the patients' home. The aim of this study was to determine the reliability of Type 2 PSG in classifying pOSA patients.

Methods: 41 consecutive patients undertaking Type 1 polysomnography (PSG) for the suspicion of OSA were included in this

investigation. Body position was recorded using a triaxial accelerometer at the midline of the lower sternum. The accelerometer was attached according to the manufacturer's instructions. To simulate a Type 2 PSG setting, technical staff were requested not correct the accelerometers attachment during the study. PSGs were scored using the 2012 AASM recommended respiratory event criteria (AASM_{2012Rec}). Type 1 body position was determined by the digital video record while Type 2 body position was determined by the accelerometer recording.

Results: The cohort was middle aged, obese, and mild OSA severity. Bland Altman analysis of supine sleep time demonstrated a bias towards the Type 2 PSG (29 ± 54 min). Type 1 PSG results displayed an increased supine AHI (median [IQR]: 25.1 [8.9, 57.2] vs. 17.8 [6.1, 40.6] $P < 0.001$) with no change in non-supine AHI (median [IQR]: 6.7 [2.4, 18.1] vs. 6.8 [1.8, 22.2] $P = 0.23$) when compared to Type 2 PSG results. This change in supine AHI resulted in a significant increase in spOSA diagnoses (18/41 vs. 12/41 $P = 0.04$) but no change in siOSA diagnoses (8/41 vs. 3/41 $P = 0.15$).

Conclusions: Due to the unattended nature of Type 2 studies, discrepancies in body position recordings were relatively common. This small study suggests that for the purposes of classifying positional OSA, a Type 2 PSG may not be appropriate.

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COMBINED FULL EEG WITH POLYSOMNOGRAPHY IN A CLINICAL SETTING: A REVIEW

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Introduction: Polysomnography (PSG) with full EEG (PSG + EEG) is indicated where patients have relevant differential/multiple neurological and sleep disorders and may better inform clinical practice, including where diseases may interact. Patients may benefit from clinical decisions based on such combined data, including by seeing temporal interactions between diseases. More broadly, the inter-department collaborative nature of these tests may enhance multidisciplinary knowledge. Disadvantages potentially include that these tests are more logistically complex to set up and report: possibly delaying diagnosis and treatment.

Aims: To review PSG + EEG outcomes.

Methods: Retrospective analysis of consecutive PSG + EEG over 5 years from June 2011 was conducted and test diagnoses reviewed. The value of individual combined test results on clinical decisions was also described.

Results/Discussion: 58 subjects (24 male) had a median (range) age 42 (17–75) years, BMI 29 (17–52) kg/m², and AHI 5 (0–72) events/h.

Table 1. Post test diagnoses

Finding	% of studies
1 only	3
2 only	6
3 only	31
4 only	6
1 and 3	9
2 and 3	16
3 and 4	6
1 and 3 and 4	3

Key:

1. Parasomnia.
 2. Seizure or significant EEG abnormality.
 3. Sleep disordered breathing.
 4. PLMD, or unexplained sleep fragmentation.
- Consensus of test value to inform clinical practice showed 31% of tests being informative, 3% not, and 66% with questionable value: most with the possibility of false negative result for parasomnia or seizure. 22% of studies had a positive seizure-related finding, with approximately 2/3 of these showing comorbid sleep disordered breathing.

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AGREEMENT IN SLEEP SCORING: DOES SCORING 200 EPOCHS REPRESENT SCORING A FULL STUDY?

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Introduction: For ongoing sleep laboratory quality control it is important to conduct monthly quality assurance to show intra-class correlation of each scorer and inter-class correlation between scorers. Kappa (k) is the measure of statistical agreement taking into account agreement by chance. External proficiency programs (EPP) are used to compare sleep scoring in sleep laboratories and contribute to quality control by showing correlation between sleep laboratories. The EPP is accessed over the internet to download 200 epochs (32 Mb) of a sleep study, scored and uploaded for comparison with experienced scorers. Since sleep studies range from 200 to 600 Mb of data, it is not possible to transfer full sleep studies.

