Abstracts

001
WHICH NUMBERS DO YOU WANT? SCORING AND OSA PREVALENCE

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Introduction: Prevalence of sleep disordered breathing (SDB) in middle-aged general population was reported to be around 9% of women and 27% of men in studies performed in the 80’s and 90’s. Considering the recent improvements in the recording techniques and the various criteria used to define respiratory events, our aim was to reevaluate the prevalence of SDB using three different apnea-hypopnea definitions.

Methods: 2114 subjects (49.6% women, 58.5 ± 11 years old, BMI 26.3 ± 4.4 kg/m²) participating in an ongoing population-based cohort study (HypnoLaus, Lausanne, Switzerland) underwent complete polysomnographic recordings at home and had an extensive clinical workup including screening for diabetes, hypertension and metabolic syndrome. Apnea-hypopnea index (AHI) was determined using AASM 1999 “Chicago”, AASM 2007 (recommended) and the new AASM 2013 scoring criteria.

Results: With AASM 99, median (Inter quartile) AHI was 10.9/h (4.8–22.4), with AASM 07: 4.3/h (1.2–11.4), and with AASM 13: 9.0/h (4.2–21.1). Prevalence of SDB with AHI thresholds of 5/h, 15/h and 30/h using AASM 99 criteria was 74.3%, 39.1% and 16.4%, AASM 07: 4.3/h (1.2–11.4), and with AASM 13: 9.9/h (4.2–21.1). Systolic blood pressure, diastolic blood pressure and blood glucose level were highly correlated with all AHI definitions, but the correlation coefficient with these clinical outcomes tended to be higher with AASM 13 compared to AASM 99 and AASM 13. Using ROC curves comparisons, AASM 13 tended to be a better predictor for the presence high blood pressure, diabetes and metabolic syndrome compared to the other criteria.

Conclusion: In HypnoLaus population-based study, the prevalence of SDB is higher than previously reported, probably due to differences in scoring criteria and to a higher sensitivity of nasal pressure sensors compared to thermocouple. AHI defined with AASM 13 criteria seems to be better correlated with clinical outcomes than AASM 99 and AASM 13.

003
DIFFERENT METHODS OF COLLECTING NUMBERS: LIMITED STUDIES, US PERSPECTIVE

SHARON KEENAN

Polysomnography has played a vital role in the history and development of human sleep research and sleep medicine.

The US is currently suffering a broken health care system and there have been important consequences for sleep medicine.

Circumstances call for clarification of goals and operational definitions for desired patient health outcome measures. Forces that drive change must be identified.

Innovation and creativity joined with dedication to highest levels of patient care and unflinching support for ongoing research will ensure best outcomes.

005
REFRESH: RESTRICTION FOR REORGANISING SLEEP HABIT – A RANDOMISED CONTROLLED TRIAL OF SLEEP RESTRICTION FOR PRIMARY INSOMNIA

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Importance: Insomnia is a common health problem for patients in primary care. Cognitive behavioural therapy for insomnia (CBT-I) is effective but its use has been limited by the time and expense required for delivery.

Objective: This study evaluated the effectiveness of a brief ‘simplified sleep restriction’ intervention in improving sleep over six months, compared with ‘sleep hygiene’ advice alone, amongst primary care patients with primary insomnia.

Design, Setting, and Participants: A randomised controlled trial involving adult patients with persistent primary insomnia recruited from general practice clinics in Auckland, New Zealand between March 2009 and May 2012.

Intervention: Participants were randomly assigned to intervention or control. Both groups received brief ‘sleep hygiene’ advice from a primary care physician after randomisation and at 2 weeks. However, the intervention group also received 15 minutes of ‘simplified sleep restriction’ instructions at the initial visit and 15 extra minutes of advice and ‘Sleep Self-Adjustment Algorithm’ at 2 weeks.

Main outcomes: The primary outcome was the change in sleep quality at six months as measured by Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), sleep efficiency (%), and categorically defined treatment response rates derived from PSQI and sleep diary sleep efficiency scores. Secondary outcomes included self-report symptom and health measures, sleep diaries, actigraphy, and adverse effects.

Results: Ninety-seven patients were eligible and enrolled in the study. The sleep restriction intervention produced higher rates of treatment response at six months compared to control (67% [28/42] vs 41% [20/49], χ² = 6.1, p = 0.01). The number needed to treat was 4 (95% CI 2-19). The sleep restriction intervention also led to significantly improved PSQI scores (p < 0.001) and ISI scores (p < 0.001), sleep efficiency (p = 0.006) and sleep onset latency (p = 0.04) as measured by actigraphy, and a reduction in feelings of fatigue (p = 0.04).

Conclusions and Relevance: Simplified sleep restriction is a practical, effective intervention for chronic primary insomnia in adults that could be disseminated throughout the primary care setting.

Trial registration: Anzctr.org.au Identifier: ACTRN12609000127202
MODAFINIL REDUCES SLEEPINESS IN MILD-MODERATE SLEEP APNEA: A RANDOMISED, PLACEBO-CONTROLLED, CROSSOVER TRIAL

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Introduction: Daytime sleepiness is common in mild-moderate obstructive sleep apnea (OSA). While Continuous Positive Airway Pressure (CPAP) is considered to be the gold standard treatment for severe OSA, it is less effective in reducing sleepiness in milder OSA. Modafinil is a wake-promoting drug that is licensed for the treatment of residual sleepiness in OSA patients on CPAP. We hypothesised that modafinil may effectively treat sleepiness in patients with mild-moderate OSA not on CPAP.

Methods: Untreated sleepy male patients with mild-moderate OSA (Aged 18–70, Apnea Hypopnea Index (AHI) 5–30/hr, Epworth Sleepiness Scale (ESS) ≥10) were randomised to receive 200 mg modafinil or matching placebo for two weeks before crossing over to the alternate treatment after a minimum two week washout.

Outcome measures were collected prior to and at completion of each treatment period. Mixed model analysis of variance was used to compare improvements within treatments and classifying all randomised patients as random factors.

Results: 32 patients were randomised (means: AHI 15.2/h, age 47, ESS 13.7, BMI 28.2 kg/m2) with 29(91%) completing the trial. The primary outcome, ESS, improved more on modafinil versus placebo (mean net improvement over placebo 3.6 points, 95% CI 1.3–5.8, p < 0.01). The secondary outcome 40-minute driving simulator performance improved significantly over placebo (0.15(1/ms) 95% CI 0.03–0.27, p < 0.05). Improvements on the Functional Outcomes of Sleep Questionnaire were not significant (5.3 points over placebo 95% CI −1–11.6, p = 0.09).

Conclusion: Modafinil significantly improved subjective and objective measures of sleepiness in patients with mild-moderate OSA not receiving CPAP therapy. The size of this effect is clinically relevant at 3–4 Epworth points of improvement compared with only 1–2 points reported from CPAP treatment (Marshall et al, Thorax, 2006, Weaver et al, AJRCCM, 2012).

THE EFFECTS OF ‘CATCH-UP’ SLEEP ON INSULIN SENSITIVITY IN MEN WITH LIFESTYLE-DRIVEN, CHRONIC, INTERMITTENT SLEEP RESTRICTION

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Introduction: Chronic, intermittent sleep restriction is increasingly common in modern society. Previous data have shown significant effects of experimental sleep restriction on insulin sensitivity and metabolic outcomes in healthy, normal sleepers. To our knowledge, this has not been studied before in men with chronic, intermittent, lifestyle-driven sleep restriction: the population of interest.

Methods: 19 men (mean ± SEM age 28.6 ± 2.0 years, BMI 26.0 ± 0.8 kg/m2) with at least 6 months’ history (5.1 ± 0.9 years) of lifestyle driven, restricted sleep during the working week (37.3 ± 6.6 min/night) with regular weekend ‘catch up’ sleep (weekend sleep extension 37.4 ± 2.3%) completed an in-laboratory, randomised, cross-over study comprising 2 of 3 conditions, stratified by age. Conditions were 3 weekend nights of either: 10 hours, 6 hours or 10 hours time-in-bed with slow wave sleep suppression using acoustic stimuli.

Reported sleep was verified at screening and before each laboratory visit by two weeks of actigraphy. Insulin sensitivity was measured on the fourth morning by minimal modelling from 19 samples drawn during a 2 hour oral glucose tolerance test. Daily fasting blood samples were taken for glucose, insulin, c-peptide, HOMA-IR, HOMA-B and QUICKI were calculated. Food intake was identical for each individual during each study visit.

Results: Insulin sensitivity improved (mean difference 8.57 × 10−4 min−1 (μU/ml)−1, 95% CI 1.1 to 16.1 × 10−4, p = 0.03) following 3 nights of sleep extension compared to persisting sleep restriction. Fasting insulin (−1.37 nmol/L, −2.4 to −0.3, p < 0.01), c-peptide (−95.8 pmol/L, −144.8 to −46.8, p = 0.0003), HOMA-IR (−0.31, −0.56 to −0.05, p = 0.02) and HOMA-B (−18.6, −29.5 to −7.6, p = 0.002) decreased, while QUICKI (0.01, 0.003 to 0.02, p = 0.01) increased with sleep extension. Slow wave sleep suppression reduced SWS quantity by 23% (−12.6 min, −23.4 to −1.8, p = 0.02), predominantly on night 1, and NREM delta power by power spectral analysis by 10% (−41.7 μV2, −69.3 to −13.9, p = 0.003), without altering total sleep time or fragmentation, but this did not alter insulin sensitivity in this sleep deprived cohort.

Conclusion: In men with chronic, intermittent sleep restriction, 3 nights of ‘catch-up’ sleep improved insulin sensitivity. Sleep extension could prevent development of insulin resistance and diabetes mellitus.

THE EFFECTS OF TEXTILE FABRICS FOR SLEEPING APPARELS AND BEDDINGS ON SLEEP QUALITY AT AMBIENT CONDITIONS OF 17°C AND 22°C

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Introduction: The microclimate of the sleeping environment can affect thermal comfort and influence sleep. This study investigated the sleep...
effects of wool and cotton sleeping apparels, and wool and synthetic beddings at 17°C and 22°C ambient conditions.

**Method:** Ten healthy young males and seven females underwent 9 nights of polysomnography testing including an adaptation night. Participants were randomly allocated to a 2 × 2 × 2 study matrix of temperatures (17°C and 22°C), sleeping apparels (wool and cotton) and bedding types (wool and synthetic).

**Results:** Regardless of bedding types and temperatures, wool apparels significantly shortened sleep onset latency (SOL) (p = 0.043) and showed an increased trend toward significance for total sleep time (TST) (p = 0.068) and sleep efficiency (SE) (p = 0.082) compared to cotton apparels. However, there was no bedding effect on sleep. Interaction effects between sleeping apparel and temperature were observed: i) wool apparels showed a significantly shortened SOL than cotton apparel at 17°C, but delayed SOL at 22°C; ii) wool apparels showed a lower amount sleep stage 2 at 17°C than at 22°C; iii) wool apparels showed a greater amount of sleep stage 3 at 17°C than at 22°C, but wool apparels displayed a reduced stage 3 compared to cotton apparels at 22°C; iv) wool apparels showed a longer REM sleep onset latency (ROL) than cotton apparels at 17°C, and v) cotton apparels showed a shorter ROL at 17°C than at 22°C. Interaction effects between bedding and temperature were observed only for ROL, synthetic bedding showed a lower ROL at 17°C than at 22°C. Increased stage 1, 3 and rapid eye movement (REM) sleep, but decreased stage 2 were observed at 17°C compared to 22°C.

**Discussion:** Sleeping in wool significantly promotes sleep onset regardless of bedding types or temperature conditions. The interaction effects suggest that wool apparels generally are more conducive for sleep at 17°C than at 22°C. These findings suggest that wool apparels worn on the skin is beneficial for sleep, through establishing a favorable sleeping microclimate attributable to wool’s textile properties of hygroscopicity, high moisture absorption rate, and its ability to insulate.

**009**

**EXCESSIVE DAYTIME SLEEPINESS AND BODY COMPOSITION: A POPULATION-BASED STUDY OF WOMEN**

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**Background:** The association between excessive daytime sleepiness (EDS) and body composition among women is poorly defined. Available literature is often drawn from specific clinical cohorts and does not assess the role of lifestyle and health factors. Therefore, we aimed to investigate this association in a representative, well characterised, population-based sample of adult women.

**Method:** A total of 1066 women, aged 21–94 yrs (median = 51 yrs, IQR 35–66) were included. Anthropometric parameters (weight, height, waist circumference), activity levels, medication use, smoking status, and energy intake (kJ) were recorded. Body mass index (BMI) was calculated as weight/height squared (kg/m²). A BMI of >25 kg/m² was considered overweight, and ≥30 kg/m² as obese. Waist circumference measurements of 88 cm were further classified as obese. Fat mass was determined from whole body dual-energy X-ray absorptiometry scans. Total percentage fat mass was calculated by dividing fat mass by the sum of body fat mass, lean mass and bone mineral content. Sleepiness was assessed using the Epworth Sleepiness scale (ESS). Scores of <10 were considered in the normal range, and scores ≥10 were considered to indicate EDS.

**Results:** 146 (13.7%) women reported EDS. After adjusting for age, alcohol intake, antidepressant medication use and physical activity, EDS was associated with greater weight [78.6 (48.2–109.0) vs. 76.0 (74.3–77.8) kg, p = .07], waist circumference [93.6 (91.2–96.1) vs. 91.0 (89.5–92.6) cm, p = .03] and BMI [30.0 (29.0–31.1) vs. 29.1 (28.4–29.7) kg/m², p = .07]. EDS was also associated with being overweight (adjusted OR = 1.5, 95%CI 1.0–1.3, p = .04) or obese (adjusted OR = 1.6, 95%CI 1.1–2.3, p = .02), and having a waist circumference greater than 88 cm (adjusted OR = 1.4, 95%CI 1.0–2.0, p = .08). These findings were not explained by the use of sedative medication, energy intake, or smoking status. No differences in %body fat or fat mass (g) were detected between those with and without EDS.

**Discussion:** Common indices of adiposity were found to be more pronounced among those women with EDS, suggesting that clinical investigation, on-going monitoring and follow-up assessments of patients who present with these symptoms is warranted.

**010**

**CORTICAL RESPONSE TO THRESHOLD RESISTIVE LOADS IN SEVERE OBSTRUCTIVE SLEEP APNOEA**

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**Introduction:** Upper airway muscles have been shown to be responsive to the collapsing force of negative pressure in the upper airway and therefore a sensory deficit in detection of respiratory stimuli has been proposed as a possible contributor to obstructive sleep apnoea (OSA) pathogenesis. The respiratory related evoked potential (RREP), the averaged cortical response to a respiratory stimulus, is an objective method proposed as a possible contributor to obstructive sleep apnoea (OSA). This may be important as impaired detection and response to small respiratory stimuli in OSA.

**Methods:** Sixteen OSA patients and 17 healthy controls participated. Awake EEG, EMG, EOG, mask and epiglottic pressure, and flow were recorded. Respiration was via a nasal mask connected to the resistive loading manifold (approx. 0, 1.2, 2.2, 3.0, 6.2 cmH2O.L−1.sec + occlusion). Loads were presented 90 times each at mid-inspiration, every 2–4 breaths and in a random block design. EEG responses were ensemble averaged separately for each load and P1 amplitude determined.

**Results:** The slope and intercept (threshold) of the P1 amplitude (at Cz) vs. epiglottic pressure (Pepi) relationship were examined, with correction made for each individual’s background conditions, using linear mixed models. There was no significant difference between OSA and control in the threshold (0.649) or slope (0.727) of the P1 amplitude – Pepi relationship.

**Conclusion:** These results suggest intact sensory detection of small respiratory stimuli in OSA.
013
PAEDIATRIC SLEEP MEDICINE – THE YEAR IN REVIEW
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This will be restricted to publications in the calendar year 2013 and will pursue three themes: First, articles of major importance, which at the time of writing this abstract features publication of the primary outcomes of the CHAT study (N Engl J Med. 2013 Jun 20;368(25):2360–76); this and several articles with related themes will be reviewed. Another major article and related publications evaluated the link between influenza vaccine and development of narcolepsy (BMJ. 2013 Feb 26; 346:f794).

Secondly theme ‘current themes’ in the field will be explored through short reports on a selection of clinical research. Finally, in the context of the two previous themes, will be providing a “report card” for our Australian paediatric research in the International context.

014
A YEAR IN REVIEW: INSOMNIA AND SLEEP HEALTH
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Papers and chapters from the past year, within Australia and internationally, from the field of insomnia, and the broader area of sleep health will be reviewed. Dissemination of new information from basic and clinical science, and implications for clinical practice will be discussed. A large number of papers will be highlighted and two of the most novel or relevant will be presented in greater detail. This review would be of interest to all clinicians, scientists and researchers who have a special interest in insomnia and sleep health.

015
SLEEP BRUXISM: YEAR IN REVIEW
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Introduction: Sleep bruxism is a common stereotyped movement disorder characterized by rhythmic masticatory muscle activity associated with tooth grinding and clenching. Traditionally, dental practitioners were mostly concerned about teeth wear and temporomandibular disorders as a result of sleep bruxism. However, it has recently become a topic of interest, as it may be associated with sleep-disordered breathing. The purpose of this review is to highlight the most pertinent research in the field of sleep bruxism over the past year.

Methods: A pubmed search of studies on sleep bruxism published between 1st July 2012 and 1 June 2013 was carried out for this review.

Results: There were 59 citations during this period. Every publication was reviewed and pertinent studies on epidemiology, pathophysiology and treatment of sleep bruxism were discussed.

Discussion: There has been advancement in the field of sleep bruxism over the past year. However, more studies in the areas of pathophysiology and treatment of sleep bruxism are required.

018
USING SLEEP EEG IN CLINICAL PRACTICE
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Recording sleep EEG in an overnight polysomnogram is routinely performed to enable identification of wake, sleep and sleep stages. Additional diagnostic information may be obtained from the usual recording montages and channels but it is limited by the few recording channels, the montages used for sleep staging, sometimes the lack of time locked simultaneous video recording which aids in artefact detection and sometimes by poor quality signals due to the intrinsic recording environment of the sleep laboratory. Some of these problems can be addressed by recording the “full head of EEG” routinely performed when a sleep EEG is done in a neurological setting but signal quality and artefact still often prevent fine interpretation when performed in the sleep laboratory. As a consequence interpretation of the “full head of EEG” is usually much easier and more accurate than standard EEG channels and montages for events such as seizures or Parasomnia episodes and justifies its use when these are suspected but is much less easy and less accurate than a sleep EEG done in a neurological setting when interictal events such as spikes, sharp waves or focal slowing are suspected.

019
BEYOND SLEEP STAGING – TAPPING INTO THE HIDDEN WEALTH OF EEG
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Clinical techniques for analysis of surface EEG data during sleep are simplistic with poor spatial resolution which do not account for the regional heterogeneity of neurological activity that occurs during normal and pathological sleep. There have been a number of exploratory studies in complex EEG analysis techniques which are of interest but not yet clinically applicable. Interhemispheric differences in EEG activity during sleep are reported and are most marked in marine mammals, possibly as a defence mechanism. Several recent studies have identified increases in interhemispheric EEG asynchrony (IHA) in OSA which may reflect a residual primitive defence triggered by airway obstruction. The presence of IHA can be used as a screening tool for OSA with reported sensitivities of >90% as well as an automated tool for predicting sleep stage. Bispectrum EEG analysis, an automatic higher order statistical analysis of the EEG used in anaesthesia, has also been shown to correlate with manual sleep staging and may show promise as an automated measure of sleepiness and sleep onset. Artificial Neural Networks have also been evaluated in automated scoring of sleep (achieving accuracies mostly to about 90%) and more specifically in the characterisation of Cyclic Alternating Pattern (achieving accuracies of mostly <80%). Power spectral analysis of various EEG frequencies has shown promise as a tool to identify the risk of mental health, cognitive and behavioural comorbidities in individuals with sleep disordered breathing and insomnia. To date, studies in new EEG analysis techniques are small and explore correlation with existing sleep staging or respiratory scoring techniques only, however have the potential to impact on the future of practice of Sleep Medicine.
020

SLEEP-DISORDERED BREATHING IN HIGH ALTITUDES
Raphael Heinzer

Sleep disordered breathing (SDB) with central apnea or hypopnea frequently occurs at high altitude. This condition is associated with sudden arousals from sleep which alter sleep quality and daytime performance. Different therapies such as oxygen, acetazolamide, and theophylline have been proposed to treat altitude-induced SDB; however, none are commonly used by mountaineers due to side effects or inconvenience. At high altitude, hypoxia increases chemoreceptor sensitivity (controller gain) and induces hyperventilation with a decrease in PaCO2 levels. When PaCO2 drops below a certain level called the “apnea threshold,” breathing stops until PaCO2 builds up and stimulates breathing again. In hypobaric hypoxic conditions (hypobaric chamber), administration of CO2 at constant SaO2 stabilizes nocturnal breathing and eliminates hypoxia-induced SDB. These results emphasize the critical role of CO2 on central SDB pathophysiology, but CO2 administration at high altitude is not feasible under field conditions. We recently showed that added dead space through a non-vented mask could be a safe and practical treatment to treat altitude-induced SDB.

023

CASE STUDY: UTILISING BIO MATHEMATICAL MODELS FOR MANAGING FATIGUE RISK IN A MINING COMPANY
Liam Wilson

The goal of a shift roster from a fatigue management perspective is to ensure that it is designed to give individuals the opportunity to obtain adequate sleep. This is to ensure that everyone is operating at an effective level. Once the roster is designed and validated against a scientific bio mathematical model, the actual sleep that workers are obtaining needs to be quantified and verified against the shift roster model. This will confirm that the roster design is providing sufficient supporting sleep obtained by the employees (Office of Research and Development, 2006) This paper outlines the sleep opportunity versus sleep obtained for shift work operators in a mining environment. It also determines whether there were differences in the individuals sleep patterns and effectiveness. Twelve operators voluntarily wore actigraphs for a month covering a number of shift roster cycles to determine their individual sleep/wake patterns, which was then compared to the modelled sleep opportunity. Each individual was given a comprehensive individual report and feedback on their statistics, positive behaviours and areas for improvement in their sleep hygiene. It also identified any abnormal sleep patterns for further investigation.

The roster analysis utilising FAST® showed that the roster was designed to provide an opportunity for eight hrs of good sleep (Archinoetics, 2006). On average the operators recorded 7.17 hrs sleep/day (SD = 0.42 min), however five out of the 12 operators recorded less than an average of 7 hrs/day.

Bio mathematical models and actigraphs are two tools that can be used as a part of a holistic fatigue management system to determine individual sleep/wake patterns and provide a potential opportunity for improvement in individual sleep hygiene and increased individual effectiveness.

026

FATIGUE MANAGEMENT WITHIN THE TRANSPORTATION AND LOGISTICS INDUSTRY – AN ALTERNATIVE INDUSTRY PERSPECTIVE
Neil Findlay

Fatigue Risk Management Systems (FRMS) are an integral component of Safety Management Systems. FRMS have been traditionally applied to industries such as aviation and rail. With an increase in shift work, 24/7 operations and a growing global economy, management of fatigue is becoming a growing concern for companies. Today many industries such as Mining, Oil and Gas, Transportation, Military and the Medical industry are embarking on the FRMS journey. In this session we will take a look at:

- Designing an FRMS for deployment in a business
- Data and evidence based systems
- Change management and operational involvement
- Training, education and change management
- International and cultural factors for consideration
- Technology and its place in FRMS

We, each of us, are encapsulated in this extraordinary physiological machine; bristling with processors, pumps, valves, sensors and actuators; built in a wide variety of sizes, shapes and capabilities; purpose-built to function at peak performance across a wide range of operating environments. Truly a wonder to behold.

Yet despite all of its amazing diversity, and matching complexity, this human machine was never designed to work at night. Herein lie many of the problems faced by 21st Century civilization. We are asking this machine to operate, to extend far beyond its design specifications; and for that matter, its limitations. Little wonder then that in our fast moving, fast changing 24/7 world there are problems arising.

Equally, it is unsurprising that the incidence of incidents, accidents and procedural deviations caused by human error rises significantly in sectors that operate 24/7, as this human machine is asked to perform...
The main reasons for discontinuing treatment have been reported to be insufficient reduction of snoring and the presence of side-effects. Most side-effects caused by MAS are usually described as mild and transient, and significant and persistent temporomandibular joint (TMJ) problems are rare. More persistent and severe side-effects, which include TMJ dysfunction and dental crown damage, appear uncommon. Long-term side effects are more recently described evaluating oral appliance side-effects over a period of more than 5 years.

We have described, using a titratable MAS, that MAS used for a mean period of 7.3 years have a significant impact on occlusal and dental structures. Changes observed in craniofacial structures were mainly related to significant tooth movements. More recently we have evaluated dental side effects over an average treatment period of 11.1 ± 2.8 years. There was a significant correlation between time under treatment and the decrease in both overjet and overbite ($r^2 = 0.10$ and $r^2 = 0.07$ respectively). Over the period evaluated there was a significant ($p < 0.000$) reduction in the overbite (2.3 ± 1.6 mm), overjet (1.9 ± 1.9 mm) and mandibular crowding (1.3 ± 1.8 mm). A corresponding significant ($p < 0.000$) increase of mandibular intercanine (0.7 ± 1.5 mm) and intermolar (1.1 ± 1.4 mm) distances was observed. It has been previously described that many patients are unaware of these changes, unless it is brought to their attention by their dentists. El-Soh and collaborators (2013) have shown a decrease in mortality rate related to CV disease in patients using mandibular advancement splints over a period of 5 years. This decrease was similar to the decrease found in the CPAP group. In conclusion, although some changes might be undesirable in certain patients, we believe that the effective treatment of a life-threatening disease such as OSA supersedes the maintenance of baseline occlusion. Patients should be aware and the side-effects should be followed and assessed in each patient.

028
THE IMPORTANCE OF MEASUREMENT IN THE CLINICAL SUCCESS OF MAS THERAPY
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Introduction: Mandibular Advancement Splints (MAS) are oral devices that are worn intra-orally during sleep to protrude and hold the mandible forward. It is thought that their mode of action alters upper airway structure and neuromuscular function thereby reducing airway collapsibility. They are increasingly being recognised as a viable treatment alternative to CPAP for the treatment of Obstructive Sleep Apnoea (OSA).

Methods: Numerous studies have objectively demonstrated the efficacy of MAS across a broad range of OSA severity. However, the prediction as to which patient will respond to MAS therapy remains elusive. Not all patients will respond favourably and receive clinical benefit. Despite recent technological advances, the exact parameters that define treatment success still remain unclear. It is likely that treatment outcomes may be influenced by a combination of patient or device-specific factors and titration methods.

Results: Current assessment of MAS efficacy in the treatment of sleep disordered breathing (SDB) has predominantly been based on the apnea hypopnea index (AHI). Snoring, a key sign and symptom of SDB is rarely measured and quantified objectively, being often reliant on subjective reports by the subject and/or partner.

Discussion: Previous studies have demonstrated dose dependent decreases in the AHI and oxygen desaturation index following progressive mandibular advancement (MA). However, there appears to be a non-linear relationship between the degree of MA, snoring and therapeutic response. Although MAS is effective in reducing AHI and snoring, snoring may persist or even increase in a significant number of patients despite increased MA. Objective quantification of snoring during MAS therapy is thus warranted as the treatment aims to abolish both apnoeas and snoring.

029
MANDIBULAR ADVANCEMENT SPLINT TREATMENT FOR SEVERE OSA – ARE WE DREAMING?
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Introduction: Existing guidelines for the use of oral appliances in the management of OSA state that oral devices are indicated as a first line therapy for patients with mild to moderate OSA who prefer an oral appliance over CPAP or who fail treatment attempts or are inappropriate candidates for CPAP. However, there is growing evidence that mandibular advancement splints (MAS) can effectively treat OSA in severe OSA. We have recently completed a comparative effectiveness study in which we hypothesized that the suboptimal efficacy with MAS would be counterbalanced by superior compliance relative to CPAP, resulting in similar overall alleviation of OSA, and that this would in turn result in similar effectiveness of both treatments for health outcomes related to OSA, including cardiovascular (24-h blood pressure, arterial stiffness), neurobehavioral (subjective sleepiness, driving simulator performance), and quality of life outcomes.

Methods: A total of 126 patients with moderate-severe OSA (apnea hypopnea index [AHI], 25.6 ± [SD 12.3]) were randomly assigned to a treatment order and 108 completed the trial with both devices.

Results: CPAP was more efficacious than MAD in reducing AHI (CPAP AHI, 4.5 ± 6.6/h; MAD AHI, 11.1 ± 12.1/h; P < 0.01) but reported compliance was higher on MAD (MAD, 6.9 ± 1.3 h per night vs. CPAP, 5.2 ± 2 h per night; P < 0.001). The 24-hour mean arterial pressure was not inferior on treatment with MAD compared with CPAP; however, overall, neither treatment improved blood pressure. In contrast, sleepiness, driving simulator performance, and disease-specific quality of life improved on both treatments by similar amounts. A subset analysis of patients (n = 33) with severe OSA (AHI > 30/h) found a Complete (AHI < 5) or partial (>50% reduction in AHI) response to MAS treatment was achieved in 21% and 33% of patients, respectively.

Discussion: These data demonstrate that clinical response to MAS treatment is achievable in patients with severe OSA, although CPAP has superior efficacy at relieving sleep-disordered breathing. Future studies
are required to identify predictors of oral appliance treatment response, particularly in such patients with severe OSA, either using a phenotypic approach or novel single-night titration methodologies.

030
OVERVIEW OF INSOMNIA: WHERE ARE WE NOW?
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Insomnia is a prevalent public health problem that produces heavy burden for the individual and for society at large. Significant advances have been made in the last two decades to improve our understanding of its long-term impact and treatment. There is also solid research-based evidence that cognitive behavioral therapy for insomnia (CBT-I) is effective, safe, and well accepted by patients. Despite this level of evidence and endorsement by the scientific and professional community, CBT-I is still not widely available and remains under utilized by health care practitioners. Several innovative and cost-effective treatment delivery models (e.g., Internet-based therapy) have yielded promising results, but this has not yet solved the imbalance between supply and demands. This lecture will summarize the current status of CBT-I, highlight some paradoxes between research evidence and clinical practices, and outlines recent innovations in treatment development and delivery models.

031
EXTENDING CBT-I TO ‘AT RISK’ POPULATIONS AND THE REALITY OF THE CLINIC
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Understanding sleep and how vulnerable different populations are to not sleeping well is an ongoing issue for researchers and clinicians. There is an overall need to get the right message or psycho-education to the right group to enable a change in behaviour. We shall be examining 3 distinct populations.

In Obstructive Sleep Apnea (OSA) it is rare to achieve a greater than 6-hour adherence to Continuous Positive Airway Pressure (CPAP) on a nightly basis for sufferers. Psychoeducation/ Cognitive Behavioural Therapy (CBT)/ Motivational Interviewing (Richards et al., 2007; Olsen et al., 2008, 2010; Aloia et al., 2001, 2007) have all been used in the past with varying degrees of success. We also know that self-efficacy is an important component in this treatment process (Stepnowsky ET al., 2002; Weaver et al., 2005, 2008). We shall be discussing the role of CBT and health coaching in the role of improving adherence in individuals with low self-efficacy as they undertake CPAP therapy.

Living in rural communities in Australia is often a considerable barrier to obtaining good health care for insomnia. We are undertaking to train Practice Nurses working in 2 rural communities who are then able to undertake brief behavioural interventions in the treatment of insomnia Troxel et al., 2012; Buysses et al., 2011). This research is based on previous research models with particular emphasis on a stepped care model (Esch, et al., 2007, 2011).

Our third area of interest is the role of sleep for new parents. So much of parent education for new parents is geared towards a normal birth and successful breast feeding post birth. Little time is spent on the role of sleep or lack of sleep in this population. We are currently undertaking a sleep intervention for first time parents in their last trimester to help them have a more realistic understanding of the changes in sleep during pregnancy and what to expect in their baby's sleep in the first year of life (Kempler et al., 2012). In doing this we are also hoping that such an intervention may reduce the risk of post natal depression. We shall be discussing some of these strategies in detail.

033
BEHAVIOUR THERAPY IN A BRIEF FORM AND APPLICATIONS TO STEPPED CARE
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Poor sleep is very distressing and left untreated potentially leads to chronic insomnia disorder. From long standing research we know Cognitive–Behavioural Therapy (CBT-I) is the most effective treatment intervention for insomnia even in combination with withdrawal of medication (Morin et al., 2011; Morin et al., 2006; Smith et al., 2002). Recently, brief behavioral interventions alone have been found to improve insomnia symptoms (Troxel et al., 2012; Buysses et al., 2011; Harris et al., 2012). When compared with multi component therapy, sleep restriction therapy (SRT), stimulus control therapy (SCT), or to waitlist control group, medium to large post-treatment effects sizes have been found for SRT, SCT and multi-component treatment on sleep diary data (SOL, WASO, %SE, TST and SQ) (Epstien et al., 2012), suggesting similar treatment effects for SRT, SCT and multi-component treatment. One of the most effective brief behavioural interventions for insomnia is SRT, however the adverse effects such as sleepiness are yet to be adequately addressed (Miller et al., 2013; Kyle et al., under review). Sleep research studies can use healthy participants to expose them to an experimentally predefined (restricted) period of sleep in order to investigate sleep loss upon cognitive and physiological functioning. Closer reference to this approach may be useful to aid our understanding of both the acute effects and the therapeutic use of brief behavioral interventions for insomnia. Further understanding of the mechanisms of action in these interventions may subsequently help disseminate and warn of any adverse effects of therapy. It is important to understand which aspects of CBT-I work, for whom and in what way. Our current research along with other researchers may further disseminate brief behavioural interventions which are most effective and for different individuals (Neylan, 2011; Troxel et al., 2012; Morin, 2012), and especially via stepped care settings (Espie, 2009).

034
FUTURE DIRECTION IN INSOMNIA TREATMENTS
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Despite important progress made in the management of various forms of insomnia, several barriers have greatly hindered access to effective therapies such as CBT-I. This lecture will discuss these barriers and review some recent innovations to improve access to therapy. Several recommendations to overcome these barriers and move the field forward will be outlined, including the need for more efficient knowledge transfer strategies to disseminate CBT-I directly to patients or to health-care providers. A call will also be made for investigators to develop new therapies instead of recycling old ones, to take a broader view of insomnia therapies with combined or sequential approaches, to move beyond interventions at the individual level to broader, population-based levels with educational and preventive programs. The sleep community needs to be more proactive in lobbying efforts with...
health agencies, employers, and government officials in order to increase the availability and offering of insomnia therapies in clinical, occupational, and community settings.

035
EXAMINING FAMILY DEMOGRAPHIC AND ENVIRONMENTAL EFFECTS ON SLEEP IN CHILDREN AGED 2–5 YEARS WITH AND WITHOUT AUTISM SPECTRUM DISORDER
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Introduction: Parents of children < 6 years frequently report that their child has sleep problems. Poor sleep is often related to bedtime associations and routines, behavioural issues surrounding sleep, or night time fears. Sleep hygiene factors, including the sleep environment, screen time, and meals prior to bed, may also impact on sleep and socio-cultural factors and parent knowledge about child sleep may also affect family sleep practices. This study investigated relationships between family demographics and environmental factors in relation to reported sleep difficulties in children aged 2–5 years.

Method: Questionnaire packages were given to 204 families attending a childcare centre and 38 families (56%) of children aged 2–5 years on a university participant registry responded to an email. The primary caregivers (n = 96) of 101 children, mean age: 47.9 months (SD = 12.9 months) returned completed packages which consisted of a demographic questionnaire, an environment and sleep questionnaire and the Children’s Sleep Habits Questionnaire (CSHQ). There were 63 boys and 34 girls, 28 of the children had ASD and 2 children had a global developmental delay.

Results: On parent report 55.4% of the children had a sleep problem (79% of the children with ASD); the average CSHQ total score was significantly higher in these children than in children without a reported sleep problem (p < .001). CSHQ scores did not differ for children with and without ASD. Results showed that higher CSHQ scores were related to family income, and primary caregiver employment and education. CSHQ score was not related to timing of meals prior to bed, or to meal type or drinks consumed, or outside play. CSHQ score was related to the child feeling too hot or cold during sleep, use of electric or gas heaters, time spent watching television and time spent on computers or tablets.

Discussion: These results indicate the importance of considering the impact of family and environmental factors on sleep problems in toddlers and pre-school children, regardless of whether the child has a developmental disability. In particular the temperature associated with the child’s sleep environment and screen time appear to be important factors. It was surprising that even at this young age screen time is impacting on children’s sleep.

036
LONG TERM EFFECTS OF CAFFEINE WITHDRAWAL
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Introduction: Caffeine ingestion has been shown to enhance alertness and performance. However, caffeine ingestion before bed has also been shown to lower the quantity and quality of sleep. For several reasons, including improved sleep hygiene to prevent or treat insomnia, caffeine withdrawal may be prescribed. Many studies have shown negative effects within the first few days of caffeine withdrawal including headaches, lethargy, and irritability. Very few studies have continued observations beyond these immediate negative effects to determine the longer term effects. In other words, are individuals benefited or impaired given a longer period free of caffeine compared to the normal caffeine consumption period? The present study investigated a period of several weeks following caffeine withdrawal.

Methods: Participants were 23 healthy young adult caffeine consumers. In addition to a caffeine consumption diary they recorded subjective evaluations of their day at 6 pm each day on a web based survey. The evaluations included headache symptoms, alertness, fatigue, moods, sleep, and overall quality of daily functioning. Measures were collected daily for a baseline week of normal caffeine consumption, a week of gradual withdrawal, and four additional weeks of caffeine abstention.

Results: Repeated measures statistical analyses compared means for the baseline week, withdrawal week and the fourth week free of caffeine. During the week of withdrawal reported headaches and sleep length increased while alertness and overall day quality decreased compared to baseline caffeine consumption. However, by the last week all of these measures had returned to be comparable with the baseline week and in most cases were marginally but not significantly better than baseline week.

Discussion: From this initial pilot study of the longer term subjective effects of caffeine withdrawal it appears that individuals rate their moods, sleep, and daytime functioning at least as favorably as during the baseline period of their normal caffeine consumption. Further studies including randomized placebo control trials using objective measures of sleep and performance are required to confirm these initial pilot findings.

037
DISSOCIATIVE IDENTITY DISORDER AND CENTRAL HYPERSONOMLENCE: CO-MORBID DIAGNOSES, OR THE SAME PHENOMENA AT DIFFERENT ENDS OF A SPECTRUM?
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Introduction: Dissociative Identity Disorder (DID), formerly known as Multiple Personality Disorder, is characterised by more than one personality state within an individual. Although the prototypical DID is distinguished by a dominant alternate identity(-ies) enforcing complete amnesia in the primary identity, there is a spectrum of amnestic qualities that are best described as “overlapping identities”. The Polysomnographic (PSG) diagnosis of Idiopathic Hypersomnia (IH) in an individual with DID have never been described. The symptomatic boundary state of DID has also never been described in sleep terms.

Methods: We report a case of DID, and co-morbid IH. Patient A had a normal Epworth Sleepiness Scale (ESS) of 9/24 with phenomena more akin to Hypersonomloences of Central Origin. She described daytime “identity overlapping” similar to her primary identity “falling asleep”, streams of consciousness interrupting her sleep entry and exit, frequent abnormal tactile and visual hallucinations suggestive of Hypnagogic Hallucinations, and recurrent symptomatic Sleep Paralysis. Her PSG and MSLT (off medications) were consistent with IH. Both her daytime and boundary symptoms improved with Modafinil.

Results: The cardinal features of DID and Central Hypersonomloences may appear distinctly different, but some manifestations share common elements. daytime sleepiness in DID may be misconstrued as the
day-time shift in the dominant identity. Excessive Daytime Sleepiness and its psychiatric interpretations are amenable to Modafinil.

Discussion: This is the first unique reported case of co-morbid ID in DID. These diagnoses may mutually co-exist. Alternatively they could be the same phenomenon at different ends of one spectrum – one occurring in isolation at the boundary of sleep, another occurring intermittently in both wake-and-sleep. Questions remain regarding where her alternate entities reside, and if Modafinil is in fact simply suppressing these.

038

HUSH-A-BY MUMMY: INTERACTIONS BETWEEN CO-SLEEPING AND MATERNAL SLEEP DISTURBANCE

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Introduction: Postpartum fatigue is one of the most common complaints of women following childbirth. Within a clinical setting the postpartum period is often defined as the first 6 weeks. Both sleep quality and quantity have a strong influence on postpartum fatigue. This study aims to investigate the impact of co-sleeping on mothers sleep and resulting daytime sleepiness.

Method: Thirty three new mothers, mean age 30.0 (SD 4.0), completed sleep diaries for seven consecutive days at three time points: 6, 12 and 18 weeks following the birth of their child. Screening ensured participants were free from psychiatric or medical problems, other than minor ailments. Mothers who had undergone caesarean section were excluded. All participants reported being in a relationship at study commencement. For half of the participants (n = 16) this was their first child. Mean sleep duration, sleep disturbance and Epworth sleepiness score (ESS) were analysed.

Results: Excessive daytime sleepiness (ESS > 12) was common; 66.7% of participants in week 6 and 60.6% of participants in week 12. ESS scores significantly reduced over time (p < .001). Those co-sleeping had higher ESS scores at weeks 6 and 12 compared with those not co-sleeping. The amount of sleep obtained during the ‘primary’ night time sleep period remained consistent (Wk6 = 7.4 h, Wk12 = 7.3 h, Wk18 = 7.4 h), as did the number of night-time wakings and amount of daytime sleep. Sleep disturbance index (SDI = awake time/sleep period) significantly decreased over time (p < .001). SDI was greater for co-sleepers than non co-sleepers during weeks 6 and 12.

Discussion: Daytime sleepiness in new mothers regularly reaches excessive levels. Although this sleepiness decreases over time the reduction occurs earlier for those choosing not to co-sleep. Daytime sleepiness appears to be driven by the duration of sleep disturbances rather than a reduction in total sleep time or number of disturbances. These results are important due to the excessive level of sleepiness experienced by the new mothers. Furthermore, results demonstrate difficulties beyond the traditional 6 week postpartum period. Consequently, interventions should target the promotion of sleep for new mothers.

039

SLEEPING DIFFICULTIES REMAIN CHRONIC OVER NINE YEARS IN YOUNG AUSTRALIAN WOMEN

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Introduction: Young women are especially at risk of poor sleep but it is not known the extent to which their poor sleep remains chronic. Here we investigated self-reported sleeping difficulties over almost a decade in a large sample of young women aged in their early twenties, who commenced the study with no reported depression or anxiety.

Methods: Data from the Australian Longitudinal Study on Women’s Health on 9,683 young women were analysed. Information on self-reported sleeping difficulties was obtained from four questionnaires mailed to participants in 2000 (aged 21–25 y), 2003, 2006 and 2009. Generalized estimating equations (unadjusted) were conducted to calculate odds ratios (OR) for the likelihood of women who reported sleeping difficulties ‘never’, ‘rarely’, ‘sometimes’ and ‘often’ during the last 12 months in 2000, to continue to report sleeping difficulties at the subsequent three surveys.

Results: Over the nine years the prevalence of reporting sleeping difficulties ‘often’ was relatively consistent at 9.1% to 10.8%, with the self-report of taking sleeping tablets varying from 2.5% to 3.7%. Women who reported sleeping difficulties ‘often’ in 2000 had a markedly increased risk of also reporting sleeping difficulties ‘often’ over the subsequent nine years (2003: OR [95% CI] = 11.33 [7.93–16.19]; 2006: 11.64 [8.08–16.77]; 2009: 10.46 [7.01–15.61]). This risk of chronicity was higher for those who experienced sleeping difficulties ‘often’, compared to those who reported sleeping problems less frequently, where the maximum OR was 4.09 for ‘sometimes’ in 2009.

Discussion: Self-reported sleep difficulties ‘often’ in non-depressed young women aged in their early twenties strongly predicted a continuation of this level of sleeping difficulty with the passage of time, with a nearly 11-fold risk over the next decade. A key issue is identifying the poor sleep perpetuating factors (including, but not limited to, depression and anxiety) and establishing whether addressing the sleep difficulties of young women early in their development is an effective strategy for improving on-going sleep health.

040

MINDFULNESS-BASED THERAPY FOR INSOMNIA

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Objective: This study investigated group delivery of a mindfulness-based intervention for primary insomnia in an Australian population. Mindfulness Based Therapy for Insomnia (MBT-I) offers an alternative approach to the current gold standard, non-pharmacological approach
to insomnia, CBT-I, with a focus on reducing sleep-related arousal. Findings have indicated reductions in several subjective sleep measures following MBT-I treatment (Ong, Shapiro, & Manber, 2008). This study aimed to investigate the outcome of MBT-I in an Australian population recruited from a sleep clinic to examine the generalizability in a diverse sample. Participants: 30 participants, consisting of 21 females (M age = 50, range = 26–72) and 9 males (M age = 45, range = 34–59) who met criteria for primary insomnia.

Methods: Treatment consisted of 6 sessions of MBT-I (Ong, Shapiro, & Manber, 2008) delivered in groups of 7–8 with each session lasting 2 hours in duration. The primary outcome measure was the Insomnia Severity Index (ISI) and secondary the Pittsburg Sleep Quality Index (PSQI). Outcome measures were recorded at four time-points (screening, baseline, post-treatment and 3 month follow-up).

Results: The average severity of insomnia as measured by the ISI reduced significantly from a moderate level of insomnia (M = 18.74) to sub-clinical insomnia (M = 12.79, p < .01) indicating that on average, participants no longer met the criteria for insomnia following treatment. The Pittsburgh Sleep Quality Index (PSQI) overall score reduced significantly (M = 13.1 to M = 9.2, p < .01) reflecting an increase in sleep quality following treatment. All 7 PSQI component scores reduced significantly. The largest change was the component score assessing sleep efficiency (the proportion of average sleep compared to time in bed), which increased from 72% to 83% (p < .01) following treatment.