Aim: To determine if 200 epochs of a sleep study is sufficient to show agreement equivalent to scoring a full sleep study.

Methods: Every month as part of our Quality Assurance (QA), sleep studies are randomly selected from the previous months and rescored according to Rechtschaffen & Kales and the AASM standard by three experienced scorers, to show the level of agreement between and within the scorers. The QA studies from 2011 to 2015 were used for this study. The k's for 200 epochs at the beginning, epochs 400–600, last 200 epochs and the full studies were calculated for Scorer 1 (S1) compared to Scorer 2 (S2), S1 compared to Scorer 3 (S3) and S2 compared to S3. The k for each of the 200 epoch segments were compared with k for the fully scored studies.

Results: A total of 53,169 epochs were rescored by S1, S2, S3.

Table: Inter-rater k for 200 epoch segments and all epochs, mean, SD, Confidence Interval

	First 200e	400–600e	last 200e	All epochs
S1S2	0.71, 0.12 0.68–0.74	0.69, 0.15 0.65–0.73	0.75, 0.11 0.71–0.78	0.74, 0.06 0.72–0.76
S1S3	0.66, 0.16 0.61–0.7	0.7, 0.13 0.66–0.74	0.7, 0.15 0.66–0.74	0.71, 0.07 0.66–0.74
S2S3	0.66, 0.14 0.62–0.7	0.7, 0.15 0.65–0.74	0.7, 0.13 0.66–0.73	0.72, 0.06 0.71–0.74

Discussion: There is moderate to strong agreement when comparing 200 epochs scored with a fully scored study. The strongest agreement was scoring the last 200 epochs of a study.

Conclusion: Scoring 200 epochs of a sleep study can be reliably used to compare sleep scoring between sleep laboratories.

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USE OF GRIP STRENGTH AS AN INDICATOR OF SLEEP PROBLEMS: PRELIMINARY ANALYSIS

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Introduction: Grip strength measured using hand dynamometry, shows a higher correlation with overall mortality than blood pressure (Leong et al., 2015). GS has also been shown to correlate with maximal inspiratory and expiratory pressures in elderly patients (Bahat et al., 2014). Endeshaw et al. (2009) showed grip strength strongly correlated with OSA severity in elderly females, but not males. The aim of this pilot study was to determine if grip strength correlate with the severity of diagnostic PSG markers.

Methods: 7 patients performed grip strength before and after overnight diagnostic PSG. GS for dominant and non-dominant hands was measured from the average of three maximal squeezes of the dynamometer. Night time grip strength was collected approximately 90 min before bedtime, and morning grip strength was collected approximately 90 min after waking. Paired samples t-test was used to determine differences between evening and morning grip strength values. Correlations were performed between evening and morning grip strength for both hands, and diagnostic PSG variables.

Results: Grip strength was significantly higher ($P = 0.03$) in the evening in the dominant hand, $22.7 \text{ N} \pm 7.7 \text{ N}$, compared to the morning, $13.9 \text{ N} \pm 4.5 \text{ N}$, equating to a $22.6\% \pm 15.5\%$ reduction. Similarly, grip strength was significantly higher ($P = 0.03$) in the evening in the non-dominant hand, $23.9 \text{ N} \pm 9.6 \text{ N}$, compared to the morning $18.1 \text{ N} \pm 6.7 \text{ N}$ for the non-dominant hand, equating to a $36.6 \pm 16.2\%$ reduction. There were no significant differences in the size of grip strength decreases between the hands. The percentage of the night spent in stage 2 sleep significantly correlated to the percent change in grip strength from evening to morning in the non-dominant hand ($r = 0.76$, $P = 0.044$). Lowest average NREM $\text{O}_2\%$ was significantly correlated to both non-dominant evening grip strength ($P = 0.79$, $P = 0.037$) and non-dominant morning grip strength ($r = 0.78$, $P = 0.039$).

Discussion: Decreases in grip strength from evening to morning is to be expected with circadian rhythm. Grip strength correlates with some PSG variables. More data are needed to further clarify relationships between grip strength/endurance vs. sleep.

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THE EFFECT OF FLOATATION RESTRICTED ENVIRONMENTAL STIMULATION THERAPY ON SLEEP

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Introduction: As the prevalence of sleep disturbance, stress and anxiety continues to rise in today's society, there is a growing need for easier, faster, more effective solutions to these problems, with an increasing demand for alternatives to pharmacotherapy. Floatation restricted environmental stimulation therapy (REST) is a potentially viable treatment option, as evidence suggests it is highly effective in inducing relaxation, reducing feelings of stress and anxiety, as well as promoting an ideal physiological state for sleep. However, the current research is limited to subjective reports of sleep quality. The current study is the first to examine the effect of floatation REST on

sleep quality using polysomnography, and also aimed to explore the mechanism responsible for these effects.

Methods: In this randomised, counterbalanced study 12 healthy young males experienced three 60-min relaxation conditions. These included a standard floatation REST condition, a floatation condition without complete sensory deprivation (dim light and sound), and a condition, which served as a control that involved lying on a bed. Each condition occurred one week apart, and was preceded by an adaptation night. There was approximately 1 h between the end of relaxation and bed, during which time PSG equipment was attached. Sleep quality was derived from sleep architecture, subjective data, and electroencephalogram spectral analysis measures.

Results: Preliminary analysis suggest that floatation REST results in reduced sleep latency ($P = 0.035$), increased slow wave sleep ($P = 0.009$), and increased sleep efficiency ($P = 0.043$) compared to control. Subjective sleep quality data also suggest that floatation REST results in increased relaxation ($P = 0.011$) compared to control. Preliminary comparisons of the two floatation conditions revealed no significant differences in sleep quality.

Conclusion: These preliminary findings suggest that floatation REST leads to greater improvements in sleep quality compared to relaxing in a dark, quiet room. They also suggest that sensory deprivation may not be the mechanism responsible for these effects as there were no significant differences in sleep quality with or without light and sound. Floatation REST could potentially be a fast, easy, and effective solution to sleep disturbance, and further research should be done to verify this effect in clinical populations.

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SLOW WAVE ACTIVITY IN OBSTRUCTIVE SLEEP APNOEA AND DEPRESSION

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Introduction: Depression and obstructive sleep apnoea (OSA) are highly comorbid disorders, with shared symptomology, posing diagnostic challenges. For each disorder individually, studies examining sleep architecture have observed reduced slow wave electroencephalography (EEG) activity and decreased percentage of slow wave sleep (SWS) in patients. The current study aimed to compare slow wave EEG activity (SWA) between OSA patients and healthy sleepers, and OSA patients with high and low depressive symptoms to identify potential diagnostic biomarkers.

Methods: Ninety participants underwent polysomnography and completed the Hospital Anxiety and Depression Scale (HADS) to indicate severity of depression. Power spectral analysis was used to quantify the SWA (0.5–4.5 Hz) of frontal EEG (F4/M1) from overnight polysomnography recordings.

Results: Participants with OSA ($AHI \geq 10$; $n = 63$) had significantly lower average SWA (μV^2) during SWS ($M = 564.94$, $SD = 337.96$) than healthy controls ($n = 12$; $M = 950.92$, $SD = 326.83$; $P < 0.001$). OSA patients with high depressive symptoms ($HADS-D > 11$; $n = 18$) had an increased REM latency ($M = 173.58$, $SD = 81.04$), and greater REM% ($M = 16.80$, $SD = 3.79$), than those with OSA with low

depressive symptoms ($HADS-D < 8$; $n = 29$; $M = 127.36$, $SD = 69.83$ and $M = 13.17$, $SD = 6.89$ respectively; $P < 0.05$). Further, patients with OSA and high depressive symptoms had greater total SWA during the first REM period ($M = 4930.75$, $SD = 3589.47$) than those with low depressive symptoms ($M = 2685.53$, $SD = 2617.77$; $P < 0.05$), but did not differ on SWA during SWS.