Conclusion: Analysis of data collected in response to a group treatment of MBT-I for insomnia delivered over 6 weeks revealed significant reductions in insomnia symptoms, and improvements in sleep quality and sleep efficiency. This suggests that MBT-I can be delivered in a sleep clinic setting with indications of effectiveness.
Introduction: The impact of sleep on child cognition and mood is well documented. Similarly, diet, and in particular high sugar consumption, is also thought to influence such behaviours. Whether sleep, diet and behaviour interact in a deterministic fashion is not known, but important in light of these previous findings and reported changes in children's dietary habits. In animal studies a reduction of slow wave sleep (SWS) is associated with slow glucose reabsorption and increased blood glucose levels. Similarly in adults an association between reduced SWS, decreased insulin sensitivity, increased insulin release, and reduced glucose tolerance has been observed. Additionally a study in youth with type 1 diabetes found that time spend in stage two sleep was positively associated with average glucose levels and the percentage of time hyperglycaemic.

Study Aims: This study aims to investigate sugar consumption as a mediator between sleep and cognition in pre-pubescent children. Secondary aims include further understanding the impact of sleep on glucose homeostasis in healthy children.

Method: Participants will be prepubescent and aged 8–12 years with normal sleep patterns for their age and not diagnosed with diabetes, behavioural disorders or sleep disorders. The sample size will aim to have 32 participants. Using a cross-over study design, participants will stay at the sleep laboratory for one night on two occasions. There will be two participant conditions: a high glucose diet and a standard glucose diet. Before the study, children will be asked to sustain from caffeine and record their diets. They will also be asked to maintain a 10 hr TIB with a wake up time of between 06:00–09:00 to ensure minimal sleep problems in the lab and no sleep debt. Sleep stages and quality will be measured using a standard PSG montage. Memory, problem solving, concentration and cognitive thinking will be assessed using objective computer tasks at various times during the two days at the lab. Food consumption will be measured to accurately determine glucose intake during their stay at the laboratory.

Results and Outcomes: It is expected that increased glucose consumption will impact on slow wave sleep and stage two sleep specifically and as a consequence alter the following day’s cognitive performance.

045
SLEEP AND PSYCHOPATHOLOGY IN ADOLESCENTS WITH HIGH-FUNCTIONING AUTISM SPECTRUM DISORDER (HFASD)
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Introduction: Anxiety and depression are commonly associated with sleep disturbance in typically developing (TD) populations. Children and adolescents with Autism Spectrum Disorder (ASD) have high rates of anxiety, depression, and sleep disturbance. However, very little is known about the impact anxiety and depression may have on the sleep patterns of young people with ASD. This study examined sleep and psychological wellbeing in 27 adolescents (13–17 years) with high-functioning ASD and 27 age- and sex-matched TD adolescents.

Method: Participants completed sleep diaries, actigraphy (55% of HFASD group, all TD group) and several questionnaires including sleep-related anxiety (The Sleep Anticipatory Anxiety Questionnaire); severity of core symptoms of anxiety (Anxiety subscale of the DASS-21); depressive symptoms (The Centre for Epidemiological Depression Scale); and chronic sleep reduction (The Chronic Sleep Reduction Questionnaire).

Results: Adolescents with HFASD had more problems associated with sleep, including poorer sleep efficiency, and more likely experienced all three insomnia symptoms than TD adolescents, but both groups had similar chronic sleep reduction scores. As well, adolescents with HFASD had significantly higher depression, anxiety, and sleep anxiety scores than TD adolescents. Sleep disturbances were more strongly associated with psychopathology in the HFASD group than the TD group. Regression analyses showed that psychopathology was a significant predictor of chronic sleep reduction score for both groups, accounting for 65% and 21% of the variance in the HFASD and TD groups respectively. Sleep anxiety was a significant unique predictor for the HFASD group but no unique predictor was identified in the TD group.

Discussion: As expected adolescents with HFASD experienced more sleep-related problems and higher rates of psychopathology than TD peers. The strong correlations between sleep and psychopathology support the notion that poor sleep in ASD has a greater impact on daytime functioning than in TD peers. The inherent anxiety in individuals with ASD may make them more vulnerable to developing sleep disturbances, which may in turn put them at a greater risk for developing depression during adolescence.
IDENTIFYING ADOLESCENT SLEEP PROBLEMS: ADOLESCENT, PARENT AND CLINICAL PERSPECTIVES

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Objectives: To compare the proportion of adolescents who self-report a sleep problem with the proportion of parents who report a sleep problem in their adolescent, and the proportion of adolescents who meet one or more clinical criteria for a sleep problem. Sleep and daytime functioning factors will be examined to determine which factors independently predict adolescents’ self-identification of a sleep problem.

Method: Participants were 308 adolescents aged 13–17 years (X = 15.6, SD = 0.94; 59% male) from eight socioeconomically diverse South Australian high schools. Adolescents completed a survey battery during class time, followed by a 7-day Sleep Diary. The Flinders Fatigue Scale was completed on the final day of the study.

Results: Parents completed a Sleep, Medical, Education and Family History Scale in the first two years of life. The correlation between sleep EEG power at 6 months of age correlated with Bayley III language score at 24 months of age. At 12 months of age, the NREM N3 delta power correlated with Bayley III motor and adaptive behaviour score at 24 months of age.

Conclusions: This study provides novel and interesting insight into the relationship between sleep EEG and development of infants in the first two years of life. Significant relationships were found, even in this cohort of typically developing infants.

SLEEP EEG MATURATION AND INFANT DEVELOPMENT

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Introduction: In this study, the correlation between sleep EEG power spectra and the development assessment of healthy infants was explored in the first two years of life.

Methods: A prospective cohort of 34 healthy typically developing infants underwent overnight polysomnography (PSG) at 2 weeks, and at 3, 6, 12 and 24 months of age, and Bayley III development assessment at 24 months age. The power spectra in AS and QS (2 weeks old) and REM/NREM N2 and N3 (at 3, 6, 12 and 24 months of age) in the delta (0.5–4 Hz); theta (4–8 Hz); alpha (8–11 Hz) and delta (11–15 Hz) bandwidths was calculated. Power was correlated with relevant a priori aspects of Bayley III development assessment.

Results: At 2 weeks old, the QS beta bandwidth power had a significant correlation with adaptive behaviour. The NREM N3 beta bandwidth power at 6 months of age correlated with Bayley III language score at 24 months of age. At 12 months of age, the NREM N3 delta power correlated with Bayley III motor and adaptive behaviour score at 24 months of age.

Conclusions: Sleep hygiene was assessed via the Bedtime Routines Questionnaire; a 31 item measure assessing the consistency & reactivity of bedtime routines, along with the presence of adaptive and maladaptive pre-bedtime activities.

Results: Bedtime routines were significantly more maladaptive in the HFA/AS group (M = 13.27, SD = 4.00), (t(28) = 2.31, p = 0.03) than in typically developing controls (M = 13.27, SD = 4.00), (t(28) = 2.31, p = 0.03). This poor sleep hygiene impacted significantly on actigraphic sleep onset latency. Specifically, the presence of maladaptive pre-bedtime activities (watching TV, playing video games etc.) correlated significantly with a longer sleep onset latency. r(28) = −.56, p = 0.03. Furthermore, greater consistency of bedtime routines (going to bed at the same time, sleeping in the same location etc.) was associated with shorter sleep onset latency, r(28) = −.54, p = 0.04.

Conclusions: Evidence is provided for the crucial role of sleep hygiene in problematic sleep initiation in children with HFA/AS. In a population of children already susceptible to delayed sleep onset, these findings suggest that attempts to improve the consistency of bedtime routines, combined with a reduction in maladaptive bedtime activities may help to reduce sleep onset time.
SLEEP QUALITY AND OVERNIGHT OXIMETRY IN CHILDREN WITH CYSTIC FIBROSIS  

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Introduction: Children with cystic fibrosis (CF) may experience poor sleep quality and nocturnal hypoxemia. We aimed to compare sleep duration, questionnaire measures of sleep disturbance and overnight oxygen saturation (SpO2) in clinically stable children with CF and age matched control children.

Methods: Children with CF and age matched healthy control children (age range 7–18 y) were recruited. All were studied over 2 weeks with sleep recorded by sleep diary together with questionnaires [OSA-18, Paediatric Daytime Sleepiness Scale (PDSS)]. Sleep Disturbance Scale (SDSC). Overnight SpO2 was measured for one night using pulse oximetry (Masimo Rad-7 set at 2 sec averaging). Data were compared between groups with one way ANOVA with Student Newman Kuels posthoc analysis if normally distributed or Kruskal-Wallis one way ANOVA on Ranks with Dunns posthoc analysis if not. Regression analysis was performed in the CF group to examine associations between oximetry and sleep questionnaires.

Results: 46 CF (24M/22F) and 39 control (19M/20F) children completed the study, and were well-matched for age (median 11 y for both). The mean (± SD) FEV1 in the CF group was 80 ± 19% predicted. CF and control subjects had similar sleep duration (median 9.2 ± 1 h during the week and 9.4 ± 1 h at weekends) and no differences in duration of night wakings. Children with CF had significantly lower mean SpO2 than controls (96.9 ± 1.7% vs 98.4 ± 0.8%, p < 0.001), and the SpO2 nadir was also lower (89.2 ± 4.8% vs 91.9 ± 2.5%, p < 0.05). In addition, children with CF had lower total scores than controls on the OSA-18 (median 35 vs 24, p < 0.05), the PDSS (median 14.3 ± 4.5 vs 10.2 ± 4, p < 0.001) and the SDSC (median 45.5 vs 35.0, p < 0.05), with higher values for all SDSC subscales with the exception of arousal. In the CF group, there was no correlation between mean or nadir SpO2 or FEV1, and total scores of the OSA-18, PDSS or SDSC.

Conclusions: Children with clinically stable CF have significantly more sleep problems than healthy children despite having a similar duration of sleep. There was no correlation between subjective sleep quality and nocturnal hypoxemia. Our study population differs from previous similar studies in that they are children and have relatively preserved FEV1.

050  
THE CHILD’S PERSPECTIVE OF SLEEP TIME IN FULL-DAY CHILD CARE CENTRES  
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Introduction: In Australia over a million children attend Early Childhood Education and Care (ECEC) settings. Children’s experiences in these settings have a significant impact on their health and well-being. Among these experiences is the daily sleep-time during which children in many centres are required to lie down without alternative activity even if they are unable to sleep. In the pre-school year this presents particular challenges as many children have already achieved monophasic sleep and do not need to sleep. There is an evident disparity between current policies and practices in childcare and the biological needs of most children. Emerging evidence from cortisol studies suggest that the experience of sleep time may be stressful. Given the importance of understanding the impact of these policies and practices, first hand reports from children on their experiences and perspectives of the sleep period in ECEC settings is informative. This study is the first to document children’s own reports of their experiences of the sleep period in childcare.

Method & Results: Interviews were conducted with pre-school aged children (aged 3–6 years) across six full-day childcare centres. A standard protocol was applied to measure: 1) the spontaneous reference to sleep time by children as a liked or disliked activity, and 2) children’s expressions of their specific experiences of childcare practices during the sleep period. Interviews with the children were subsequently analysed to identify major emergent themes. Group differences in experiences of sleep periods between children in centres with flexible practices (where the child is able to choose to sleep if needed) and compulsory practices (where day time sleep period is mandatory for all) were examined.

Conclusions: Our results provide a detailed account of the impact and experience of current ECEC policies and practices around the sleep time by children in these settings. The results highlight the need for greater attention to individual experiences of children across centres with flexible and compulsory sleep practices. This insight is essential to informing quality standards relating to sleep practices in childcare setting that promote positive child development and well-being.

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PARENTAL PREFERENCES TOWARDS DAYTIME SLEEP FOR PRESCHOOL AGED CHILDREN IN EARLY CHILDHOOD EDUCATION AND CARE SETTINGS  
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Introduction: Children aged 3–5 who engage in daytime sleep are more likely to go to bed later and have more night waking than children who do not. Children’s sleep disruptions can impact the family functioning and well-being so it is important to understand parental view points and the factors which influence parent preferences when reviewing daytime sleep/rest periods. In Australia, approximately 50% of children aged 3–5 attend an Early Childhood Education and Care (ECEC) settings, and a daytime sleep/rest period is a prominent feature of their daily routines. Previous research reports that parental decisions regarding children’s sleep patterns are influenced by various factors, including financial conditions, family size, cultural practices and beliefs, parent work schedules and child factors, to name a few. To date, no research has been conducted to examine a) parental preferences towards the daytime sleep/rest period in ECEC settings and b) the underlying reasons behind these preferences.

Method: We present data from a large, longitudinal project of preschool-aged children in Australia. Participants included Australian parents (N = 1302) of preschool aged children (aged 3–6.5) from metropolitan, regional and rural sites across two Australian states and included the diversity of social groups in Australia. Children participating in the study were enrolled in a range of ECEC services including long day care, kindergarten and family day care.

Results: This study utilised both quantitative and qualitative data obtained from parent-report questionnaires to document parental...
preferences regarding the day sleep/rest period in ECEC settings and to obtain their rationale for their preference. The association of these responses with demographic indicators, family/child factors and systemic, contextual factors were explored to assess their influence on parental desires towards preschool children's day sleep routines.

Conclusions: The results provide important information on the views of parents towards the sleep/rest period in ECEC settings. The data on parental preferences inform policy and practice in early childhood education and care.

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IS THE CHANGE IN SLEEP AND DEPRESSION IN ADOLESCENT MALES SIMULTANEOUS OVER A SCHOOL TERM?

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Introduction: Adolescents experience poor sleep, including reduced total sleep time and sleep quality. Male adolescents report feeling sleep deprived, especially during the school week, and therefore try to catch up on their sleep on the weekend. However, they may not completely recover their sleep debt and consequently may suffer from chronic sleep loss over the school term. Sleep loss has negative effects on mental health, particularly depression. This study aims to assess whether an increase in sleep loss co-occurs with an increase in depression over the school term.

Method: 12 adolescent males aged 14–16 years old (M = 15.29, SD = 0.83) completed baseline and weekly measures of their mental health (DASS-21). Sleep was measured using wrist activity monitors and sleepiness using the Stanford Sleepiness Scale (SSS).

Results: Baseline measures show an average total sleep time of 537 minutes and sleep efficiency of 84.10%. The average score for depression (M = 3.31, SD = 0.59). The remaining results will be collected longitudinally within-subject over the 10 week term until July 7th 2013.

Discussion: This pilot study is exploring the hypothesis that cumulative changes in sleep will correlate inversely with depression. The results will provide insight into the relationship between sleep and mental health in adolescents.

Acknowledgements: This study is financially supported by Beyond Blue.

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PROBLEM NAPPERS: ARE THEY REALLY A PROBLEM?

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Introduction: Research across a range of cultures document that after the age of three years, the majority of children cease to have a daytime sleep. However, in Australian childcare centres up to 2 hours a day is allocated to sleep or rest periods for children until they enter school. While some children sleep during these assigned sleep-rest times, others do not. Several studies have identified the subgroup of children who find it difficult to nap or lie still during sleep/rest time as problematic. To date, the factors that distinguish this subgroup of children from those who nap is unclear, and the aetiology of the “problem” of failure to nap is unclear.

Method & Results: We present data from a study conducted in Australia where most childcare services provide sleep periods through to the time children enter school. This study utilized the variation in napping behaviour across centres to explore the child characteristics and demographic variables associated with problem nappers and to identify the underlying explanations for children’s inability to sleep during nap time at childcare centres. Data were obtained from children (N = 245) attending early childhood education and care programs (N = 130) in which sleep/rest observations were conducted. Child outcomes included parent report of sleep behaviours and sleep difficulties, parent and teacher report of behavioural difficulties via the Strengths and Difficulties Questionnaire (SDQ) and direct assessments of cognitive and academic functioning via the Woodcock Johnson III (WJIII). Analyses examined differences between those identified as nappers and non-nappers on each of the measures.

Conclusions: Our findings provide important information regarding policy and practice of sleep time for all children in childcare settings and suggest that being a non-napper is not a problem of the child, but rather the context.
OBSERVING EMOTIONAL CLIMATE OF SLEEP-TIME IN EARLY CHILDHOOD EDUCATION AND CARE SETTINGS

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Introduction: The majority of children cease napping between 3 and 5 years old, yet the allocation of up to 2 hours per day for sleep/rest through to school entry is common practice in Early Childhood Education and Care (ECEC) settings in Australia. Sleep-time in these PrePrep rooms may cause a divergence from normative sleep patterns and practices. This divergence may increase the risk of emotional and behavioural challenges, both for children and for their supervising carers. To date no studies have directly examined the emotional context of sleep in ECEC settings.

Methods: This study used a subset of the Classroom Assessment and Scoring System (CLASS) Pre-K (Pianta, La Paro & Hamre, 2008) to assess the change in emotional climate and behavioural management between the morning and sleep-time sessions in 113 ECEC rooms in Queensland, Australia. A total of 2,114 pre-school-aged children (age range = 3 to 6.4 years) were observed within these rooms. Centres had varying policies regarding the permitted level of activity for children not sleeping during sleep-time which were classified into three groups: Flexible (≤30 mins, lie on bed only, 24 rooms), Inflexible (31 to 60 minutes, lie on bed only, 41 rooms) and Highly Inflexible (261 minutes, lie on bed only, 48 rooms).

Results: 71% of children did not sleep at any point during the allotted sleep-times. The CLASS Pre-K measure detected a significant drop in emotional climate between the morning and sleep-time sessions in all groups $F (1, 110) = 193.30, p < .001$. Furthermore, Highly Inflexible policy in ECEC rooms was associated with significantly lower overall emotional climate and ratings of behavioural management ($p < .05$).

Discussion: Rigid sleep practices for preschool aged children in ECEC centers present the potential for daily difficulties with behavioral management and attendant reduction in the classroom’s emotional climate. This study raises questions about the biological and developmental worth of a standard scheduled sleep-time for all children in the later years of ECEC, and directs attention to the value of flexibility in policy and practice. Further studies are needed to examine the antecedents and consequences of sleep in ECEC on children’s night-time sleep, health and well-being.

ASSESSING THE OPTIMAL SLEEP DURATION FOR COGNITIVE PERFORMANCE IN SCHOOL AGED CHILDREN

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Introduction: How much sleep school aged children need is relatively unknown. The current literature suggests sleep need in terms of range of sleep need but debate has suggested that this needs refinement. A working party and steering committee of the ASA has been established to explore the optimal sleep needs in school aged children and young people. This paper presents meta analytic data on the sleep duration needed in school aged children to obtain optimal performance in cognitive parameters.

Methods: A search strategy was undertaken in the major databases (Ebscohost, CINAHL, PsycArticles, PsycInfo, Ovid, Medline, Embase, Cochrane, Web of Science, Scopus, Informit Health Database, Pubmed) with the words, Children, Adolescent, Youth, Young People, Pediatric, Paediatric, Sleep, Wake After Sleep Onset , Sleep Onset Latency, bed time / bedtime, wake time / waketime, sleep efficiency, Cognitive, Reaction Time, Attention, PVT, Psychomotor Performance, Memory, Intelligence, Problem solving and Neuropsychological. Abstracts generated were scrutinised for inclusion criteria, resulting in critical appraisal of the remaining papers to be included in the review using the CRITICAL APPRAISAL SKILLS PROGRAM (CASP). Papers were extracted and utilised in a systematic review and meta-analysis.

Results: The systematic review process is ongoing and will be completed by September 2013. Literature will be tabulated and meta-analysis will be undertaken.

Conclusion: This will be one of the first attempts to understand optimal sleep duration for specific cognitive processes. This process will advance the understanding of optimal sleep need in school aged children. This process can then be utilised to understand sleep need in other behaviour and mood parameters as well as in other age groups such as adolescents and preschool children.

HOW DO CURRENT SLEEP PRACTICES IN EARLY EDUCATION AND CARE SETTINGS REFLECT CURRENT KNOWLEDGE ABOUT GOOD SLEEP HABITS AND ENVIRONMENTS?

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Introduction: Sleep is an essential component of the physiological restoration of the body. Poor sleep is linked to negative effects on not only physiological wellbeing, but psychological health and cognitive functioning as well. The study of sleep practice and environments is generally acknowledged to cover three domains; the immediate environment of the sleeper; the behaviour and practices that precede sleep and activities undertaken during the day that may impact on the quality of sleep. The regulation of these variables ensures effective and continuous sleep that is seen as being of benefit to the individual. Although there is a substantial body of research in the literature on the sleep
GROUP DIFFERENCES IN DIURNAL SALIVARY CORTISOL PATTERNS IN RELATION TO SLEEP PRACTICES IN CHILDCARE
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Introduction: Data from a large Australian longitudinal study suggests that almost three-quarters of preschool aged children (aged 3–6 years) do not sleep during sleep periods in early childhood settings. Despite this, many centres currently require all children to lie quietly, without alternate activities provided, during sleep periods of up to, and in some cases in excess of, 2 hours. Whether such practices have implication for children’s night-time sleep, health or development is currently unknown. It is possible that compelling children to lie down without other activity for prolonged periods when they are unable, or unwilling, to sleep could induce stress and that this stress may generalise to bedtime at home. This study utilised the variation in sleep practices across childcare centres to examine the effects of mandatory versus flexible sleep practices on children’s diurnal cortisol patterns.

Method: Salivary cortisol samples were collected from 62 children attending childcare centres with either mandatory (all children must lay on their beds without alternate activities allowed; n = 41 children), or flexible (alternative activities are provided for children who are unable or unwilling to sleep; n = 21 children) sleep practices. Salivary samples were collected across two days in which the child attended childcare, with measurement at four time points (morning waking, prior to daytime sleep period, directly following daytime sleep period and prior to night time sleep). Each child’s sleep in the childcare setting was assessed using both direct observation and actigraphy. Analyses were conducted to examine the effects of sleep practice (mandatory vs. flexible) and child response (sleepers vs. non-sleepers) on children’s diurnal stress trajectories.

Results: Our results suggest a relationship between childcare sleep practices and diurnal cortisol patterns. Notably, non-sleepers in childcare settings with mandatory sleep practices did not show a significant reduction in cortisol levels between post sleep period at childcare and night-time sleep.

Discussion: The findings from this study raise important questions regarding the effects of mandatory sleep practices in childcare for children. Future studies should examine the potential implications of variations in diurnal cortisol patterns between children in childcare settings with mandatory versus flexible sleep practices on children’s night-time sleep patterns and behaviours.
PREVALENCE OF SLEEP DISORDERS IN CHILDREN AGED 5–12 YEARS IN THE ILLAWARRA AND THE IMPACT ON QUALITY OF LIFE

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Introduction: Sleep problems in the paediatric population are common with estimates ranging from 25–40% (Mindell, 2008). In a revised clinical practice guideline “Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome”, the American Academy of Pediatrics (AAP, 2012) recommends that all children or adolescents who snore regularly be screened for OSAS. Questions about sleep health are not routinely included as part of a child’s medical history in Australia, and as such accurate information on incidence and type of sleep disorder in this demographic is scarce. Currently, many children across the Illawarra with chronic and serious sleep disorders are not diagnosed due to lack of awareness, presenting a considerable challenge to ongoing good health, educational and behavioural outcomes. The overall aims of this study are to improve clinical practice through better awareness of symptoms and sleep issues in the local community.

Methods: Collection of data from 5–12 year-old acute admissions to the Wollongong Hospital Paediatric Ward will continue for six months from June 2013 using the PedsQL 4.00 (Varni, 1998) and the Sleep Disorder Inventory for Students (Luginbuehl, 2004). De-identified data will be used to calculate the prevalence of sleep disorders, impact on quality of life and co-morbidities.

Discussion: Sleep disorders are known to be very common involving up to 1/3 of children. Abnormal sleep is known to have major impacts on children’s physical and mental health as well as causing learning problems. Sleep histories are rarely taken on children admitted to hospital despite peak Paediatric bodies having recommended routine sleep histories be taken on children for more than 10 years. The exact incidence of sleep disorders in children admitted to hospital has not previously been researched.

RESILIENCY MEDIATES THE IMPACT OF SLEEP PROBLEMS ON QUALITY OF LIFE IN CHILDREN

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Background: The associations between sleep, resilience and quality of life (QOL) in children and adolescents aged 7–18 years were investigated in this study. It has been demonstrated that children with reduced sleep quality have a lower self-reported quality of life. However, the role of resilience in the mediation of this association is not known. It may be that resilience is an important and under-recognised factor in determining the negative impacts of sleep problems in children.

Methods: A correlational design was used to determine the relationships between total sleep problems, indices of resilience, and QOL in a sample of 61 children and adolescents (31 male; Mean age 11.23 years). Participants completed measures of the above factors, which were then analysed for correlations and meditational relationships.

Results: Sleep problems, resiliency variables and self-reported QOL measures were found to be strongly correlated and, further, sleep problems were found to be predictive of resiliency and QOL scores. Resiliency variables significantly mediated the relationship between increased sleep problems and quality of life.

Discussion: Sleep problems impact levels of resilience. Reduced sleep quality lowers resilience and consequently negatively impacts on quality of life, potentially predisposing individuals to psychopathology in addition to the often reported health outcomes of chronic sleep disturbance. This highlights the role of adequate quality and quantities of sleep in the maintenance of mental health and positive adaptation to the environment. These results further indicate the potential usefulness of resilience, QOL and other subjective measures in a clinical setting to help guide treatment decisions.

DAY-TIME SLEEP PATTERNS OF AUSTRALIAN PRESCHOOL AGED CHILDREN

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Introduction: During the early childhood years children’s sleep patterns are characterised by a gradual consolidation of sleep into the night-time, and a commensurate reduction in day-time. There is a transition from polyphasic sleep/wake pattern seen in early infancy, where children sleep at multiple times during the day, through a biphasic sleep/wake patterns where children nap only once and finally a monophasic pattern of a single night sleep characteristic of adult patterns. Whilst most studies agree that rates of day-time sleep decrease beyond age two and cease by the time children enter school, there remains considerable cultural variation regarding the timing of cessation of napping for children over the preschool years. To date, no studies have reported on the rates of napping for preschool aged children in the Australian population. Accordingly, this study aimed to (1) provide the first data regarding the rates and cessation of napping behaviour for preschool aged within an Australian cohort and (2) examine the effects of child and family characteristics on reported rates of napping within this period.

Method: This study utilised data from E4Kids a large longitudinal study of Australian pre-school children. Parent reports of children’s sleep patterns, including day-time sleep duration, sleep locations and timing of cessation of day-time sleeps, and familial and child characteristics were analysed for 1700 children in the year prior to school (mean age 4 years 6 months). Regression analyses were conducted to examine the effects of familial background (SES, cultural group, parent education, parent work status, age at first birth, current maternal age) and child characteristics (age, temperament, gender, disability and health status) on children’s napping patterns.

Results: Normative patterns in Australian preschool age children confirm that the majority have ceased napping in the pre-school year though with some sub-group variation.

Discussion: This study documents for the first time the rates of napping amongst preschool aged children in Australia. The findings from this study are important in informing not only parent expectation about day-time sleep patterns for this age group, but also sleep policies and practices for preschool aged children within the early childhood education and care sector and may form the basis of practice guidelines in these settings.
A REVIEW OF MULTIPLE SLEEP LATENCY TESTING OVER 12 MONTHS

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Introduction: The aim of the study was to document the number, indications, results and outcomes in patients referred to a tertiary level sleep laboratory for Multiple Sleep Latency Testing (MSLT) over a 12 month period.

Methods: A review was undertaken of all MSLT testing within a 12 month period. Information was obtained from patient files at the sleep laboratory and from local hospital patient records where appropriate. Demographics, medical history (including medication use), level of subjective sleepiness, overnight polysomnography and MSLT results were collected.

Results: Fifty tests were done on 46 subjects (4 repeats). Data was available for 43 of the 46 subjects. There were 29 males and 17 females. Average BMI = 27 kg/m². Fifteen tests were performed for external public hospitals. The most common indication for testing was Narcolepsy in 21/43. Fifteen/42 were considered to have no other co-morbid condition which might account for their sleepiness. ESS scores ranged from 4/24 to 22/24. A sleep diary prior to MSLT was completed by the majority (41/43). Eleven of the 43 subjects were considered to have a diagnosis of Narcolepsy / Idiopathic Hypersomnolence or similar post MSLT. Nine patients were taking medications which may have affected their MSLT result – only one stopped prior to testing.

Conclusion: Around 25% of those referred for MLST have narcolepsy or similar. Medications which can affect results should ideally be stopped prior to MSLT to allow correct interpretation. The use of a sleep diary can be helpful in determining sleep restriction and other reasons for daytime sleepiness.

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QUANTITATIVE SNORE INDEX USING HIGHER INTENSITY SNORING PERFORMS BETTER AT DETECTING THE PRESENCE OF OBSURCTIVE SLEEP APNEA

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Background: Snoring is often associated with obstructive sleep apnoea (OSA). There are minimal data regarding the relationship between severity of snoring and severity of OSA. Snoring may be more severe in obese patients and relate more strongly to OSA.

Aims: 1) To determine the predictive value of snoring sound intensity for presence and severity of OSA in a sleep clinic population. 2) To investigate the influence of obesity on this relationship.

Methods: Demographic information, BMI, and polysomnographic data were collected in patients undergoing diagnostic polysomnography for suspected OSA. Quantitative snore indices (events/hr) at levels 30 dB, >40 dB, >50 dB were derived. The diagnostic accuracy of snore indices at these thresholds for detecting AHI ≥15 and AHI ≥30 was examined using area under the curve (AUC) of receiver-operator characteristic (ROC) curves. The influence of BMI on these relationships was examined.

Results: 97 patients were analysed. 71 (73%) had AHI ≥15 and 51 (53%) had AHI ≥30. The presence of higher intensity snoring (>50 dB) more accurately reflected presence of OSA than when lower intensity snoring was included. Using snore intensity >50 dB, snore index of >5/hr had sensitivity 83% and specificity 65% for detecting AHI ≥15/hr and snore index of >10/hr had sensitivity 82% and specificity 59% for detecting AHI ≥30/hr. Patients with BMI >30 had higher snore index than those with BMI <30 (107/hr vs. 36/hr, p < 0.05) but it was less discriminatory for the presence of OSA in this obese group, particularly when including lower intensity snoring.

<table>
<thead>
<tr>
<th>ROC AUC results</th>
<th>All patients (n = 97)</th>
<th>Patients with BMI &gt; 30 (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AHI ≥ 15</td>
<td>AHI ≥ 30</td>
</tr>
<tr>
<td>Snores &gt; 50 dB/hr</td>
<td>0.808</td>
<td>0.778</td>
</tr>
<tr>
<td>Snores &gt; 40 dB/hr</td>
<td>0.773</td>
<td>0.737</td>
</tr>
<tr>
<td>Snores &gt; 30 dB/hr</td>
<td>0.751</td>
<td>0.725</td>
</tr>
</tbody>
</table>

Conclusions: 1) Higher intensity snoring was a better discriminator for the presence of OSA, 2) Those with BMI >30 had more frequent loud snoring, but its presence was less discriminatory for presence of OSA than in non-obese patients.

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BREATHING AND SNORING SOUND ANALYSIS TECHNOLOGY FOR THE DIAGNOSIS AND TREATMENT OF SLEEP APNEA: THE PRESENT AND THE FUTURE

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Snoring is one of the commonest nocturnal symptoms of Obstructive Sleep Apnea (OSA). Almost all patients with OSA snore, but not all snorers have the disease. The traditional view among the medical community had been that snoring could not provide a specific enough marker to diagnose OSA.

Over the past 15 years we1 as well as some other researchers have developed mathematical methods, which demonstrate that snore (and breathing) sounds carry vital information in the diagnosis of Sleep Apnea. We have reported2 fully automated, objective technology (based on snore sounds collected via non-contact microphones) that can achieve diagnostic sensitivities and specificities exceeding 90%. Breathing sounds too have been used as a diagnostic modality by researchers. In this presentation we will critically survey the state of the art technologies in breathing and snore sound analysis in diagnosing sleep apnea. We will also discuss technological opportunities for future applications including in the design of better sleep apnea treatment devices. The existence of OSA can aggravate lung gas exchange in other respiratory illnesses such as pneumonia. We will present sound-based technology and implementations that may be capable of the simultaneous monitoring of both diseases; we have recently developed3 a sound-based, non-contact technology for the diagnosis of childhood pneumonia.

1. www.itee.uq.edu.au/srse
SNORE EPISODE CLASSIFICATION BASED OBSTRUCTIVE SLEEP APNEA DIAGNOSIS
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Introduction: Obstructive sleep apnea (OSA) is a sleep disorder with serious medical consequences. Polysomnography (PSG) is the standard method for OSA diagnosis. However, due to the inherent limitations of PSG, it is desirable to develop a simple non-invasive method for OSA diagnosis. Previous studies confirm that snoring is the most prevalent and early symptom of OSA. Also, it is reasonably correlated with the upper airway (UA) resistance which is the main cause for OSA. As snore sounds (SSs) can be captured non-invasively, SSs is a powerful information source for non-invasive OSA diagnosis. Previous attempts to utilise SSs for OSA diagnosis paid little attention to the dynamic aspect of SSs. Therefore, they could not capture SS signal dynamics that have diagnostic value. Due to this drawback, it was hard to distinguish different classes of snore episodes. According to our observations, it is clear that acoustic properties are dynamically changing within snore episodes and there are certain significant patterns of generating sequences of snore episodes, esp. around apnea/hypopnoea events.

Hidden Markov Models (HMMs) with Mel Frequency Cepstral Coefficients (MFCCs) are successfully applied in modelling speech. Due to the similar characteristics existing between speech and SSs, in the current work we also took an HMM-based snorer group approach to model temporal dynamic behaviour of acoustic characteristics of SSs belonging to snorer groups with different OSA severity levels. In this approach, each snore episode was represented as a sequence of MFCC vectors.

Methods & Results: A set of male (M) and female (F) subjects chosen from different OSA severity ranges using AHI thresholds 15 and 30. For AHI threshold 15, 28 subjects (14 M, 14 F) and for AHI threshold 30, 46 subjects (24 M, 22 F) were chosen. The HMMs were trained using the snore episodes obtained from each group by running an automatic snore segmentation algorithm. The models were evaluated using Leave-One-Out Cross Validation method for snore episode recognition and OSA diagnostic accuracy. The diagnosis accuracy reported for threshold 15 is 85.7% sensitivity and 71.4 specificity for male, and for female both sensitivity and specificity is 85.7%. For threshold 30 it was reported as, 91.6% sensitivity and 75.0% specificity for male, and 81.8% sensitivity and 72.7% specificity for female.

VALIDATION OF AN AUTOMATED ALGORITHM TO IDENTIFY AND REJECT ARTEFACT FOR QUANTITATIVE EEG ANALYSIS DURING SLEEP IN PATIENTS WITH SLEEP-DISORDERED BREATHING
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Introduction: Quantitative EEG analysis (qEEG) of neurophysiological information collected in the sleep laboratory is an underutilised resource which may provide insight into the deleterious cognitive effects of sleep-disordered breathing (SDB). Artefact in the electroencephalogram (EEG) signal is problematic and manual identification of contaminated data is prohibitively time-consuming and difficult to perform consistently. The aim of this study was to develop and validate a new tool for automated artefact detection and removal that allows subsequent quantitative analysis of sleep EEG data collected during routine overnight polysomnography (PSG) in subjects with and without SDB.

Methods: We evaluated the accuracy of an automated algorithm to detect sleep EEG artefact against manually-scored artefact by three experienced technologists (reference-standard method) in 40 PSGs. Spectral power was computed using artefact-free EEG data derived from 1) the reference-standard and 2) the algorithm; and 3) from EEG data without any prior artefact rejection (raw method).

Results: The algorithm showed a high level of accuracy of 94.3%, 94.7%, 95.8% and 89.1% for detecting artefact during the entire PSG, NREM sleep, REM sleep and wake after sleep onset, respectively. There was good to moderate sensitivity and excellent specificity of the algorithm detection capabilities in all sleep and wake states. EEG power spectra for the reference-standard and algorithm were significantly lower than the power spectra of the raw EEG signal.

Conclusion: These preliminary findings demonstrate an alternative, automated way to process EEG artefact during sleep, providing the opportunity to investigate new qEEG markers of neurobehavioural impairment in SDB in future studies.

It is possible that qEEG analysis of neurophysiological information collected during routine overnight PSG may provide further insight into the adverse effects of obstructive sleep apnea on daytime functioning.
INVESTIGATION INTO PERIODIC LIMB MOVEMENTS (PLM) MUSCLE ACTIVATION PATTERNS AND THE IMPACT OF SENSOR TYPE ON PLM DETECTION

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Introduction: There is little published evidence supporting the currently employed PLM detection methods. Sensor types in use are predominantly EMG or movement sensors. Recommended sensor site assumes highly stereotyped PLM movements. In this study, we aim to: 1) identify the type of sensor and sensor placement that most reliably detects PLMs 2) characterise PLMs in terms of leg muscle group involvement and determine the degree of stereotypicity within and between PLM patients.

Methods: Overnight PSG was performed on four patients previously diagnosed with PLMD. In addition to standard PSG, on one leg, EMG signals for six leg muscles were recorded (Tensor Fascia Latae(E1), Quadriceps (E2), Biceps Femoris (E3), Tibialis Anterior (E4), Soleus(E5) and Extensor Digitorum Brevis (E6)). Three movement signals using piezoelectric sensors were recorded from the thigh (P1), lower leg (P2) and foot (P3). For each subject, 100 consecutive PLMs were recorded using piezoelectric sensors placed over the muscle. However, PLMS counts (PLM index) do not correlate well with clinical symptomology. In this study, we hypothesized that because EMG and piezo derived signals measure muscle activation rather than actual movement, they may count events with no appreciable movement of the limb and therefore no contribution to sleep disturbance.

Aim: To determine the percentage of clinically scored limb movements which are not associated with movement of the great toe measured using accelerometry.

Methods: Nine participants were studied simultaneously with an overnight diagnostic polysomnogram (including EMG and piezo instrumentation of the right leg) and high temporal resolution accelerometry of the right great toe. Sleep stage, respiratory, limb and EEG events were scored by an experienced sleep scientist according to American Academy of Sleep Medicine criteria. Scored limb movements, and peak acceleration during each scored movement was quantified.

Results: Across the participant population, 54.9% (range: 26.7–76.3) and 39.0% (range: 4.8–69.6) of limb movements scored using piezo and EMG instrumentation respectively, were not associated with toe movement measured with accelerometry.

Discussion: If arousals following limb movements are the cause of sleep disturbance in PLMD, this observation may explain why the PLM index is poorly correlated with clinical symptoms. Future work to develop new indices of disease severity on the basis of accelerometry and existing data may lead to improved understanding of PLMD, and more effective diagnosis and management of patients with the disease. Quantification of movement in terms of peak acceleration may provide more accurate automated analysis of PLMS index during sleep.

069

MEASURING LIMB MOVEMENTS DURING SLEEP USING ACCELEROMETRY: COMPARISON WITH ELECTROMYOGRAM AND PIEZO-ELECTRIC SCORED EVENTS

MATTHEW LEONG

Queensland Health, Brisbane, QLD, Australia

Introduction: Periodic Limb Movements during Sleep (PLMS) can cause significant disturbance to sleep, resulting in daytime sleepiness and reduced quality of life. In conventional clinical practice, PLMS are measured using overnight electromyogram (EMG) of the tibialis anterior muscle, although historically they have also been measured using piezoelectric gauges placed over the muscle. However, PLMS counts (PLM index) do not correlate well with clinical symptomology. In this study, we hypothesized that because EMG and piezo derived signals measure muscle activation rather than actual movement, they may count events with no appreciable movement of the limb and therefore no contribution to sleep disturbance.

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070

ASSESSING SLEEP USING HIP AND WRIST ACTIGRAPHY

JAMES SLATER1,2, THALLA BOTIS1, LEON STRAKER3, PETER EASTWOOD1

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Introduction: Though Polysomnography (PSG) is the gold standard measure of sleep, actigraphy is becoming more widely used due to its simplicity, ease of use and low cost. Wrist and hip actigraphy have been widely used to assess sleep and physical activity, respectively. However, it is unknown whether hip actigraphy can accurately measure sleep.

Methods: Twenty healthy young adults (35 females, 35 males) aged 22 ± 0.3 years were recruited from the Western Australian Pregnancy Cohort (Raine) Study. Participants underwent overnight polysomnography (PSG), while also wearing actigraphs (GTX3) on
their hip and non-dominant wrist. Measurements were obtained from PSG, wrist and hip actigraphy of total sleep time (TST), sleep efficiency (SE), sleep onset latency (SOL) and wake after sleep onset (WASO). Sensitivity, specificity and accuracy were assessed on an epoch-by-epoch basis.

<table>
<thead>
<tr>
<th></th>
<th>PSG</th>
<th>Wrist</th>
<th>Hip</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST (minutes)</td>
<td>394 ± 62.0a</td>
<td>385.2 ± 62.8b</td>
<td>436.4 ± 51.8</td>
</tr>
<tr>
<td>SE (%)</td>
<td>86 ± 10.6a</td>
<td>85.1 ± 10.0b</td>
<td>96.5 ± 4.5</td>
</tr>
<tr>
<td>SOL (minutes)</td>
<td>18.4 ± 14.2a</td>
<td>9.7 ± 9.2c</td>
<td>2.2 ± 3.9</td>
</tr>
<tr>
<td>WASO (minutes)</td>
<td>42.2 ± 47.4b</td>
<td>57.0 ± 44.3b</td>
<td>13.3 ± 18.6</td>
</tr>
</tbody>
</table>

a = PSG vs wrist; b = PSG vs hip; c = hip vs wrist; (all p < 0.05).

Results: Compared to PSG: TST and SE were overestimated by hip actigraphy; TST and SE were similar by wrist actigraphy; SOL was underestimated on both wrist and hip actigraphy and WASO was overestimated by wrist actigraphy but underestimated by hip actigraphy (see table). The sensitivity, specificity and accuracy of wrist actigraphy would be 91 ± 18%, 43 ± 18% and 84 ± 7% respectively and of hip actigraphy would be 99 ± 3%, 13 ± 12% and 86 ± 9%.

Discussion: A hip-worn GT3X + actigraph cannot be used to accurately measure sleep variables in young adults due to its very poor ability to detect wakefulness during sleep. Although wrist actigraphy is widely used in both clinical and research settings the present study shows it to have a limited capacity to detect periods of wake during sleep.

071

AN ANDROID SMART PHONE APP FOR THE SNORE SOUND BASED DIAGNOSIS OF SLEEP APNEA

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1The U of Queensland, Brisbane, Australia, 2Princess Alexandra Hospital, Brisbane, Australia

Introduction: Snoring is one of the earliest symptoms of Obstructive Sleep Apnoea (OSA). We1 have shown that snoring carries vital information on OSA and can be used to diagnose the disease at a sensitivity and specificity2 of >90%. In our previous work, we used external bedside microphones and a data acquisition device to collect snore sounds. In this paper we present our work on developing an Android-based algorithm to diagnose OSA.

Methods: We used data from 24 subjects undergoing routine Polysomnography (PSG). We collected snore sounds with a Samsung Galaxy S-II mobile phone (Android version 4.0 Ice-cream Sandwich, sampling rate 44.1 kHz) using an application developed by our team. We have currently implemented our simplest algorithms that use two simple mathematical features, the Non-Gaussianity Index (NGI)3 and the Pitch. These can be augmented with the Neck Circumference (NC) and Gender (GD). In this paper, we analysed the performance of these algorithms using a leave-one-out validation technique on our data set. The reference standard was the diagnosis provided by clinicians with the help of routine PSG. We compared the outcomes of the algorithms at different RDI thresholds, RDI = 5, 10, 15 & 30. Table shows the sensitivity (specificity) of our method. Results indicate that smartphone-based methods may be feasible for the population screening of OSA. The performance of the technology should increase if we incorporate multiple mathematical features described earlier3-4. Further investigations with a larger data set are needed for a firm conclusion.

072

REPEATABILITY OF SUPINE RELATED OBSTRUCTIVE SLEEP APNOEA PHENOTYPES

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1Monash Lung and Sleep, Monash Medical Centre, Clayton, Victoria, Australia, 2Ritchie Centre, Monash Institute of Medical Research, Monash University, Clayton, Victoria, Australia, 3School of Mathematical Sciences, Monash University, Clayton, Victoria, Australia, 4Institute for Sleep and Breathing, Austin Hospital, Heidelberg, Victoria, Australia

Introduction: Up to 60% of patients with obstructive sleep apnoea (OSA) can be classified as having a supine related form of the disease (supine AHI: non-supine AHI >2:1). In the context of the known variability of the apnoea and hypopnoea index (AHI) it is not known how consistent a patient’s classification of having supine related OSA is from night to night.

Method: We recruited 41 patients who underwent 2 in-lab diagnostic sleep studies within 1 week. For each night, patients were classified as either having or not having supine related OSA based on published definitions. We explored the repeatability of the supine AHI and the non-supine AHI with a Bland Altman analysis as well as using the kappa statistic to interrogate the consistency of categorising a given patient as having supine related OSA on consecutive nights. We iteratively tested alternative definitions of supine OSA to determine the most reproducible method of defining the phenotype.

Results: The supine and non-supine AHI have high night-to-night variability and wide limits of agreement. For supine isolated OSA (where also the non-supine AHI is <5 events/hr) the classification agreement between nights is moderate for males (kappa = 0.56 P = 0.005), but non-significant for females. The repeatability of the supine OSA phenotype can be improved for males by increasing the ratio of supine AHI to non-supine AHI to 4:1, particularly when the non-supine AHI is <5/hr (kappa = 0.75, P < 0.001), but remains nonsignificant for females for all definitions.