Conclusion: Study findings reflect the presence and complexity of the OSA-depression relationship. While no apparent biomarker of SWA was observed in the current study, the differences in SWA during the first REM period warrant further investigation. The novel examination of SWA in likely depressed and non-depressed individuals with OSA raises questions for further research, and highlights the importance of examining these highly comorbid conditions together.

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RELATIONSHIP BETWEEN SLEEP, NIGHT EATING AND SUBSTANCE USE

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Introduction: The purpose of this study was to examine the factors that predict poor sleep quality in a community sample.

Method: 773 healthy adults were recruited to participate in the online study. Participants were asked to report their BMI and complete the Pittsburgh Sleep Quality Index (PSQI). They were also required to answer questions regarding their engagement in night eating, binge eating, physical exercise, as well as disclose about their substance use and working and study habits.

Results: It was found that 76% of the participants reported having poor sleep based on clinical cut offs on the PSQI. Poor sleep was shown to be significantly correlated with eating food at night, soft drink and alcohol consumption, stress and older age. In particular, waking up in the middle of the night to eat a meal was found to be associated with poor sleep. However, BMI and tea and coffee intake were not significantly associated with poor sleep outcomes.

Discussion: The study indicates that soft drink and alcohol intake during the day and at night may disrupt sleep. Similarly, consuming food late at night appears to have a negative impact on sleep quality. Further research is required to better understand how these factors are impairing sleep.

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38 QUESTION PAEDIATRIC SLEEP UNIT FEEDBACK SURVEY

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Introduction: We performed the paediatric patient feedback survey with the aim of formally engaging with families to improve quality of care and enhance patient experience.

Methods: The questionnaire had 38 questions in seven sections of: 1. Patient experience, 2. Information prior to admission, 3. Waiting times, 4. Scheduling and registration, 5. Facilities and rooms, 6. Service, and 7. Overall assessment. The questions were answered with a 5 point likert scale and free text for comments at the end of each section. Surveys were administered by the clinic nurse via a scripted interview technique. The inclusion criteria was for children to have had one diagnostic sleep study at our unit. Exclusion criteria

was to have had more than one sleep study, here or at any other unit, as we wanted to establish a baseline of our own service.

Results: Data collection was complete when 50 families had performed the survey; this included 3 children, 46 parents and 1 other family member. Our highest scoring area was the families confidence in the skill of the nurse caring for their child; 86% excellent, 14% very good, 0% good, 0% fair, 0% poor, 0% n.a. The area in which we scored the lowest was the time between referral and first contact letter; 16% excellent, 16% very good, 16% good, 8% fair, 32% poor, 12% n.a. Some families identified the wait time for a sleep study as being too long. Several families found it difficult to maneuverer the double arm on the television to face their child directly. Positive feedback was given about the comfort and cleanliness of the unit and four staff members were praised individually for providing excellent service.

Discussion: The survey provided a tool to listen to the families we care for and work together to address areas of concern; user instructions have been put up on the television arm, waitlist management strategies are in place and families are receiving a faster first letter. We intend to repeat the survey every second year for continuous quality improvement.

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A PROTOCOL EXPLORING CAREGIVER SEMI-STRUCTURED CAREGIVER TELEPHONE INTERVIEWS AND QUESTIONNAIRES

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Introduction: The round-the-clock care needs of patients with advanced cancer can mean that caregivers sleep can become compromised. The impact and consequences of sleep disturbances on health and wellbeing are well documented in healthy adults subjects. A systematic review performed to inform this protocol identified 10 international studies assessing the sleep of caregivers of advanced cancer patients. These studies found that 72–100% of the caregivers reported moderate to severe sleep disturbances. Caregivers also did not achieve the recommended 7–8 h of sleep with most caregivers averaging 270.14 min (± 53.76) over a 24-h period. These results demonstrate the need to investigate whether sleep disturbances are a burden for Australian caregivers of advanced cancer patients.