Discussion: This project is the first to describe the high variability of the supine AHI, the non-supine AHI and the moderate reproducibility of the categorisation of men into the supine OSA phenotype. Supine OSA is more reproducible across nights in men if the phenotype definition is altered to include only those with a greater supine predominance. This has important implications for treatment recommendations for patients. The lack of repeatability of supine OSA in women warrants further investigation.
Sleep Apnea (OSA). We have shown that snore-based algorithms can diagnose OSA at a sensitivity and specificity of $90\%$ based on consensus-based rules. In this paper, we hypothesize improved synchrony of abdominal and chest wall motion as upper airway obstruction is overcome by CPAP will correlate with the appearance of the KML. We aim to determine the role of the KML in determining optimal CPAP pressure.

Methods: Completed CPAP titration studies were retrospectively screened and eligible for inclusion where:-
1) An optimal CPAP pressure was determined by the reporting physician. This is defined as the pressure required to control snoring, respiratory events and flow limitation.
2) 10 minutes of uninterrupted N2 sleep were seen at the optimal pressure (OP) and at 2 further pressures at least 2 cm H2O below the OP.
KMLs for each breath in these sleep periods were assessed and categorized as (A) Synchronous chest / abdominal motion, (B) Non synchronous non paradoxical motion (C) paradoxical motion. Proportion of breaths assigned to each category was correlated to physician determined optimal pressure using a univariate Pearson product moment correlation. Sensitivity and specificity for identification of optimal pressure by proportion of synchronous breaths was determined.

Results: 17 studies were analysed and included for analysis. Proportion of breaths assigned synchronous significantly decreased as CPAP deviated from OP (p = 0.001). Where 90% of breaths are synchronous there is specificity of 90.9% and sensitivity of 40% for being within 2 cm of the physician determined OP.

Conclusion: Although there is a correlation between thoraco-abdominal synchrony and control of airway obstruction by CPAP, KMLs are insufficiently sensitive at determining CPAP pressure. KMLs have high specificity at assessing optimal CPAP pressure where more than 90% of breaths are synchronous. We aim to further evaluate the KML's performance by using oesophageal manometry to validate its role as a surrogate for respiratory effort.

074

EPISODE-BY-EPISEOD ASSESSMENT OF SNORE EVENTS IN THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA
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Introduction: Snoring is one of the earliest symptoms of Obstructive Sleep Apnea (OSA). We have shown that snore-based algorithms can diagnose OSA at a sensitivity and specificity of $90\%$, with reference to the Apnea-Hypopnea-Index (AHI) from Polysomnography (PSG). The AHI is a blunt summary attempting to represent streams of PSG data. It does not sufficiently capture the temporal dynamics of the upper airway. Furthermore, it resorts to a hard-classification of the airway into apneal/hypopnea/normal states based on consensus-based rules. In this paper, we propose a method to map individual snore events to a continuous scale as a representation of the upper airway. A main target of our approach is to capture temporal changes in the upper airway.

Methods: Our method uses a Hidden-Markov-Model (HMMs) to model snores. HMM methods are widely used in speech processing. As the mathematical features, we used Mel Frequency Cepstral Coefficients (MFCCs) and their derivatives computed from snores. We trained individual HMM models to estimate the likelihoods $L_{15H}, L_{15L}, L_{30H}$ and $L_{30L}$ of any snore event belonging respectively to the categories AHI $<15$, AHI $15$, AHI $30$ and AHI $>30$. Altogether we trained 8 models, building separate models for males and females.

Results: The output of HMMs provided a continuous scale characterising individual snore events. Comparing HMM outputs in pairs (e.g. $L_{15H} > L_{15L}$) we assigned each snore into the groups AHI $>15$ or AHI $15$ etc. A simple majority rule then determined the overall disease severity class, which was compared with the PSG based AHI index. The Table shows our results. Results for the AHI threshold 15 and 30 are respectively based on 28 subjects (14 males, 14 females) and 46 subjects (24 males, 22 females). The performance of the models was evaluated using a leave-one-out cross validation technique. Our results indicate that HMM can capture temporal dynamics of upper airways and provide useful diagnostic information on OSA.

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075

VALIDATION OF FINITE-IMPULSE-RESPONSE BASED ALGORITHM FOR ESTIMATION OF EVENT RELATED POTENTIAL COMPONENTS IN SLEEP RESEARCH
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1. NHMRC Centre for Integrated Research and Understanding of Sleep (CIRUS), Woolcock Institute of Medical Research, Central Clinical School, The University of Sydney, Sydney, NSW, Australia, 2. School of Physics, The University of Sydney, Sydney, NSW, Australia, 3. Department of Respiratory and Sleep Medicine, Royal Prince Alfred Hospital, Sydney, NSW, Australia, 4. Adelaide Institute for Sleep Health, Repatriation General Hospital, Adelaide, SA, Australia, 5. Department of Medicine, Flinders University, Adelaide, SA, Australia

Introduction: Event related potentials (ERP) provide an objective marker of cortical information processing and have been increasingly used to examine neural processing in sleep disorders and sleep deprivation. Manual processing/analysis of ERP data is time consuming and somewhat subjective, while commercial software is expensive. We used ERP data from OSA patients to validate automated ERP analysis software developed at the NHMRC Centre for Integrated Research and Understanding of Sleep (CIRUS).

Methods: An auditory odd-ball task was used to acquire ERPs in two 15 min trials blocks in 14 OSA patients (age 51.4 ± 10.3 yrs, BMI 33.3 ± 6.6 kg/m², AHI 31.1 ± 20.2 events/hr). Single ERP trials in each trial block were manually scored as “noisy” or “clean” for EEG/EOG artefact (deflections > 50 μV) and compared with automated artifact selection. Automatically identified clean target and non-target trials
were then ensemble averaged, followed by a comparison of ERP peak type (N1, P2, N2 and P3, see Figure) identification between manual scorer vs automatic algorithm based on a finite-impulse-response filter.

**Results:**

Table 1. Manual vs. automatic artefact identification

<table>
<thead>
<tr>
<th>Accuracy % (Range)</th>
<th>Sensitivity (Range)</th>
<th>Specificity (Range)</th>
<th>κ (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>93.4–100</td>
<td>0.96–1.00</td>
<td>0.63–1.00</td>
<td>0.75–1.00</td>
</tr>
</tbody>
</table>

There was high agreement between manual and automatic artefact identification (Table 1). There was 100% agreement in peak type identification of target ERP components (56/56 peaks) and 96% (27/28 peaks) agreement for non-target components.

**Discussion:** This initial validation of newly developed ERP analysis software demonstrates high agreement in eye/movement artefact detection prior to ERP averaging, and accurate ERP peak type identification for target and non-target ERPs. This software provides a useful, user friendly and accurate tool for ERP analysis in sleep research.

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077 INVESTIGATION INTO THE ROLE OF MORNING BICARBONATE AND CARBOXY-HAEMOGLOBIN AS BIOMARKERS OF SEVERITY OF OBSTRUCTIVE SLEEP APNOEA

**Introduction:** Bicarbonate (HCO₃⁻) and carboxy-haemoglobin (COHb) show theoretical promise as biomarkers of obstructive sleep apnoea (OSA) reflecting overnight response to acid-base buffering of repetitive hypercapnia and intermittent hypoxia respectively.

**Methods:** Subjects were prospectively recruited from a sleep clinic with a suspected diagnosis of OSA. Morning (8–10 am) at rest arterial and venous blood gases (pH, PCO₂, PO₂, HCO₃⁻, and COHb) were compared with polysomnographic indices of OSA severity (apnoea hypopnoea index [AHI], average desaturation event duration) according to tertiles by t-tests or regression. A sub-group with AHI > 30/hour were treated with nasal continuous positive air pressure (CPAP) and returned for repeat venous blood gas measurement.
Results: 15 subjects, 13 male and 2 female, mean age 47.8 years (range 25–66), BMI 32.9 kg/m² (23.9–56.3), AHI 19.8 (2.5–156) participated.

<table>
<thead>
<tr>
<th>pH</th>
<th>PCO₂mmHg</th>
<th>PO₂mmHg</th>
<th>HCO₃ mmol/L</th>
<th>COHb%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most severe</td>
<td>7.39</td>
<td>41.8</td>
<td>76.2</td>
<td>25.2</td>
</tr>
<tr>
<td>Least severe</td>
<td>7.41</td>
<td>39.2</td>
<td>93</td>
<td>24.2</td>
</tr>
<tr>
<td>p value</td>
<td>0.07</td>
<td>0.26</td>
<td>0.09</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Mean morning arterial sample by tertile

No significant differences in pH, PCO₂, HCO₃ by severity of OSA. CPAP therapy in 5 subjects did not change morning venous HCO₃. Arterial COHb weakly correlated with AHI (r² 0.26) and trended lower with CPAP (mean pre 1.15%; post 0.975%; p = 0.07).

Discussion: Our results do not support the use of morning arterial or venous bicarbonate as a biomarker for OSA. Potential reasons for our findings include: the net CO₂ changes in OSA may minimal with periods of hypocapnia balanced by hypocapnia; indirect measurement HCO₃ by analyser, buffering of intermittent hypocapnia may be via plasma proteins; we have a small number of CPAP treated patient. The finding of a reduction in COHb is preliminary but consistent with a reduction in intermittent tissue hypoxia reducing the expression of inducible haeme-oxygenase.

079

RELATIONSHIPS BETWEEN NUTRITION KNOWLEDGE, OBESITY AND SEVERITY OF SLEEP-DISORDERED BREATHING

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Introduction: There is a known causal relationship between obesity and sleep-disordered breathing (SDB) and weight loss is a recommended intervention. Nutrition knowledge (NK) allows healthy dietary choices and may assist in weight loss strategies; however this has never been assessed in the sleep disorders population. We aimed to document the nutrition knowledge of patients referred for diagnostic assessment of suspected sleep disorders, and to assess any relationship between NK, obesity and SDB.

Methods: Consecutive adult patients attending a public hospital-based sleep laboratory for polysomnography (PSG) for the first time completed 3 of 4 parts of a validated nutrition knowledge questionnaire1. Relationships between NK and anthropometric and PSG findings were investigated. Ethics approval was obtained for this study.

Results: 89 patients (40% male) completed the study with mean (SD) age of 48 (16). 65% were obese, and the mean BMI was 34.3 (9.0). PSG revealed a mean AHI (AASMα) of 22.6 (27.0). Mean test score for overall NK was not significantly different between sexes (t-test p = 0.53). Overall NK was not correlated with BMI, waist circumference or neck circumference, nor with AHI, however there was a single moderate correlation between one domain of NK (everyday food choice) and BMI (r = 0.204, p = 0.027).

Discussion: Nutrition knowledge in this patient cohort is no worse than that of the general Australian community1 suggesting that lack of NK is not the reason for the higher levels of obesity observed in this group. The overall lack of a relationship between nutritional knowledge and severity of SDB, and between NK and markers of obesity suggest that knowledge deficit is not a contributory cause of obesity or SDB in patients being investigated with PSG. It appears that nutritional knowledge in this group does not determine dietary behaviour. These data suggest that providing education to improve knowledge of diet and nutrition may not be effective as an intervention in achieving weight loss for the management of sleep disordered breathing.

ANTHROPOMETRIC AND CRANIO-FACIAL SEXUAL DIMORPHISM IN OBSTRUCTIVE SLEEP APNOEA PATIENTS: IS THERE MALE-FEMALE PHENOTYPIC CONVERGENCE?

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Introduction: Obstructive Sleep Apnea (OSA) is more common in men than women. On average, body size is greater in men (sexual dimorphism), but large body habitus is associated with OSA for both genders. We hypothesised that, in OSA, male-female phenotypic convergence (reduced sexual dimorphism) occurs for body-size parameters that distinguish patients from same gender healthy subjects (acquisition of same pathogenic phenotype). This may provide a potential mechanism for gender-based OSA prevalence inequality.

Methods: Utilising an established database (Perri et al. Sleep and Breathing DOI 10.1007/s11325-013-0845-0, 2013) we calculated (Caucasian ethnicity) male-female (group average) ratios (MFR) for 8 anthropometric and 33 surface cephalometric variables from 85 healthy volunteers (36 males) and 104 OSA patients (72 males). Data were compared using ANOVA and post-hoc unpaired t-tests.

Results: Healthy versus OSA MFR differed for hip circumference (0.99 [0.95–1.03; mean ± 95% CI] versus 0.92 [0.87–0.98]); lower face height (1.04 [0.99–1.09] versus 1.11 [1.05–1.17]); upper lip height (1.00 [0.94–1.08] versus 1.11 [1.04–1.19]); retro-mandibular height (1.06 [1.01–1.10] versus 0.99 [0.96–1.03]); and retro-mandibular enclosure volume (RMV; 1.33 [1.23–1.43] versus 1.19 [1.09–1.28]; all P < 0.05). Thus, sexual dimorphism in OSA was reversed for hips, enhanced in the middle/lower face and reduced for the retro-mandibular space only. However, RMV was larger in OSA for females only (177.2 ± 30.0 ml versus 196.5 ± 42.5 ml; P < 0.03).

Conclusion: No variable satisfied the hypothesis. Gender-based OSA prevalence is likely mediated by factors other than the 41 phenotypic characteristics included in this analysis.

Supported by: NH&MRC Australia. Project Grant ID: 457573.
SUPINE POSTURE INCREASES THE PREVALENCE, BUT NOT THE SEVERITY, OF OBSTRUCTIVE APNOEAS IN OBSTRUCTIVE SLEEP APNOEA (OSA) PATIENTS

STEVEN MAI, STEPHEN LAMBERT, TERRY AMIS, JOHN WHEATLEY

1Ludwig Engel Centre for Respiratory Research, Westmead Millennium Institute, Westmead, NSW, Australia, 2Westmead Sleep Investigation and Research Centre, Westmead, NSW, Australia, 3Sydney Medical School, University of Sydney at Westmead Hospital, Westmead, NSW, Australia

Introduction: It is well-known that the prevalence of apnoeic events in OSA patients can vary with sleeping posture (typically increased when supine). However, it is less certain whether the severity of oxygen desaturations associated with such apnoeic events also varies with posture. The aim of the present study was to examine interactions between apnoea occurrence, oxygen desaturation metrics and sleeping posture in a group of OSA patients undergoing standard overnight polysomnography (PSG).

Methods: In a retrospective study, we examined the digital PSG records for 22 obese subjects (17 male; age: 57 ± 13 years [mean ± SD]; BMI: 38 ± 7 kg/m²; apnoea-hypopnoea index: 62 ± 21 events/hour) referred for investigation of OSA. PSG records were selected for study on the basis of: 1) an overall obstructive apnoea index [OAI] > 10 events/hour; and 2) sleep time > 60 minutes in the supine posture. From each record, and during NREM sleep, the OAI was calculated separately for the supine and lateral postures. We then chose 10 obstructive apnoea events (as defined by AASM 2007 scoring manual) occurring in (separately) the supine (SP) and lateral postures (LP). Each event record was then manually analyzed, for apnoea duration, initial oxygen saturation (SaO₂), minimum SaO₂, and SaO₂ after 20 seconds of apnoea (desaturation rate). Data were expressed as within-subject-posture average values and then pooled to obtain group mean values (± SD). Data were compared using a paired t-test.

Results: OAI was significantly greater in SP (48 ± 28 events/hour) than in LP (34 ± 30 events/hour; p = 0.005). However, there were no significant differences between SP and LP values for apnoea duration (22 ± 5.4 secs vs 21.5 ± 3.7 secs), initial SaO₂ (94.0 ± 4.5% vs 93.9 ± 4.9%), minimum SaO₂ (87.1 ± 7.9% vs 87.7 ± 7.1%), or desaturation rate (5.3 ± 3.7%/s vs 4.8 ± 2.7%/s; all P > 0.20).

Conclusion: During NREM sleep in obese subjects with severe OSA, the prevalence, but not severity, of apnoeic events is greater in the supine posture. The mechanism by which OSA patients are more susceptible to apnoeas when supine is unclear. However, we speculate that postural effects on end-expiratory lung volume (lower in supine obese subjects) may offer a plausible mechanism.

Supported by: NHMRC Fellowships ID: 1013234 and 632910.

SIMULATION OF UPPER AIRWAY COLLAPSE WITH AND WITHOUT MAS: ENHANCING COMPUTATIONAL MODELLING USING FLUID-STRUCTURE INTERACTION

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Introduction: Mandibular Advancement Splints (MAS) protrude the lower jaw, altering airway geometry and circumventing upper airway (UA) collapse in OSA. The limitation of MAS treatment is that not all patients will respond and currently response can only be determined after treatment is implemented. A promising, non-invasive approach to predicting MAS treatment outcome is the use of computational techniques to simulate airway behaviour under treatment conditions. We have previously used computational fluid dynamics (CFD) to simulate regional flow and pressure profiles in individual patient airway geometries with MAS and found good concordance with outcome on polysomnography. However previous models are limited in the assumption of rigid airway walls. Our aim was to use fluid structure interaction (FSI) method, permitting modelling of airway wall deformation, to assess UA behaviour in an OSA patient before and after MAS treatment.

Method: A male OSA patient (52 years, BMI 29.6 kg/m², baseline AHI 41.5 hr⁻¹) known to be a responder to MAS treatment (MAS AHI < 5 hr⁻¹) was selected. Magnetic resonance imaging (MRI) was used to obtain UA geometry without and with MAS in situ. Computational models of both UA geometries were reconstructed for use in the FSI simulations.

Results: FSI modelling of the UA without treatment demonstrated full collapse in the oropharynx (maximum 5.83 mm) which was induced by low oropharyngeal pressure (−51.2 to −39.1 Pa) and velopharyngeal jet flow (maximum 10.0 m/s). In the UA with MAS in situ, a much smaller deformation was observed (maximum 2.03 mm). Modelling results were validated by physical experiments using a replica airway model constructed of flexible polymer.

Conclusions: This is the first study of airflow dynamics in a deformable UA structure during inspiratory flow. The model results indicate a less collapsible airway with MAS and match the known clinical response of the patient. These results expand on previous computational models and lay a platform to study biomechanical properties of the UA in the pathogenesis and treatment of OSA.
rabbit models, we have demonstrated that snoring vibrations are transmitted to the carotid artery and that snoring-like vibration energy, when directly applied to this vessel, results in endothelial dysfunction. In the present study, we aimed to develop a methodology for non-invasive quantification of overnight peri-carotid tissue vibration dose in human snorers.

**Methods:** Eleven subjects with suspected sleep disordered breathing (7 male, 4 female; age: 60.9 ± 6.8 (mean ± SD) yrs, BMI: 32.9 ± 5.1 kg/m²) underwent routine overnight laboratory polysomnography, including measurement of sound pressure levels (SPL, dBA) using an in-room sound level meter (NL-20; Rion, Japan). Tissue vibrations were measured at the skin surface of the neck (at the level of the carotid artery bifurcation) using a tri-axial (X,Y,Z axes) accelerometer (LIS344AL; STMicroelectronics, Switzerland). Total overnight tissue vibration dose was quantified as the vibration dose value (VDV; ms⁻¹.⁷⁵), a standard metric (dependent on both exposure duration and intensity of measured accelerations) used in industry to assess whole body vibration exposure. The average number of snores per hour of sleep (snore index, SI) was determined from the PSG, where a snore was defined as a deviation of the SPL signal from baseline during inspiration. Relationships between SI and VDV were examined using linear regression.

**Results:** Overnight recording durations (sleep onset to morning wake) ranged from 5.2 to 7.7 hours, SI from 16 to 787 snores/hr and VDV from 3.3 to 7.6 ms⁻¹.⁷⁵. There was a significant linear relationship between SI and VDV (r² = 0.84; P < 0.01).

**Conclusion:** We conclude that natural snoring in humans is associated with incident vibration energy in the soft tissues surrounding the carotid artery. Overnight measured VDV values are similar to whole body exposures associated with travel in a small car for 0.2 to 6.7 hrs, a tractor for 5.3 to 149 s or use of a chainsaw for 0.003 to 0.09 s. Pathological consequences to the human carotid artery which may arise from this snoring-associated vibratory energy warrant further investigation.

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**085**

**VALIDATION OF RESPIRATORY MAGNETOMETERS TO MEASURE END EXPIRATORY LUNG VOLUME (EELV) IN THE SUPINE POSITION IN MEN AND WOMEN**

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**Introduction:** Respiratory magnetometers are increasingly being used to investigate end expiratory lung volume (EELV) changes during sleep in both healthy subjects and patients with obstructive sleep apnea. Typically, the magnetometers are calibrated by either the Banzett (JAP 1995) or Sackner (JAP 1989) methods. However, both of these calibration procedures have only been validated for tidal volume measurements seated or standing, not EELV supine. In addition, only non-obese men were studied. Therefore the aim of this study is to assess the accuracy of respiratory magnetometers at determining EELV changes in non-obese and obese men and women in the supine position.

**Methods:** Healthy weight and obese men and women are being recruited. After respiratory function testing, the subjects are fitted with respiratory magnetometers, a mask and pneumotachograph. 10 minutes of resting breathing in the supine position are collected (for calibration using the Sackner method) before a spirometer is attached to the mask and the subjects asked to take breaths with a range of tidal volumes (for calibration using the Banzett method). The subject then breathes for 12 × 45 s periods with EELV increased up to 1.5 L or decreased 0.5 L from FRC using video feedback. EELV changes determined by each technique are compared to spirometer based values.

**Results:** To date 34 subjects have been studied (7 obese, 19 men). One subject couldn’t voluntarily alter EELV and was excluded. On average the Sackner and Banzett methods were similar (Absolute EELV difference from spirometer with each method = 0.33 ± 0.05 L and 0.39 ± 0.1 L respectively). Both methods appear to perform equally in men compared to women and the obese compared to non-obese (no significant difference by t-test). However, both techniques were poor in some individual subjects (>0.5 L error in 5 subjects).

**Discussion:** Preliminary data suggest that both the Sackner and Banzett calibration techniques are equally valid in determining voluntary EELV changes. Whether this extends to passive EELV changes such as those occurring during sleep remains to be determined.
significant correlations were found between baseline mean $T_a$ and drive performance (crashes; $r = 0.43, p = 0.004$ and steering deviation; $r = 0.48, p = 0.001$). Alpha and theta power correlated significantly with crashes ($r = 0.33, p = 0.03$) and steering deviation ($r = 0.33, p = 0.03$) but not with thermoregulatory variables.

**Discussion:** These preliminary findings indicate that DPG was not associated with driving performance decrements or increased alpha or theta power in OSA patients. However, increasing mean $T_a$ at each drive baseline and mean absolute alpha and theta power were related to driving impairment. These findings suggest that EEG power and mean $T_a$ may hold promise as biomarkers of neurobehavioural dysfunction related to driving performance in patients with OSA.