Methods: This study is the first part of a three-phase exploratory mixed methods project exploring the sleep of caregivers of patients receiving palliative care for advanced cancer. 40 caregivers will be recruited from community palliative care services at three Sydney hospitals.

Caregivers will complete questionnaires that measure their sleep quality (Pittsburgh Sleep Quality Index), level of depression (Center for Epidemiological Studies – Depression), and level of burden (Zarit Burden Interview – Short). After these are completed caregivers will take part in semi-structured interviews investigating their perceptions of their sleep. Descriptive and correlational statistics will also be performed on the questionnaires with analysis of transcripts being guided by theoretical and procedural direction from grounded theory.

Results: Findings from this project are designed to provide an understanding of caregivers' perception of their sleep and whether sleep disturbances are a burden for caregivers that requires assistance from palliative services to optimise their sleep.

Discussion: Given the known consequences of sleep disturbances and the tasks required of a caregiver supporting and optimising sleep could have a positive impact on caregivers' health, well being and level of burden of caregiving. The development of a sleep intervention program used in community palliative care to help support caregivers' sleep.

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SLEEP'S KERNEL: INITIATION OF SLEEP WITHIN SMALL NETWORKS

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Krueger and Obal proposed that sleep is a local use-dependent phenomenon in 1993. Using sleep regulatory cytokines, tumor necrosis factor alpha (TNF) and interleukin-1 beta (IL1), information is accumulating in support of this theory. Thus brain expression of TNF and IL1 is activity-dependent; their expressions increase in the somatosensory cortex following enhanced facial whisker stimulation. IL1 and TNF are expressed by neurons and glia. Unilateral application of either TNF or IL1 to the cortex enhances ipsilateral EEG delta wave power suggesting deeper local sleep intensity. Individual somatosensory cortical column evoked response potentials (ERPs) are higher during sleep than waking and have homeostatic properties. The state of an individual column can affect whole animal behaviour; if a column is in a sleep-like state, the rat makes mistakes. TNF induces the sleep-like state in somatosensory cortical columns. It is thus not surprising that neuronal/glia co-cultures also oscillate between sleep- and wake-like states as characterized by slow wave (SW) synchronization, SW power, and ERPs. Optogenetic stimulation of such cultures induces TNF and IL1 expression in the stimulated neurons. TNF induces a more intense sleep-like state in culture. If neurons and glia taken from mice lacking a neuron-specific IL1 receptor accessory protein (AcPb), SW synchronization, SW power, and ERPs develop more slowly than if cells from wild type mice are used. Both IL1 and TNF enhance ERPs in co-cultures of cells from wild type mice suggesting a deeper sleep-like state. If cells from AcPb knockout mice are used for the neuronal/glia co-cultures, IL1-enhanced ERPs are of lower magnitude. We conclude that local networks oscillate between sleep- and wake-like states and the genetic-, molecular-, and electrical pattern- dependencies of emergent network properties that are used to characterize sleep in vivo can be studied using tissue cultures.

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DYNAMICS OF SLOW WAVE SLEEP – CLUES TO THE FUNCTION OF SLEEP

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Despite over a century of research, no single unitary function of sleep has been identified. Instead, and unsurprising given the complexity of the sleep state, the function of sleep is multifaceted and largely dependent on the sleep stage in question. The sleep period can be divided into two distinct states using polysomnography: NREM and REM sleep. Each of these states are associated with different behavioural and physiological characteristics, and reflect different functions for both physical health and behaviour, and psychological function and performance.

This talk will focus on the deepest stage of sleep, referred to as slow wave sleep due to the large amplitude slow wave oscillations observed during this stage (slow wave activity, SWA). The function of SWS/SWA has long been associated with cerebral restoration and a marker of sleep pressure. More recent research, however, also shows its role in synaptic strength and memory consolidation.

By examining the dynamics of SWS/SWA, from its temporal and spatial organisation to its rebound following sleep deprivation, we will understand the significance of this sleep state, particularly for higher cognitive function and synaptic strength. By evaluating the impact of slow wave deprivation or slow wave enhancement, we will further understand the essential role SWS/SWA plays in cognitive function, in particular memory consolidation.

While much is still to be discovered in relation to the function of sleep, and more specifically the function of SWS/SWA, experimental evidence points clearly to a critical role of SWS/SWA in maintaining multiple aspects of brain function.

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SLEEP BRUXISM, MORNING HEADACHE, SLEEP APNEA: COINCIDENTAL OR CONCOMITANT? A DIFFERENTIAL DIAGNOSIS CHALLENGE!

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Sleep bruxism (SB) is a sleep related movement disorder characterized by repetitive jaw muscle contractions with tooth grinding and morning headache or orofacial pain – temporomandibular complaints. Risk factors and mechanisms related to SB genesis are debated in literature for decades. SB can be triggered by several factors including stress & anxiety, autonomic cardiac activation, genetic & environmental predisposition. The differential diagnosis (Dx) of SB is complicated by the presence of co morbidities such as insomnia, periodic limb movements during sleep, and sleep-disordered breathing (e.g., apnea-hypopnea, upper airway resistance or limited upper airway flow or RERA) or neurological disorders (e.g., epilepsy, RBD). The association can be coincidental or real due to aging or medical factors. If co morbidity is suspected, further sleep medical evaluation is recommended to select best management strategies.

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RECENT SURVEY FINDINGS ON PARENTAL OPINION ON SLEEP INTERVENTIONS

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Background: Despite over 50 years of research into the significant impact of sleep disturbance on new parents of young children, parental opinion and concerns regarding the most common cry intensive methods of sleep management, controlled crying, have rarely been investigated. This is particularly important for two reasons (1) 40% of new parents report sleep disturbed infants (2) many studies report parental distress and dissatisfaction with controlled crying and subsequent attrition. This paper presents two recent surveys investigating these issues.

Methods: The Controlled Crying Rationale (CCR) questionnaire, developed and piloted by the authors, was completed online anonymously by parents of children aged between 6–18 months who were invited to participate via parenting blogs, social media, and relevant websites. Online surveys were made available in 2012 (Study 1) and as part of a larger study in 2014 (study 2). Five items in a yes/no/don't know format with additional information via tick box options, asked parents to respond to questions about what sleep management method they used or did not use and why.

Results: In study 1, 71% ($n = 73/104$) of parents would not use or continue to use controlled crying methods citing emotional distress as the reason. Those that did use controlled crying cited positive thoughts about routines and helpful limit setting as the reasons. These results were replicated in study 2, with 63% ($n = 502/790$) not using or continuing controlled crying for the same reasons.

Conclusions: Despite their success and common usage, many parents have expressed dissatisfaction with cry intensive sleep management techniques. Alternative methods need to be developed and empirically tested to reduce attrition and improve health care delivery.

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ROLES OF THE BASAL GANGLIA IN SLEEP-WAKE REGULATION, WITH FOCUS ON DOPAMINE D₁/D₂ RECEPTORS

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The basal ganglia (BG) are the largest structures in the forebrain and consist of four major nuclei, the striatum, globus pallidus, subthalamic nucleus, and substantia nigra. The BG has been demonstrated to act as a cohesive functional unit that regulates motor function, habit formation, and reward/addictive behaviors, but the debate has only recently started on how the BG regulate sleep-wake behavior to achieve all these fundamental functions of the BG. It is well known that dopamine D₁ and D₂ receptors are densely expressed in the BG. By means of optogenetics and the DREADD (designer receptors exclusively activated by designer drugs) system to specifically manipulate neuron activities, adeno-associated virus encoding hrGFP as a tracer, EEG/electromyogram recording for the judgment of sleep-wake stages, and receptor-cre mice, we provided several lines of evidence showing that activation of neurons expressing dopamine D₁ receptors in the caudate putamen, major input of the BG, and in the nucleus accumbens promoted wakefulness, while activation of neurons expressing dopamine D₂ receptors induced non-rapid eye movement sleep. In addition, fundamental neuron circuit and molecular mechanisms by which neurons expressing dopamine D₁/D₂ receptors in the BG regulate sleep-wake cycle were revealed.