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**087**

**COMPREHENSIVE CEPHALOMETRIC ANALYSIS OF PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA IN THREE AXIS**

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**Background:** Cephalometric CT scan are increasingly performed on patients to assist surgical management of these patients. There is a lack of data investigating the relationship of the bony and soft tissues cephalometric measurements with the severity of the disease. This study aims to investigate the relationship of the various bony/ soft tissue measurements and the sleep study outcome.

**Method:** Retrospective analysis of patients who presented with symptoms of OSA between January 2008 and December 2012. Forty-nine patients with complete sleep study results and cephalometric CT were identified. Relationship of the variables were analysed with linear regression analysis.

**Results:** The mean age of the patients is 45.1 ± 11.3 years old, with a BMI of 29.2 ± 5.0 kg/m². The mean AHI for these patients are 29.2 events/hour, with lowest saturation of 85.0 ± 5.4%. SNA and SNB angles have a negative, but linear correlation with AHI ($p = 0.014$ and $p = 0.021$). There is also significant interaction between the SNA and SNB angles ($p = 0.014$). Coronal measurements of the hyoid bone (distance between the greater horns), maxilla (distance between the maxillary tuberosities) and transverse distance of the airway have no significant relationship with the AHI. Of all the soft tissue measurements, only soft palate length and thickness correlate with worsening AHI ($p < 0.01$). As for sites of obstruction, hypo pharyngeal airway space correlates significantly with worsening AHI ($p = 0.001$), however, this relationship is not noted in oropharyngeal or nasopharyngeal airway spaces ($p > 0.05$).

**Conclusion:** This study confirms that SNA/ SNB angles are reliable measurements to guide management of OSA. No relationship was noted for bony measurements in coronal axis. Hypopharyngeal airway seemed more important than oropharyngeal or nasopharyngeal airway in influencing the AHI.

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**088**

**IDENTIFYING SITES IN THE BRAIN RESPONSIBLE FOR THE INCREASE IN MUSCLE SYMPATHETIC NERVE ACTIVITY IN OBSTRUCTIVE SLEEP APNOEA**

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**Introduction:** Muscle sympathetic nerve activity (MSNA) is greatly elevated in patients with obstructive sleep apnoea (OSA) during normoxic daytime wakefulness. By recording MSNA concurrently with functional Magnetic Resonance Imaging (fMRI) we are aiming to identify the central processes responsible for the sympathoexcitation.

**Methods:** Spontaneous fluctuations in muscle sympathetic nerve activity (MSNA) was recorded via tungsten microelectrodes inserted into the common peroneal nerve in 18 OSA patients while lying in a 3T MRI scanner. Blood Oxygen Level Dependent (BOLD) contrast gradient echo, echo-planar images were continuously collected in a 4 s ON, 4 s OFF (200 volumes) sampling protocol. MSNA burst amplitudes were measured during the OFF periods and BOLD signal intensity was measured during the subsequent 4 s period to allow for neurovascular coupling and nerve conduction delays.

**Results:** Fluctuations in BOLD signal intensity correlated with the intensity of the concurrently recorded burst of MSNA. Preliminary group analysis showed positive correlations between MSNA and signal intensity in orbitofrontal and cingulate cortices, precuneus, cerebellar cortex and hippocampus.

**Conclusions:** These findings suggest that changes in the activity of suprabulbar regions may be responsible for the elevated MSNA in OSA. Ultimately, we hope to correlate the functional changes in the brain with the structural changes and thereby increase our understanding of the underlying mechanisms responsible for the sympathoexcitation associated with OSA.

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**089**

**RETINAL MICROVASCULAR DIAMETERS APPEAR UNAFFECTED BY SLEEP IN HEALTHY ADULTS**

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**Introduction:** Emerging data is highly suggestive of an independent role for obstructive sleep apnoea (OSA) in the pathogenesis of stroke. However, the mechanisms underlying this observed stroke risk are unknown and include a wide variety of suggested possibilities, including cerebral microvascular disease. The cerebral and retinal microvasculatures are closely related. Thus, digital retinal photography, which provides a quantitative assessment of the retinal microcirculation, can be used as an index of cerebral microcirculatory status. In a group of patients with OSA, we previously demonstrated retinal vessel diameters changes from evening to morning (arterioles decrease and veins
increase in diameter), a finding compatible with an acute impact of OSA on retinal microvascular function. In order to exclude a normal circadian physiological effect of sleep, we have now measured overnight retinal microvascular diameters in a group of healthy young adults.

**Methods:** We studied 16 healthy subjects (10 male; age: 18–24 years; BMI: 22.8 ± 2.6 kg/m² [mean ± SD]) all with no history of sleep disorder breathing. Subjects underwent in-lab polysomnography with retinal photography (Canon CR6-45) performed both in the evening before sleep and immediately upon wakening in the morning. Retinal vessel diameters were measured by an experienced operator blinded to the timing of the photograph and using an objective computer-assisted grading method. Data were compared using a paired t-test.

**Results:** Group mean AHI=Hypopnoea Index (AHI) was 0.4 ± 0.7 events/hr. Evening retinal arteriolar diameter was 170.9 ± 9.6 μm, morning diameter was unchanged at 172.0 ± 12.1 μm (P > 0.05), venular diameter in the evening was 242.0 ± 17.0 μm, and was unchanged in the morning (242.1 ± 13.7 μm; P > 0.05).

**Conclusion:** In contrast to older OSA subjects, retinal vessel diameters do not change over a night of sleep in young healthy adults. We conclude that any overnight changes in retinal vessel morphology that may occur in OSA patients, do not represent normal circadian physiology of the retinal microvasculature.

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### 090

**THE ACUTE EFFECTS OF PRE BEDTIME ALCOHOL CONSUMPTION ON HEART RATE AND BLOOD PRESSURE DURING SLEEP AND AT AROUSAL**

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**Introduction:** At sleep onset there is a marked reduction in heart rate (HR), blood pressure (BP). These changes are beneficial for long term cardiovascular health and the absence of these changes is thought to contribute to the increased risk of adverse cardiovascular events. Arousals from sleep cause reflexive increases in HR and BP and in disorders where repetitive arousal occurs surges in HR and BP also increases cardiovascular risk. Alcohol consumption is known to increase HR during wakefulness and sleep. We investigated whether acute pre-sleep alcohol consumption prevents these ANS changes during sleep.

**Methods:** We evaluated the effect of pre bedtime alcohol consumption on HR and BP during pre sleep wakefulness and sleep in 10 healthy young males (18.7 ± 0.67 yrs) under two conditions. The first with pre-sleep alcohol administration (Dosed to 0.1% peak BAC), and the second with a placebo beverage. All abstained from alcohol for 48 hrs prior to testing. Artefact free epochs were identified, and HR and BP values pre/post beverage consumption were calculated for wakefulness and during NREM and REM sleep. Arousals from non-REM sleep were also identified. These data compared between conditions and pre and post arousal.

**Results:** Alcohol increased HR during wakefulness (p < 0.001) and across all sleep stages (p < 0.001). No alcohol/placebo effects were observed for BP. Pre arousal HR was higher in the alcohol condition (p < 0.001) with no differences in Systolic or Diastolic BP. An interaction between alcohol condition and post arousal HR was also present with HR being higher on post arousal beats 1–3 in the placebo condition (all p < 0.05). Systolic and Diastolic BP showed the same pattern of results.

**Conclusion:** The findings suggest that pre-sleep consumption of alcohol ameliorates the beneficial sleep related changes in autonomic nervous system activity and that these changes persist throughout the night, even after alcohol has been eliminated. Alcohol also alters the components of the cardiovascular response to arousal. Implications of regular pre sleep alcohol consumption include an increased risk of cardiovascular disease, which may exacerbate these problems in ‘at risk’ patients such as those with sleep apnea.

### 091

**INADEQUATE CONTROL OF OSA USING ORO-NASAL MASKS**

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**Introduction:** There are a variety of interfaces that deliver positive pressure to the airway. In some patients upper airway obstruction appears to be hard to control whilst using an oro-nasal mask. In these patients, positive pressure delivered through a nasal interface resulted in better control of sleep apnea.

**Methods:** We have reviewed Polysomnography and CPAP downloaded data in four patients who had incomplete control of obstructive sleep apnoea on CPAP via an oro-nasal mask. There was paradoxical worsening of AHI at higher CPAP pressures. Retitration through nasal interface ensured good control of OSA at lower CPAP pressures. Mask leak scores were not markedly different between the two interfaces.

**Results:**

<table>
<thead>
<tr>
<th>Patients</th>
<th>Oro-nasal mask pressure–AHI at that pressure</th>
<th>Nasal Mask and AHI at that pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19 cm AHI 51</td>
<td>18 cm AHI 1.7</td>
</tr>
<tr>
<td>2</td>
<td>5 cm AHI 45</td>
<td>5 cm AHI 4.8</td>
</tr>
<tr>
<td>3</td>
<td>20 cm AHI 12</td>
<td>14.5 cm AHI 3.6</td>
</tr>
<tr>
<td>4</td>
<td>14 cm AHI 21</td>
<td>7 cm AHI 2</td>
</tr>
</tbody>
</table>

**Conclusion:** It is worth considering a change of interface from oro-nasal mask to nasal mask, if the control of OSA proves difficult at higher CPAP pressures.

### 092

**ORAL PRESSURE THERAPY: A NEW TREATMENT FOR OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** This study evaluated an oral pressure therapy (OPT) system (Winx, ApniCure) for three months of home use as treatment for obstructive sleep apnoea (OSA).
Methods: Seventy-three subjects with mild to severe OSA and prior 28-night OPT trial experience were evaluated for participation in a 3-month nightly usage trial. OPT usage was recorded by the system console. Epworth Sleepiness Scale (ESS), a modified Functional Outcomes of Sleep Questionnaire (mFOSQ), and Clinical Global Impressions Change (CGI-C) were assessed. Subjects completed a daily diary. Statistical analysis used paired t-test.

Results: Thirty-nine subjects (24 men), BMI 32.7 ± 4.7 kg/m² (mean ± SD), 57.0 ± 8.2 years (range 33–72) enrolled. Twenty-three subjects were actively using CPAP immediately before participation in this 3-month trial. Six subjects withdrew before completion of 3 months of treatment: 4 due to inadequate resolution of OSA symptoms, 1 due to oral discomfort, and 1 due to an unrelated family illness. Nightly usage, calculated as total hours on divided by the number of nights in the month, was 5.6 ± 1.9 h (month 1), 5.4 ± 2.0 (month 2), and 5.2 ± 1.9 (month 3). The median percentage of nights in a month with at least 4 hours of use was 83% (month 1), 84% (month 2), and 81% (month 3). When the device was not used for a night, the frequency of the reason being device-related was 43% (month 1), 36% (month 2), and 26% (month 3). CGI-C was much improved or very much improved in 70% of subjects while none scored much worse or very much worse for the 3-month period. ESS decreased 1.6 ± 4.0 (p < 0.05) and mFOSQ increased 1.5 ± 2.0 (p < 0.001) over the 3 month treatment. Bed partner ratings indicated substantial improvement in snoring. Compared to baseline without treatment, AHI was significantly reduced with treatment and there were significant improvements in N1 shifts, arousal index, WASO, and sleep efficiency with OPT.

Conclusion: In this specific study cohort, nightly usage was high over the 3 month study period. Symptomatic measures and bed-partner rated snoring improved. Oral pressure therapy was effective in substantial proportion of studied patients and thus shows promise as a potential chronic treatment option for selected patients with OSA.

093

AUTOTITRATING POSITIVE AIRWAYS PRESSURE REDUCES SYMPTOMS OF AEROPHAGIA

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Introduction: This study was designed to assess whether autotitrating positive airways pressure (APAP) would be better tolerated and reduce gastro-intestinal symptoms in patients experiencing aerophagia as a consequence of continuous positive airways pressure (CPAP) therapy.

Method: This was a randomised, crossover, double blinded study. Patients were randomised to either CPAP at their recommended pressure or APAP (20–6 cm H2O) for a fourteen day period of each. They were requested to complete a daily diary to document the degree of belching, flatulence and abdominal discomfort. A morning measurement (upon waking) of abdominal girth was also obtained. Visual analogue scales assessing symptoms of aerophagia were also completed at the end of each treatment period.

Results: Each subjective measure of abdominal pain or discomfort, belching and flatulence was significantly lower during APAP therapy compared to CPAP. Abdominal girth was unchanged between the two therapies. Thirty of the 48 patients preferred APAP therapy, and eight preferred CPAP. The remainder reported no preference. The Epworth Sleepiness Score (ESS) and Functional Outcomes of Sleepiness Questionnaire (FOSQ) were not altered by type of therapy. Usage was higher during APAP therapy but this was only significant compared to baseline but not compared to CPAP therapy.

Discussion: Aerophagia symptoms due to CPAP therapy are not only physically uncomfortable, but can also result in social embarrassment and awkwardness. To reduce these symptoms, decreases in pressure, change of interface, humidification and over-the-counter remedies have been utilised. There are no current evidence-based guidelines for managing CPAP induced aerophagia. Decreases in pressure are common (19 of these patients), but may result in sub-optimal therapy. This study does not, however, indicate a difference in sleepiness between baseline, CPAP and APAP, as measured by ESS and FOSQ. APAP reduces the overall pressure required and this study supports that this approach significantly reduces symptoms of aerophagia. The study is on-going and significant increases in usage may yet be identified once sufficient numbers are enrolled.

094

DEVELOPMENT OF A PATIENT CARE MODEL FOR PHARMACY-BASED CPAP PROVIDERS: PHASE ONE

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Introduction: A small proportion (approximately 3–4%) of community (i.e. non-hospital based) pharmacies are involved in CPAP and sleep apnea-related services. A pilot study conducted by the researchers found variability in the range and quality of current CPAP service provision in pharmacies and identified a need to standardise care within this setting. Participants in the pilot study expressed a desire for pharmacy-specific guidelines to direct their practice. This study aims to develop a model of care for pharmacy-based CPAP providers.

Methods: The study is being conducted in phases using an action research approach. Phase 1 sought input from pharmacists and pharmacy-based CPAP practitioners on the key elements required for a high quality pharmacy-based CPAP care model. Semi-structured in-depth telephone interviews were conducted with 22 participants currently involved in CPAP provision in a community pharmacy. Convenience purposive sampling was used to achieve a diverse study sample and continued until saturation of data was achieved. Each interview was audio recorded and transcribed verbatim. Thematic analysis was conducted to identify emerging themes. Participants also completed a questionnaire further exploring the key elements of a pharmacy CPAP model of care.

Results: Key emerging themes included: Practitioner support/needs. The primary item in this theme was the need for accessible, independent and professionally recognised training programs. There was also an insistent expression of need for professional pharmacy guidelines/models/programs. Treatment pathway delineation was another thematic area of discussion. Several models exist for referral, diagnostic and treatment pathways and the developed model of care should achieve consensus on best practice. Professional role acknowledgement was another identified issue with respondents signifying that the role of a CPAP provider was much more than supply. Viability fears and lack of professional/systems support were expressed barriers.

Discussion: The first phase of this study has provided a description of pharmacy practitioner needs. The next phase of this research will seek broader stakeholder input from key professional and industry representatives to further develop a pharmacy-based CPAP patient model of care.
CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY ADHERENCE IN MILD TO MODERATE OBSTRUCTIVE SLEEP APNOEA (OSA)

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Introduction: CPAP therapy is highly effective for OSA, however is often poorly tolerated with reported adherence (>4 hours per night) varying between 17 and 71% (Weaver & Grunstein Proc Am Thorac Soc V5 pp 173–178, 2008). Low CPAP adherence is thought to be associated with milder disease severity levels. We examined CPAP adherence (on an intention to treat basis) in a group of mild/moderate OSA patients prescribed CPAP as part of a 12 month duration vascular disease outcome study.

Methods: Subjects referred to a sleep clinic for evaluation of sleep disordered breathing (SDB) were screened for OSA using laboratory polysomnography. Individuals with an apnoea-hypopnoea index (AHI) < 30 events/hr were invited to participate. Sleepiness was assessed using the Epworth Sleepiness Scale (ESS). CPAP titration was performed on a separate night. Subjects were then supplied with an individually fitted mask (± chin strap) and a CPAP machine with humidifier (REMstar Auto A-Flex 551P, Philips Respironics Inc., USA; fitted with an adherence-monitoring card). Follow up included: (i) phone call at 24 hrs; followed by (ii) 3 optional face to face visits in week 1; and (iii) face to face visit with education and device/interface review at 7 days. Subsequent phone support was provided, with monthly adherence review and further contact either face to face, via phone or email. Adherence rates were defined as percent subjects using CPAP ≥ 4 hrs (on average) per night. Data were expressed as mean ± SD.

Results: We studied 31 subjects (20 males; age: 54 ± 11 yrs; BMI: 31.2 ± 6.0 kg/m²) with an ESS score of 10.6 ± 5.6 au (range 1–21). AHI was 9.9 ± 7.1 events/hr (range 0–24), respiratory disturbance index (RDI) was 19.9 ± 9.7 events/hr (range 5–46). Group average CPAP pressures were 10.0 ± 1.8 cm H2O (range 7–13), while adherence rates over 3 and 6 months were 65% (20/31) and 64% (16/25), respectively.

Conclusion: In a group of mildly sleepy volunteer subjects with predominantly mild/moderate OSA, CPAP use of at least 4 hours per night was achieved in > 60% of subjects over a 3–6 month period. We conclude that good levels of CPAP adherence can be achieved in SDB patients even in the face of mild levels of sleepiness and disease severity.

Supported by NH&MRC Project Grant ID: 632597 and Fellowship ID: 1013234 & 632910.

COMPLIANCE WITH CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY IN OBSTRUCTIVE SLEEP APNOEA PATIENTS WITH AND WITHOUT CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction: Chronic obstructive pulmonary disease (COPD) and obstructive sleep apnoea (OSA) are two of the most frequently encountered respiratory conditions. There is a well-described overlap syndrome between the two diseases, with a prevalence of around 0.5–1% in the adult population, and an associated increased risk of serious complications than either condition taken separately. The mainstay of treatment for moderate to severe obstructive sleep apnoea remains continuous positive airway pressure (CPAP) with some studies suggesting an improvement with COPD symptoms in patients treated with CPAP. This study looked at the characteristics and compliance with CPAP in patients with COPD and OSA (overlap syndrome, OS) versus OSA alone.

Methods: Between 2011–2013, all patients undergoing treatment with CPAP at the Gold Coast Hospital for OSA and Overlap syndrome were analysed, with compliance data from CPAP machines obtained at follow up clinic appointments (n = 46). All patients had undergone lung function tests and a sleep study within the previous 24 months. Data was analysed using Microsoft Excel, using an unpaired Students t-test, and significance taken as p < 0.05.

Results: There was no difference between the groups in relation to age, gender and medical comorbidities. There was a significant difference in the minimal saturation during the sleep study of the two groups (OS: 75.2% vs OSA: 83.0%, p = 0.02) but no appreciable difference in the ESS (OS: 10.2 vs OSA: 9.6, p = 0.73). We found no significant difference in the compliance with CPAP between the two subsets (OS: 5.2 hr vs OSA: 6.1 hr, p = 0.23).

Discussion: Compliance data between the two subsets was similar, suggesting reasonable tolerance of CPAP overall in our population, regardless of coexisting COPD. Further research is warranted to examine whether there was any qualitative or quantitative improvement in COPD component of the overlap syndrome population after continued use of CPAP.

DEPRESSION PREDICTS POOR ADHERENCE DURING AN INITIAL AUTO-TITRATING CONTINUOUS POSITIVE PRESSURE TRIAL

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Introduction: Depression is a risk factor for medication non-compliance. We aimed to identify if depression is associated with poorer adherence during home-based autotitrating continuous positive airway pressure (autoPAP) titration.

Methods: We conducted a retrospective-observational study in a tertiary, university hospital sleep clinic. 240 continuous positive airway pressure (CPAP) naïve patients with newly diagnosed obstructive sleep

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Factors Influencing CPAP Adherence Following In-Lab CPAP Titration

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Introduction: Information was gathered from 20 patients (13 male, 7 female, aged from 30–82 years, mean age 53.6±13.9 years) approximately 3 to 5 months after their in-lab CPAP titration studies (n=20). They were asked questions about their experiences of CPAP therapy, CPAP settings, mask selection and side effects of CPAP therapy such as nasal congestion.

Method: Information was obtained from prior sleep study data, hospital paperwork, pre-assessment questionnaires and structured telephone interviews conducted with patients.

Results: Preliminary, descriptive statistics showed that 55% of patients were using CPAP when contacted. Non-adherence was attributed to factors such as negative side effects of therapy, limited subjective experience of benefits from therapy, perceived disadvantages or side effects of therapy, bed partner dissatisfaction with therapy and cost of therapy. Nasal prong masks were being used by 8% patients, 54% of patients had nasal masks and 38% of patients were using full face masks. Most patients (64%) were not using the mask interface recommended from their in-lab titration. Humidification was used by 100% of patients. Only 45% of patients currently using CPAP therapy knew their prescribed pressure. Despite having a prescribed fixed pressure, 36% of patients currently using CPAP therapy reported that they were using auto-titrating machines.

Discussion: The preliminary data highlighted factors associated with increased CPAP adherence, as well as identified factors associated with a greater likelihood of non-adherence. The role that bed partners played in treatment adherence was noteworthy and suggests there is value in educating partners about the impact of untreated sleep apnoea on a patient’s health. These findings support the implementation of better patient and bed-partner education by both sleep technicians during in-lab titrations as well as CPAP suppliers. The overall aim of this study is to achieve higher levels of CPAP adherence in patients who have had an in-lab CPAP titration. Further, the importance of on-going support from CPAP suppliers was considered important by many patients, hence the importance of upskilling them.

Humidified High Flow Nasal Prongs (HHFNP) Can Improve Initial CPAP Acceptance

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Introduction: Continuous positive airway pressure (CPAP) is a highly effective therapy for obstructive sleep apnoea (OSA), and in many cases it is the only suitable treatment modality. Initial CPAP acceptance can be affected by patients’ claustrophobic reactions and often these patients do not persist with the therapy and continue with untreated OSA. Humidified high flow nasal prongs (HHFNP) can provide a low end-expiratory pressure and ameliorate OSA severity. We describe the use of HHFNP to facilitate CPAP acceptance in claustrophobic patients.

Method: Patients diagnosed with at least moderate symptomatic OSA were offered a trial of CPAP in the outpatient setting. Those whose average nocturnal compliance was poor on account of claustrophobia were offered a trial of HHFNP (Fisher & Paykel Airvo®) with a view to returning to CPAP in the long-term. Subjects commenced nocturnal HHFNP at 25 L/min, and if tolerated the flow rate was gradually increased at 1–2 week intervals, to a maximum of 40 L/min. CPAP was re-introduced if 40 L/min was tolerated.

Results: Five adults (2 females, 3 males, ≥ age 63 years, ≥ BMI 28.6) were diagnosed with OSA (≥ AHI = ≥ 46 per hour) using the Comumedics Ambulatory Somte' system. The pre-treatment Epworth Sleepiness Score was ESS 9/24 (range 5–13/24). CPAP therapy was introduced in the standard way. Patients trailed CPAP for a ≥ 4.6 weeks, during which the average nocturnal CPAP compliance was 1.4 h/night, before HHFNP was introduced. HHFNP was used for a ≥ of 3.6 weeks before CPAP was re-introduced. Post-HHFNP the average CPAP compliance was 3.9 h/night by week 5. Three subjects proceeded with long-term, fixed CPAP therapy (≥ 7.3 cm H2O).

Conclusions: HHFNP can improve patients’ acceptance of CPAP therapy for OSA.
Methods: Retrospective audit of all patients aged over 75 diagnosed with OSA at Concord Repatriation General Hospital NSW in 2008. Diagnostic polysomnography and CPAP Pressure determination study parameters as well as patient symptomatology and long term compliance (3 months or more) were recorded.

Results: 434 Patients (266 male) underwent diagnostic polysomnography in 2008, 27 patients (6.2% of total studies) were aged over 75 years (19 male). In the elderly group, 7 had normal studies, 5 were diagnosed with mild OSA, 6 with moderate and 9 with severe OSA (RDI > 30). During follow up, the uptake of CPAP was 9% in mild and moderate OSA and 55% in the severe OSA group. No other factors were associated with CPAP compliance and long term use except from severity of OSA.

Conclusion: CPAP compliance in the elderly is comparable to the general population. CPAP use is very unlikely to be maintained in other than severe OSA and the confounding factors remain unclear. More research is required in this area to clarify the reasons.

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APPLYING THE PRINCIPLES OF QUALITY IMPROVEMENT TO MANUAL CPAP TITRATION OUTCOMES

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Background: Manual CPAP titration is the gold standard for determining the optimal pressure required to eliminate obstructive respiratory events. Previous studies report that improvement in sleep quality during titration is important in predicting compliance with therapy. Therefore, determining optimal pressure is important for patient outcomes.

Aim: We applied the FADE model of quality improvement to improve the outcome of manual CPAP titrations (Focus, Analyse, Develop, Execute and Evaluate).

Methods: Ten CPAP titrations per technician were randomly selected for auditing in 2012. Titrations were graded as optimal, good, adequate or unacceptable, based on AASM guidelines. If titrations were not optimal, reasons were determined (e.g. no supine REM, emergence of centrals, not controlled at 20 cmH2O, under-titrated etc). Each pressure change was evaluated for compliance with guidelines. Based on data, action plans for improvement were developed and executed including group and individual feedback of results, revision of titration guidelines, and a focus on identified areas of improvement. Program success was evaluated by repeating the audit in 2013.

Results: 217 titrations assessed in 2012 (optimal 41%, good 13%, adequate 26%, unacceptable 20%). 71 titrations assessed in 2013 (optimal 51%, good 13%, adequate 22%, unacceptable 14%). Chi square test showed a trend (p = 0.28) to improving combined optimal, good and adequate titrations.

Conclusions: Applying the principles of quality improvement to manual CPAP titrations may have a positive impact on determining the optimal pressure for more patients. However, reasons for unsuccessful titrations require further evaluation and some may be beyond the control of the technician.

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FORMAL POLYSOMNOGRAPHIC TITRATION STUDIES LEAD TO SIGNIFICANT PRESSURE SETTING CHANGES IN PATIENTS USING POSITIVE AIRWAY PRESSURE FOR OBESITY HYPOVENTILATION SYNDROME

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Aim: To compare pressure settings in patients with Obesity Hypoventilation Syndrome (OHS), before and after in-laboratory titration polysomnography (PSG) with Bilevel (BPAP) and Continuous Positive Airway Pressure (CPAP).

Methods: Data from 12 patients with new diagnosis OHS over an 18-month period (August 2011–February 2013) were retrospectively collated. 10 of these patients were part of a clinical trial and randomised to either CPAP (3) or BPAP (7). Of the 2 remaining patients, one was commenced on CPAP and the other BPAP. 4 patients started treatment during an acute hospital admission with respiratory failure; pressure settings were based on clinical response (PaCO2, SpO2) and symptom relief. 8 patients were commenced on treatment during a 1–2 hour afternoon treatment acclimatisation session in the sleep laboratory. A PSG titration study was performed approximately one week after initiation. Pressures were titrated to control upper airway events, as well as hypventilation as evidenced by a rise in PtcCO2 or persistent hypoxia in the absence of respiratory events. Local guidelines on BPAP/CPAP titration are consistent with current American Academy of Sleep Medicine (AASM) guidelines.

Results: Baseline data; median age 56 years [range 34–77], BMI 48.9 kg/m2 [33.4–75.1], daytime PaCO2 53.5 mmHg [44–72]. Diagnostic PSG data (5 patients); median AHl 58 events/hr [18.5–117.6], SpO2 ≤88% total sleep time 56.3% [14.7–93.1]. Diagnostic oximetry data (5 patients); median ODI 63 events/hr [42–153], SpO2 ≤88% of total time 48% [12–99]. 2 patients had no diagnostic study. BPAP patient data; empiric IPAP mean 16.5 ± 2.4 cmH2O, post-titration IPAP mean 20.6 ± 2.1 cmH2O (p = 0.007), empiric EPAP mean 9.5 ± 1.7 cmH2O, post-titration EPAP mean 11.8 ± 1.4 cmH2O (p = 0.008). CPAP patient data; empiric pressure 11 ± 2.2 cmH2O, post-titration pressure 15.5 ± 1.3 cmH2O (p = 0.006). Percentage of patients with post-titration setting changes: IPAP/EPAP 75%, CPAP 100%, BURR 50%.

Discussion: PSG titration studies lead to significant increases of all pressure settings. Such changes were necessary to eliminate obstructive events and maintain satisfactory ventilation and oxygenation.

Conclusion: This study is concurrent with current AASM guidelines, demonstrating that PSG titration is necessary for the setting of optimal pressures in all OHS patients being treated with BPAP or CPAP.
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PULSE WAVE AMPLITUDE DROPS DURING SLEEP: ASSOCIATION WITH DIABETES AND HYPERTENSION IN THE GENERAL POPULATION

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Objectives: Pulse wave amplitude (PWA) variations estimated by digital plethysmography have been shown to reflect sympathetic activations during sleep. The aim of this study was to determine normal values for PWA drops in the general population and to assess the association between PWA drops during sleep and the prevalence of hypertension and diabetes.

Methods: 2114 subjects (49.6% women, 58.5 ± 11 years old, BMI 26.3 ± 4.4 kg/m²) participating in an ongoing population-based sleep cohort (HypnoLaus, Lausanne, Switzerland) underwent complete polysomnographic recordings at home. The PWA drops index (PDI), defined as the number of PWA drops per hour of sleep, and the PWA drops duration (PDD) were determined using Somnolica software. All subjects had an extensive clinical workup including morning blood pressure and fasting glucose measurements. Diabetes was defined as the number of PWA drops per hour of sleep, and the PWA drops duration (PDD) were determined using Somnolica software. All subjects had an extensive clinical workup including morning blood pressure and fasting glucose measurements. Diabetes was defined as a fasting glucose level ≥126 mg/dL or the use of an antidiabetic treatment. Hypertension was defined as SBP ≥140 or DBP ≥90 or antihypertensive treatment.

Results: In subjects without sleep disturbances (AHI < 5/h; PLMI < 15/h; Epworth < 11/24), mean PDD was 13.3 ± 2.5 sec and mean PDI was 40.1 ± 15.6/h. The prevalence of hypertension increased with increasing PDD. In the 1st PDD quartile (shortest duration) hypertension prevalence was 36.7%, 2nd quartile: 38.6%, 3rd quartile: 43.6% and 4th quartile: 45.1%. After controlling for age, sex, BMI, and AHI, this association remained significant (p < 0.0013). The prevalence of diabetes also increased with increasing PDD. 1st quartile: 7.9%, 2nd quartile: 7.6%, 3rd quartile: 10.3%, 4th quartile: 12.9%. After controlling for the same confounding factors, this association remained significant (p < 0.0011). Compared with the 1st quartile the 4th quartile had an OR of 1.74 (1.1–2.7) for the presence of diabetes. PDI was not associated with hypertension or diabetes.

Conclusion: In the HypnoLaus population-based sleep cohort, increasing pulse amplitude drops duration is associated with a higher prevalence of hypertension and diabetes.

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AUTONOMIC DYSFUNCTION IN OSA

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In the past two decades, a number of animal and human studies have improved our understanding of the pathophysiological mechanisms linking intermittent hypoxia (IH) and arousals from sleep with sympathetic activation and subsequent hypertension in obstructive sleep apnea (OSA). Animal models of OSA involving IH exposure have revealed clear afferent and efferent pathways involved in sympathetic activation. Excess sympathetic output to the heart, kidneys and blood vessels all contribute to raising blood pressure however emerging evidence now suggests that other OSA co-morbidities may also in part be driven by sympathetic overactivity including arrhythmias and insulin resistance. Together with hypertension, these co-morbidities strongly contribute to the increase in cardiovascular mortality in this group.

Although some studies suggest a central remodelling of autonomic cardiovascular control after chronic nightly exposure to sympathetic surges associated with IH and arousals from sleep, this presentation will focus on peripheral aspects of sympathetic overactivity in OSA and the cardio-metabolic consequences. The effect of OSA treatment on autonomic dysfunction and related co-morbidities will also be examined. Finally, newer therapeutic approaches including new generation beta-adrenergic receptor blockers, electrical carotid baroreceptor stimulation and catheter based sympathetic nerve ablation, which are showing promise in the general hypertension population will be examined in the OSA context.

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THE IMPACT OF SLEEP DEPRIVATION AND CIRCADIAN MISALIGNMENT ON THE AUTONOMIC NERVOUS SYSTEM

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Misaligned and restricted sleep opportunities are common for many people in our modern around-the-clock society. Studies on both humans and rodents have shown that insufficient sleep produces a stress response that impacts the autonomic system and increases the activity of the hypothalamic-pituitary-adrenal axis.

Insufficient sleep may not only have a direct activating effect by itself but it may also affect the reactivity of these systems to other physiological and psychological stressors. This could have serious repercussions for health and well-being including an increased risk for cardiovascular disease. Additionally, data from prospective cohort studies show that adverse cardiovascular events peak in the morning (i.e., between 6 am and noon) and shift work is associated with cardiovascular disease, obesity, and diabetes.

Shift work forces sleep to the daytime, when the drive for wakefulness is high, and requires work during the night, placing stress on physiological systems that are usually at rest. Laboratory based studies have found that this circadian misalignment impacts autonomic outputs such as heart rate, vagal cardiac modulation, platelet activation, epinephrine and norepinephrine. This suggests that misalignment between the behavioural sleep/wake cycle and the circadian timing system in shift workers could contribute to their increased risk for cardiometabolic disease. However, more research is needed to explain the mechanisms linking insufficient and misaligned sleep with adverse health outcomes and studies of napping and/or sleep extension in habitual short sleepers would allow better characterization of the overall health benefits of adequate sleep duration.

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WILL IMPROVING SLEEP IMPROVE MENTAL HEALTH IN THE TROUBLED ADOLESCENT?

DOROTHY BRUCK

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This paper will consider some of the mental health concerns that affect millions of adolescents and consider the latest evidence concerning their relationship with sleep. The focus will be on reviewing our current understandings of the role of sleep in adolescent and adult depression.
Unsurprisingly, the evidence shows that significant sleep difficulties co-exist with many mental health concerns, especially depression. Of particular concern is the significant body of evidence that shows that sleeping difficulties in adolescence are a strong predictive risk for subsequent depression, even though depression was initially absent.

The implementation of evidence-based interventions around sleep difficulties are frequently overlooked in the management of troubled adolescents, with the presenting ‘daytime’ problems being tackled exclusively or almost exclusively. Given that mental health problems may need time-intensive interventions over a prolonged period it is important to ask whether the incorporation of specialised attention to overcoming sleep problems into an overall treatment program will help treatment outcomes.

Evidence that considers the efficacy of the simultaneous management of sleep and depression, particularly in adolescents, will be reviewed. Practical sleep improvement strategies that may be implemented will be considered and, where available, the literature on the use of such strategies will be evaluated.

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ELECTRONIC COMMUNICATION FOR THE SPECIALIST MANAGEMENT OF A REMOTE COHORT: CYSTIC FIBROSIS AS A MODEL

SCOTT BELL

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Throughout life, specialist CF care is associated with improved clinical outcomes and survival. The delivery of specialist care is challenging in the wide plains of Australia. Of the 300 patients attending the Adult Cystic Fibrosis Centre at The Prince Charles Hospital (TPCH) in Brisbane, only 40% live within 90 minutes drive of the hospital.

Providing specialist care, particularly in remote and rural parts of Queensland, Northern Territory and Northern New South Wales can be challenging with the limited local resources. The patients are ‘spread widely’ stretching as far as Port Macquarie (NSW) in the south, the Cape (Qld) in the north and Katherine (NT) in the west. Electronic communications including email, Telehealth and Outreach Clinics undertaken by the multidisciplinary team in various and changing forms have been performed over the past 15 years by the Adult Cystic Fibrosis Centre Team at TPCH.

This talk will discuss the perceived benefits, risks and challenges of undertaking this electronic communication and outreach programs for the delivery of specialist care. The presentation will be supported by a review of the available literature of electronic communication.

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PILOT PROGRAMME FOR REGIONAL MANAGEMENT OF OBSTRUCTIVE SLEEP APNOEA IN INDIGENOUS COMMUNITY HEALTH CENTRES

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Introduction: Although there are little specific data, it is believed that there is a substantial disease burden of obstructive sleep apnoea (OSA) in indigenous populations but relatively few patients access existing (usually metropolitan) sleep services. We report on the early outcomes of a pilot programme of an Indigenous Community Health Nurse led model of care.

Methods: Following a two week training programme at a tertiary referral Sleep Disorders Centre, six existing Indigenous Community Health Nurses incorporated screening for OSA into regular indigenous health assessments (including age, gender, BMI, Epworth Sleepiness Scale (ESS), Multivariant Apnea Prediction and Berlin Questionnaires, Comorbidities and Medications). A Type 4 Diagnostic Test was performed in the home recording nasal pressure and oxygen saturation (ApneaLink) with where positive patients were commenced on CPAP with optimal pressure determined by APAP. Patients with negative screening tests but positive clinical features were referred to the tertiary sleep service.

Results: To date, 70 patients have been screened by the Type 4 studies (age 51.5 ± 13.0 years, 35 male, BMI 35.6 ± 8.5). Baseline ESS was 8.9 ± 5.3 and 48/70 had positive hypersomnolence scores on the Berlin questionnaire. Results of the overnight monitoring (311.1 ± 142.1 minutes) showed an average AHI of 16.3 ± 16.7, oxygen saturation 93.1 ± 2.6% and time below saturation of 90% of 17.3 ± 22.2%. AHI was > 20 in 27/70 (34%) and ≥ 30 in 12/70 (17%). Four Type 4 studies required repeating due to inadequate duration or signal loss. 34 patients have been recommended treatment with CPAP. Referral to the tertiary sleep service has been recommended in 16 patients and 20 patients required no further action. Interim data are available on 12 patients recommended CPAP. Two refused therapy. In the rest, recommended pressure was 13.5 ± 3.1 cm H2O with a compliance of 5.06 ± 2.37 hours/night after 2.3 ± 1.0 months. There was a trend for improved ESS (9.2 ± 4.2 to 6.0 ± 1.9, p = 0.09).

Conclusion: Early results suggest that the majority of Indigenous patients can be screened and treated in regional community centres with acceptable treatment outcomes utilising existing Community Nurses following a brief training programme.

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USING BRIGHT LIGHT AND MELATONIN FOR THE ADJUSTMENT TO NIGHT SHIFT WORK

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Approximately 20% of people work non-standard hours, and often complain of difficulties sleeping during the day and remaining alert during night work. Many of the difficulties in night work relate to circadian misalignment. In this talk I will briefly review the human circadian system, and address the concept of circadian misalignment leading to sleep and performance problems. I will then describe several approaches to improving circadian adjustment to night shift work, including approaches to shape light/dark exposure and the use of exogenous melatonin. Some of the controversies surrounding phase shifting to adjust to night shifts will also be presented.

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CHRONOTHERAPY FOR TREATMENT OF SEVERE SLEEP PHASE DELAY IN ADOLESCENCE

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During adolescence, sleep phase delays occur due to a delayed secretion of the sleep inducing hormone, melatonin. These results in a delayed onset of sleepiness and subsequently, adolescents go to sleep later. If this natural tendency is not kept in check, they can result in severe sleep phase delays, with sleep onset as late as 2:00 am. Clearly during school time this is debilitating. Treatment for these severe cases, is based on the behavioural
Manipulation of the sleep wake cycle, and can include chronotherapy, a combination of behavioural intervention and exposure to light. This paper describes the successful treatment of an adolescent with severe sleep phase delay with severe sleep phase delay.

**Breath Timing Changes in Paediatric Respiratory Disorders**

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**Introduction:** Duchenne muscular dystrophy (DMD), Myotonic dystrophy (MD) and Prader Willi syndrome (PWS) are rare genetic disorders characterised in part by a progressive onset of sleep disordered breathing over a period of years. This progression typically leads to an intervention such as non-invasive ventilation or low-flow nasal oxygen. The derivation of a threshold at which such treatment should commence and its determination for each child is difficult due in part, to having no objective measurement of the changes in breathing pattern. In this study, we propose that breathing pattern characterised by inspiratory and expiratory timing provide a useful signature of the worsening pathology in the lead-up to treatment intervention.

**Method:** Retrospective overnight diagnostic polysomnogram (PSG) was obtained from 28 children with DMD, MD or PWS at three longitudinal study points, and 39 age and gender matched normal controls. Ten minute segments of stable N2 sleep were identified and nasal flow data exported from three periods across the night (during the first, middle and latter third of the study). For each period, mean inspiratory period, mean expiratory period, and mean total breath period and fractional inspiratory time were calculated.

**Results:** Longitudinal data over three year period show change in mean fractional inspiratory time in PWS patients is 1.7% and DMD patients is 2.8%. There is also a change in confidence interval for fractional inspiratory time in PWS patients is 3.6 to 2.7% and DMD patients is 4.7 to 13.5%.

**Discussion:** DMD, PWS and MD patients show a characteristic increase in nocturnal flow limited breathing as disease progresses, and the change in fractional inspiratory time in PWS and DMD patients is likely to be a reflection of this worsening pathology. Changes in the fractional inspiratory time are not confounded by increases in absolute breath duration that occur with age, and it is therefore a useful measure for investigating longitudinal data in growing children. Further work will investigate the morphology of nasal flow data to provide more subtle measures of flow limited breathing, and will investigate other measures to distinguish ventilatory muscle insufficiency, upper airway obstruction and ventilatory control pathology.

**Midface Deformities in Children Receiving Non-Invasive Ventilation: The Extent of the Problem**

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**Background:** The true extent of midface deformity in children receiving NIV is not fully quantified in the existing literature. We aim to identify the extent of the problem, factors contributing to development of midface deformity and approaches to alternative treatment strategies considered in a tertiary sleep setting.

**Aim:** To describe a tertiary sleep clinic experience of midface deformities with the use of non-invasive ventilation (NIV) in children aged 0–18 yr.

**Methods:** A case review of all children receiving NIV and attending a large tertiary sleep unit from Jun 2012-Jun 2013 was performed. Information collected included 1) Basic patient demographics, 2) Underlying diagnosis for each patient, 3) The mode of NIV received (CPAP/Bilevel) with details of ventilator settings utilised 4) The interface used, 5) The duration of NIV treatment and details of any complications to treatment and 6) Review of any clinical photographs or cephalometry performed. For the purpose of this study we classified a child with risk of midface hypoplasia as someone who has been identified clinically by a physician or ventilation nurse specialist and where alternative treatment approaches are being considered or implemented.

**Results:** 21/126 (17%) of children receiving NIV therapy, during the period studied, were identified as having midface deformities. Median age at starting therapy was 5 yrs. 11/21 (52%) children received CPAP therapy with a median maximum CPAP pressure of 8.6 cmH2O (6.6–12 cmH2O).10/21 (48%) children received bi-level (VPAP) therapy with a median maximum IPAP setting of 17 cmH2O (15–20 cmH2O) and EPAP setting of 5.3 cmH2O (4.8–cmH2O).16/21 (76%) had an underlying congenital syndrome with associated dysmorphic features. Achromadropia was the most common condition associated with midface deformities (24%, n = 5).

**Discussion:** A significant proportion of children receiving NIV therapy were classified as having midface deformity in this study. Children with an underlying congenital condition appear more vulnerable and specifically children with achondroplasia are at risk.

**Conclusion:** Midface deformity is a significant concern in children receiving long term NIV therapy & requires close surveillance particularly in children with congenital disorders.

**Severe Central Apnea and Hypoxia Treated with Acetazolamide in a Toddler with Brainstem Ganglioglioma**

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Brain-stem tumours have been reported to associate with hypoventilation, central apnoea or abnormal breathing patterns relating to proximity of the tumours to the dorsal respiratory group or due to raised intracranial pressure. An 18 month old girl with low grade brainstem ganglioglioma (involving left middle cerebellar peduncle, left cerebellar hemisphere, pons, medulla and the cochlear nerve) was referred for evaluation of witnessed apnoea, repeated arousal and snoring during sleep. The ganglioglioma has been managed conservatively since diagnosis at 9 months of age with 4-monthly MRI. Apart from left sided sensorineural hearing loss, and torsional nystagmus, she has been clinically well and meeting all her developmental milestones. Most recent cranial MRI demonstrated mild to moderate increase in the size of the tumour 9 months since diagnosis without evidence of raised intracranial pressure. Diagnostic sleep study demonstrated severe central apnoea with a central apnoea index (CAI) of 4.5/hour (>5 is abnormal). There was no evidence of hypoventilation. Acetazolamide at 15 mg/kg/day was
commenced after discussions between the sleep, oncology, neurosurgical, and neurology teams. Repeat sleep study was performed after 3 doses of acetazolamide demonstrated marked improvement of CAI to 16.2 / hour. Her serum bicarbonate level was slightly low at 17 mmol/L. Repeat sleep study after 4 months and 6 months treatment with acetazolamide did not show ongoing benefit with worsening CAI (20.1/h, 41.7/h respectively), repeated hypoxia, no CO2 retention, despite persistent metabolic acidosis (HCO3⁻ 17 mmol/L).

Acetazolamide may provide short term benefit for the treatment of central apnea associated with hypoxia in children. However long term and sustained benefit was not demonstrated in our case. Acetazolamide stimulates ventilation by producing metabolic acidosis through its action as a carbonic anhydrase inhibitor. Previous infant and adult studies suggested acetazolamide is effective in improving CAI in central sleep apnoea even just after 1 dose, and continued CAI and oxygen saturation improvement in chronic use without significant side effects. Although gangliogliomas are benign neoplasms, in this case it had a malignant effect on breathing control.