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HOME SLEEP STUDIES: CLINICAL CORRELATION IS REQUIRED

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Background: Home sleep studies (HSS) are a frequently used method of investigation for disorders of sleep which have been validated in clinical research studies. In Australia, these can be performed without physician supervision and clinical review and the process has not been standardised. Study quality is therefore potentially open to inaccurate results and incorrect recommendations. The paper aims to explore the aforementioned issues.

Method: Retrospective review of all patients referred to an ENT surgeon for investigation and management of obstructive sleep apnoea in a 6 month period from Mid September 2015 to Mid March 2016.

Results: A total of 208 patients were identified, of which 75 had HSS prior to ENT referral. 8 were excluded due to incomplete workup. Of the 67 included, only 28 (41.8%) had clinical review by a sleep physician after HSS and prior to treatment. 38 patients trialled CPAP after HSS but of these only 8 (21.1%) were successful. Sleep physician review improved CPAP success by a further 15.8%. After clinical review by ENT and Sleep physician in a multidisciplinary clinic the initial diagnosis was changed in 37 (55.2%) and the same number had a subsequent change in management plan. Only 27.8 % were deemed to be candidates for surgical reconstruction of the airways. Of those having a sleep physician review, 30 (85.7%) were offered treatments other than or in addition to CPAP. Level 1 Polysomnogram was performed in 29 patients, of these 16 (55.2%) were not in agreement with the HSS diagnosis. 9 (13.4%) patients ultimately did not have obstructive sleep apnoea. 12 (17.9%) patients had HSS diagnosis that were not congruent with AHI reported or used terms not accepted within the sleep medicine community.

Conclusion: HSS quality in this cohort was highly variable with subsequent clinical assessment leading to management changes in a significant proportion. There is a need to standardise quality and an important component of this must be clinical review after HSS, as it is critical to the optimal treatment of patients.

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PALATAL FISTULA AFTER TRANS-PALATAL ADVANCEMENT PHARYNGOPLASTY SURGERY: A REVIEW OF INCIDENCE AND CONTRIBUTORY FACTORS

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Published English-language literature specific to trans-palatal advancement pharyngoplasty is scant and provided by only two main authors. Only one paper examines palatal fistula after such surgery, the main operation-specific complication, and said paper found 16% fistula rate via gothic arch approach and 2.5% fistula rate via propeller incision in a total of 89 patients (49 and 40 in each respective group). This paper reviews potential risk factors for fistula after trans-palatal advancement pharyngoplasty.

Forty two (42) cases of adult patients undergoing trans-palatal advancement pharyngoplasty via gothic arch incision as a component of their staged multi-level airway surgery for failed CPAP in OSA were reviewed. 3/42 (7%) cases of palatal fistula, with 2/3 spontaneously resolving with conservative management and 1/3 requiring operative closure were noted.

9/42 (21%) patients had documented high arch palates. All three palatal fistulas occurred in the group of patients with high arch palates. Two also had narrow palates, and one did not. The patient requiring surgical correction for fistula also had uncontrolled nasal inflammatory disease. 10/42 (24%) patients smoked or were recent ex-smokers, none of whom developed a fistula. 5/42 (12%) patients had significant reflux disease, none of whom developed a fistula. 14/42 (33%) patients had had previous tonsil and or palatal surgery, and none of those patients developed fistula. Apnoea Hypopnoea Index outcomes from surgery were comparable in this later group (13/14 had full data, AHI reduction 37.5 to 13.0) to the overall group (37/42 had full data, AHI reduction 37.2 to 12.6).

The incidence of fistula via gothic arch incision in this cohort is favourable (3/42 or 7%) compared to the only published paper (8/49 16%), and comparable to the incidence in propeller incision approaches (1/40 2.5%) and suggests that the anatomy of the palate (particularly high \pm narrow arch) is a major contributory factor to fistula risk.