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SLEEP RELATED BREATHING PROBLEMS IN CHILDREN WITH TRISOMY 21: A TERTIARY CLINIC EXPERIENCE

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Aim: To describe the prevalence and spectrum of sleep related breathing disorders in children with trisomy 21 undergoing polysomnography (PSG) at a tertiary sleep clinic.

Methods: A retrospective review of clinic notes was undertaken for all patients with trisomy 21 attending a large tertiary sleep clinic over a 12 year period. Data collected included:
1) Basic patient demographic information including associated co-morbidity
2) Details of PSG variables from sleep study
3) Details of obstructive sleep apnoea diagnostic category (normal/mild/moderate/severe)
4) The presence of associated sleep problems
5) Information regarding ongoing treatment effects.

Results: Collation of complete PSG data was possible for 115/157 (73%) of identified children over the 12 yr period. Noisy breathing or snoring were the commonest symptoms leading to referral and obstructive sleep apnoea (OSA) was diagnosed in 83/115 (73%) of patients studied. Apnoea-Hypopnea Index (AHI) on 1st PSG performed, was <5 in 42/115 (37%) of children, 5–10 in 26/115 (22%) and >10 in 47/115 (41%). CPAP was attempted in 27/115 (17%) of cases but consistent compliance was achieved in only 56%.

Discussion: This study confirmed a significant burden of sleep related breathing disorders (SRBD) in children with trisomy 21. OSA dominated as the cause of SRBD in this population. Adenotonsillarctomy was the treatment of choice but obstruction persisted in a subset of children in whom CPAP therapy was then attempted. Where trialled, CPAP was successfully established in approximately ½ of cases. Behavioural issues relating to the underlying diagnosis of trisomy 21 largely contributed to failure of CPAP therapy.

Conclusion: Children with trisomy 21 are recognised as having a significant degree of sleep related morbidity. This study emphasises the importance of screening for sleep problems in this group of children. In addition to SRBD, behavioural issues in this population are identified as providing additional challenges for long term management and may have an impact on overall outcome.
Introduction: We present an unusual case of a paediatric patient with late onset central hypventilation who has been effectively managed non-invasively, using the adaptive servo-ventilation.

Case Report: A 7 yr female presented with a history of increasing fatigue, cough and ataxia. Noticeable change in breathing pattern had been observed with associated weight gain and lethargy over a 6-month preceding period. Initial assessment showed the child to be drowsy, with reduced power in all limbs (4/5) and absent reflexes. Investigation revealed a pCO2 of 120 mmHg on capillary blood gas with elevated bicarbonate (47). The child was ventilated in PICU and gas exchange normalised. On extubation, ongoing profound desaturations to <40% were observed. Polysomnography confirmed central apnoeas and hypopnoeas lasting up to 70 seconds with no patient trigger of ventilator. Episodes predominated in NREM (stage 2) and at sleep onset, with REM sparing noted. TcCO2 was above 60 mmHg. Extensive additional radiological, serological and genetic testing revealed no abnormality. Specifically PHOX 2B genetic testing was negative and there was no evidence of autonomic dysfunction. The patient was commenced on Bi-level ventilation via a full face mask but ongoing difficulties with persistent hypcapnia, tachycardia and profound central events relating to positional change were noted. Daytime hypventilation also continued. Acetazolamide use resulted in a more stabilised clinical status. A trial of adaptive servo-ventilation has been successfully implemented in this patient, resulting in improved gas exchange and patient-ventilator synchrony. The patient, now 12 yrs of age, continues to remain stable on this mode of ventilation at present.

Discussion: The introduction of adaptive servo-ventilation provides a novel ventilatory method that may have a role in selected paediatric patients as illustrated by this unique case. The potential role for acetazolamide in complex central hypventilation is also highlighted in our report.

Methods: Sleep variables were compared retrospectively from baseline polysomnography performed at the University of Michigan Sleep Disorders Centre between August 2008 and January 2013 in DS children and non-DS controls matched for age, gender and total apnoea hypopnoea index (AHI). Sensor-recorded position (supine, prone, lateral) was expressed as the percentage of total sleep time. The AHI (total number of apnoeas and hypopnoeas per hour of sleep) was calculated in each sleep state (rapid eye movement, REM, non-REM), position and position-sleep state combination, and compared between DS and non-DS subjects using the Wilcoxon-signed rank test.

Results: The median age and AHI of DS subjects (n = 76; 55%M) was 4.6 years (range 0.2–17.8) and 7.4 events/hour (range 0–133). In all subjects, AHI was higher in REM than non-REM (p < 0.05) however the non-REM AHI was higher in DS subjects than controls (p < 0.05). Percentage of either non-REM or REM sleep was not different between groups. Compared to controls, the percentage of prone sleep was greater in DS subjects (p < 0.05) but the percentage of supine or non-supine (prone plus lateral) sleep was no different. For DS subjects alone, non-REM AHI was higher in supine than non-supine sleep (p < 0.05).

Conclusion: In DS and non-DS children alike, respiratory events are predominantly REM-related. However, when matched for OSA severity, children with DS have a higher non-REM AHI, which is worse in the supine position, perhaps indicating a positional effect compounded by underlying hypotonia inherent to DS. These findings illustrate the clinical importance of non-REM respiratory events in the DS population, even in the context of REM-predominant OSA. Both sleep state and position warrant consideration when interpreting OSA severity and choosing treatment for children with DS.

Introduction: Given the high prevalence (31%–79%) of obstructive sleep apnoea (OSA) in children with Down Syndrome (DS), US guideline recommend routine polysomnography (PSG) at 4 years of age. Overnight oximetry is recommended as a screening tool in the UK, but this test has not been formally evaluated in children with DS. This study aimed to compare potential screening tools for OSA, the OSA-18 questionnaire and overnight oximetry, in children with DS and healthy children with a comparable severity of OSA.

Methods: 82 children with DS who had PSG for suspected OSA between 2008–2012 were identified. 31 were excluded (no consent, inadequate data, previous adenotonsillectomy, other major developmental disability, no suitable matches). 49 were matched with otherwise healthy children of the same gender, with age within 2 y and comparable severity of OSA by obstructive respiratory disturbance index (ORDI) criteria (OSA group). A parent completed the OSA-18 prior to PSG. Oximetry performed as part of the PSG was scored according to the McGill Oximetry Score (1 = inconclusive, 2 = mildly abnormal; 3 = moderately abnormal and 4 = severely abnormal). Questionnaire and oximetry scores were compared between groups using Wilcoxon rank sum tests.

Results: DS and OSA groups had mean age of 6.3 y, range 0.3–16.7 y; 24 female. 15 had primary snoring and 34 had OSA (9 mild, 6 moderate, 19 severe); median ORDI was 6/h (range 0–50/h). There was no difference between groups in OSA-18 score (median 59 for DS and 63 for OSA, p = 0.31). SpO2 nadir was comparable between the groups.
(85% for DS and 88% for OSA, p = 0.16) and number of SpO2 dips below 90% was also similar (p = 0.25). There was a greater average SpO2 fall with respiratory events in DS (median 4% vs 3% in OSA, p = 0.05) and desaturations of ≥4% were more frequent in DS (median 2.4%/h vs 1.1/h, p = 0.04). The McGill score was discordant in 17 pairs in 11 pairs DS was worse than OSA including 7 pairs where oximetry was abnormal in DS but not OSA.

**Conclusions:** When compared with closely matched children with OSA of comparable severity, children with DS have a similar symptom profile but worse desaturation. The performance of home overnight oximetry should be formally assessed in DS, but these results suggest it may have a better sensitivity for OSA than in the general population.

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INFANTILE LARYNGOMALACIA AND OBSTRUCTIVE SLEEP APNEA – PSG OUTCOME AND MANAGEMENT

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**Introduction:** Infantile obstructive sleep apnea (OSA) can co-exist with laryngomalacia (LM). Previous studies have suggested treating LM with supraglottoplasty (SG) can improve PSG outcomes in infants with OSA. Our aim was to describe the characteristics and management (including the use of CPAP) in these infants with both LM and OSA, which has not been documented before.

**Methods:** Written and electronic records of infants < 12 months of age at the time of referral to the Sleep Medicine Department at Sydney Children’s Hospital (SCH) in 2012 were reviewed. Infants with chronic conditions including syndromes, genetic abnormalities, craniofacial anomalies, cerebral palsy, and neuromuscular disease were excluded. Children with noisy breathing (including stridor and/or snore) who had LM confirmed by nasoendoscopy and/or laryngobronchoscopy (LBO) were included in the review.

**Results:** 42 infants were referred to the Sleep Medicine Department for various reasons in 2012, out of which 24 infants did not have significant chronic conditions and were referred due to ‘noisy breathing’ including stridor and/or snore. 16/24 (66.6%) infants were confirmed to have LM, where 5/16 (31.3%) were referred due to persistent noisy breathing post SG. 10/16 (62.5%) infants with LM were diagnosed with OSA (OAHI > 1/hour) after PSG, 4 post-SG, 6 pre-SG. Infants with LM and OSA were younger (median 3.6 mth, range 2.4–11 mth) than those without OSA (6 mth, range 2.4–8.4 mth). The majority of the infants with OSA had moderate OSA on PSG (OAHI 10–15/h) after PSG, 4 post-SG, 6 pre-SG. Infants with LM and OSA were younger and had lower power when compared with the averaged power spectra of infants with PWS across all sleep stages, which may indicate delayed brain maturation. The lack of change in theta bandwidth may be related to the attention problems of infants with PWS. Generally, infants with PWS with Class I deletion had higher power while Class II deletion had lower power when compared with the averaged power spectra of the healthy infant cohort.

**Conclusions:** The sleep EEG characteristics of infants with PWS indicate delayed brain maturation and may be related to the neurocognitive symptoms of infants with PWS.

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CHARACTERISTICS OF SLEEP EEG POWER SPECTRA OF INFANTS WITH PRADER WILLI SYNDROME COMPARED WITH HEALTHY INFANTS

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**Introduction:** This study characterises the maturational evolution of sleep electroencephalogram (EEG) of infants with Prader Willi Syndrome (PWS) and compares with healthy infants from 1 to 24 months of age.

**Methods:** A retrospective cohort of 25 infants with PWS underwent overnight polysomnography (PSG) at 1, 3, 6, 12 and 24 months of age. Sleep epochs were scored as Active Sleep (AS) and Quiet Sleep (QS) at 2 weeks of age and as Rapid Eye Movement (REM) and Non-REM (NREM) stages from 3 months onwards. Representative epochs were used to generate the EEG power spectra, from the central C3 derivation. These were analysed visually and quantitatively in AS/REM and QS/NREM sleep in the following bandwidths: delta (0–4 Hz); theta (4–8 Hz); alpha (8–11 Hz) and delta (11–15 Hz). The sleep EEG power spectra of PWS were also graphically and statistically compared with data from PSG in healthy typically developing infants.

**Results:** There was a lack of significant change in sleep EEG power spectra of infants with PWS across all sleep stages, which may indicate delayed brain maturation. The lack of change in theta bandwidth may be related to the attention problems of infants with PWS. Generally, infants with PWS with Class I deletion had higher power while Class II deletion had lower power when compared with the averaged power spectra of the healthy infant cohort.

**Conclusions:** The sleep EEG characteristics of infants with PWS indicate delayed brain maturation and may be related to the neurocognitive symptoms of infants with PWS.

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SLOW WAVE ACTIVITY IN CHILDREN WITH EXCESSIVE DAYTIME SLEEPINESS: A POTENTIAL ROLE IN IDENTIFICATION OF NARCOLEPSY

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**Introduction:** Diagnosis of narcolepsy in children is difficult, as excessive daytime sleepiness (EDS) is often the only diagnostic feature. Slow wave activity (SWA), an indication of homeostatic regulation, has been shown to be attenuated in adults with narcolepsy, but is yet to be studied in children. The aim of this study was to examine homeostatic regulation, via the characteristics of SWA, in children with significant EDS.

**Methods:** Retrospective analysis of nocturnal PSG was conducted in a pilot group of children who met the diagnostic criteria for narcolepsy (NARC, N = 9), idiopathic hypersomnolence (IH, N = 14), or obstructive sleep apnoea (OAHI > 5; OSA N = 19) as a positive control. One-way ANOVA and Kruskal-Wallis tests were used to determine group
differences in respiratory and sleep parameters. Repeated Measures ANOVA determined differences in the dissipation of SWA over the night.

Results: There were no group differences in age (mean 13 ± 4 y) or BMI-Z score (mean 1 ± 1). Proportionately more males were in the OSA (53%) and NARC (44%) groups than in the IH group (21%). As per study design, OAH1 was higher in the OSA group (p < 0.001). TST and percent of spontaneous arousals were greater in IH and NARC compared to OSA (p < 0.001). NARC had the shortest sleep onset (p < 0.05) and IH the greatest proportion of arousals in NREM (p < 0.05). Overall, SWA dissipated significantly over the night (p < 0.01). Average SWA was reduced in IH compared to OSA, suggesting impaired recovery of sleep debt (p < 0.01). Although the interaction effect was not significant due to limited power, paired comparisons were conducted to determine trends in the trajectory of SWA dissipation. SWA in the final NREM period was significantly less than the first NREM period in the OSA and IH groups (p < 0.001), but not in the NARC group (p = 0.09).

Conclusion: These preliminary results suggest that SW power is most attenuated in children with IH, albeit with intact dissipation. Although caution need be taken, it appears the dissipation of SWA is more impeded in children diagnosed with narcolepsy than those who do not meet formal diagnostic criteria for that condition. Analysis is on-going; however these results are promising for identifying characteristic patterns in homeostatic regulation in children with narcolepsy.

This study was supported by the Rob Pierce Grant in Aid.

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THE EFFECTS OF PERSISTENT PERIODIC BREATHING IN PRETERM INFANTS AFTER HOSPITAL DISCHARGE
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Introduction: Periodic breathing (PB) is a respiratory pattern typical of preterm infants, and can persist during the first weeks to months of life after hospital discharge, but its occurrence and impact has not been clarified. The aim of our study was three-folded: to describe the anthropomorphic characteristics of preterm neonates incidentally detected with PB, their PB patterns and to assess the impact of PB on oxygen saturation (SpO2) and brain tissue oxygenation index (TOI).

Subjects and methods: 35 preterm neonates (gestational age 31.2 ± 2.6 weeks, birth weight 1699 ± 551 g) were recruited as part of a larger study. Infants underwent daytime polysomnography at 43.5 ± 0.5 wks postmenstrual age during which SpO2 (Nellcor Puritan Bennett Inc., Pleasanton, CA, USA) and TOI (NIRO-200 spectrophotometer, Hamamatsu Photonics KK, Tokyo, Japan) were also recorded. PB epochs were defined as ≥ 2 or more sequential apnoeas lasting more than 3 s and categorised depending on the number cycles of PB recorded: 2 cycles, 3–5 cycles, 6–10 cycles, 11–20 cycles and ≥20 cycles. SpO2 and TOI values for each category were expressed as % change from a 30-s baseline.

Results: 9 infants (26%) were detected to have PB. Their anthropomorphic characteristics did not differ from the non PB-group. 203 individual cycles of PB were recorded. The proportions of total PB cycles were 29% for 2 cycles (in all 9 infants), 39% for 3–5 cycles (in all 9 infants), 18% for 6–10 cycles (in 7 infants), 7% for 11–20 epochs (in 6 infants) and 6% for ≥20 cycles (5 infants). Mean % change in SpO2, or TOI did not differ significantly between the different cycle lengths, although there was a trend for decreased SpO2 and TOI with increasing duration. However, in one infant who had 11 separate episodes of PB including 3 of 11–20 cycles and 3 of ≥20 cycles had significant desaturations of −23% and −28% respectively and TOI of −14% and −13% respectively. In this infant all PB epochs were detected in quiet sleep.

Discussion: In our study, a quarter of preterm infants discharged home without clinical respiratory problems were incidentally detected to have persistent PB at 2–4 weeks corrected age. Our identification of one infant who had significant desaturation and reduced TOI suggests that routine overnight oximetry before discharge may be warranted.

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LONG TERM IMPROVEMENT IN SLEEP DISORDERED BREATHING SEVERITY AND SLEEP PARAMETERS FOLLOWING TREATMENT IN PRESCHOOL CHILDREN
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Introduction: Preschool-aged children have the highest prevalence of sleep disordered breathing (SDB) as this is the age when the lymphoid tissue of the upper airway is largest compared to the surrounding bony structures. Adenotonsillectomy (AT) is the most common treatment for SDB; however there has been limited research investigating the outcomes following treatment in this age group and those studies have had short follow-up periods. This study aimed to compare sleep and respiratory parameters in preschool children 3 y following initial diagnosis by overnight polysomnography (PSG).

Method: These are preliminary data from 43 children (33 SDB, 10 controls; 6–8 y). All subjects underwent repeat overnight PSG 3 y after baseline PSG. Subjects were assigned to control (n = 10; ORDI ≤ 1 no history of snoring), treated (n = 19; ORDI > 5, n = 10; ORDI ≥ 5, n = 4; ORDI ≤ 1, n = 5) or not treated (n = 14; ORDI 1–5, n = 4, ORDI ≤ 1, n = 10) groups. Sleep variables (total sleep time (TST), sleep efficiency (SE), sleep latency, %TST in each sleep stage (N1, N2, N3, REM)) respiratory arousal index (RAI), spontaneous arousal index (SAI) and total arousal index (tAI) and respiratory variables (obstructive respiratory disturbance index (ORDI) and desaturation index > 4% (ODI4)) were compared between the baseline study and the follow-up study using two way repeated measures ANOVA.

Results: There was a significant reduction in ORDI at follow-up compared to baseline in the treated group (p < 0.001 for all). There was no change in the ORDI between studies for the not treated group. There was a significant effect of time but not treatment for ODI4 (p < 0.05 for both). RAI was reduced and SAI increased in the treated group (p < 0.05 for both) with tAI significantly decreasing in both SDB groups at follow-up (p < 0.01 for both). %N1 and %REM were reduced and %N2 increased at follow-up for both SDB groups (p < 0.05 for all) and there was no change in SE, sleep latency or TST between studies. The control group did not change significantly between studies for any parameter.

Conclusion: This study has demonstrated that following treatment, preschool children with SDB had decreased ORDI, RAI and tAI, indicating that treatment is effective in the long term in reducing SDB severity and improving sleep quality in this age group. Overall, SDB severity did not worsen in the children who remained untreated.
RESIDUAL OBSTRUCTIVE SLEEP APNOEA (OSA) POST ADENO-TONSILLECTOMY IN A COHORT OF CHILDREN REFERRED TO A TERTIARY CHILDREN’S HOSPITAL
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Introduction: Adenotonsillar hypertrophy is the primary cause of OSA in children. Paediatric OSA is not always resolved or improved with T&A. Previous studies have shown that 15–20% of children have persistent OSA post T&A.1

Aim: To describe the characteristics and to identify risk factors for residual OSA post adeno-tonsillectomy in a cohort of children referred to a tertiary children’s hospital.

Methods: Children who had polysomnography (PSG) post adeno-tonsillectomy for persistent symptoms of OSA, between the year 2007–2012 were included in the study. Children who had major craniofacial, neurological and genetic abnormalities were excluded from the study. Demographic and PSG variables were analysed.

Results: 73 children [mean (SD) age = 9.7 years; 69% males; race: 55% Chinese; 31% Malays, 10% Indians and 4% Eurasians] underwent PSG post adeno-tonsillectomy. 59 (81%) children had residual OSA (mild OSA in 24 (33%); moderate OSA in 13 (18%) and severe OSA in 22 (30%)) on the PSG. Mean (SD) ages of children with and without residual OSA were 10 (3.8) years and 10.1 (3.4) respectively and there was no significant difference (p = 0.8). There was weak correlation (r = 0.29, p = 0.01) between age and obstructive apnoea hypopnoea index (OAHI). There was moderate correlation (r = 0.37, p < 0.01) between the body mass index (BMI) and residual OSA (OAHI).

Conclusions: Significant proportion of children with persistent symptoms suggestive of OSA post adeno-tonsillectomy had evidence of residual OSA on PSG. The results of this study show that age of the children has a weak correlation with OAHI post adeno-tonsillectomy. There was a moderate correlation between BMI and residual OSA post adeno-tonsillectomy.

Reference

THE SLEEP SERVICE AT A TERTIARY PAEDIATRIC HOSPITAL – RESULTS OF A SIX MONTH AUDIT
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Introduction: Our sleep centre is the only public tertiary paediatric sleep centre in our state, with a growing population. Previous audit of our service demonstrated that the number of paediatric sleep studies performed in the state increased by 53% between 2002 and 2007, with a 24% increase from 2007 to 2012. Numbers of referrals wait time for clinic appointments and sleep studies appears to be increasing in our centre. We undertook an audit of referral numbers and waiting times over six months to assist the design of a service delivery quality improvement project for our service.

Method: A prospective audit of all new outpatient referrals from September 2011 to April 2012.

Results: 296 new outpatient referrals were received, with 270 cases analysed after exclusions. Median delay from the referral being received to triage by a clinician was 5 days. 90% of referrals were triaged as priority 2 (to be seen within 90 days) and 10% were priority 1 (to be seen within 30 days). Only 42.3% of priority 1 referrals were assessed within the recommended time, and 26% of priority 2 patients. The median wait time for in-lab PSG prior to clinic was 110 days (range 5–247) and 79 days (range 15–231) for home ambulatory PSG prior to clinic. Median wait time for a clinic only appointment was 115 days (range 1–262), with subsequent median wait time of 128 days (3–248) for PSG. For these patients seen in clinic initially, median wait time from initial referral being received to PSG being performed was 226 days (14–356).

Conclusion: The American Academy of Otolaryngologists recommends that a waiting time of over 6 weeks for PSG is unacceptably high, and our wait times clearly exceed this recommendation. Between 50 and 75% of patients are not assessed within the recommended period of time by referral triage. Wait times will continue to increase with the large number of referrals being received and the growing population. Implementation of a service delivery quality improvement project is a priority to allow timely delivery of a paediatric sleep service, and based on the results of this audit, recommendations have been drafted including utilising Telehealth services, investigating alternatives to in-lab PSG and improving communication with ENT surgeons.

DOES OPTIMAL POSITIVE AIRWAY PRESSURE (PAP) FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNOEA (OSA) IN CHILDREN, CORRELATE WITH THE BODY MASS INDEX (BMI)?
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Introduction: Clinical guideline1 for the manual titration of PAP in patients with OSA acknowledges the insufficient evidence for selecting a higher starting PAP for patients with higher BMI.

Aim: The aim of this study was to determine whether the optimal PAP as determined by a manual PAP titration study, for the treatment of OSA in children, correlates with the BMI.

Methods: Clinical details and Polysomnography variables of children who underwent PAP titration study for the treatment of OSA, at a tertiary children’s hospital between Jan 2009 to Dec 2012, were retrospectively reviewed. Children with known syndromes (except Down syndrome), craniofacial abnormalities, neuromuscular diseases and skeletal deformities were excluded.

Results: 129 children [mean (SD) age = 13.6 (4.5) years; 68% males; race: 62% Chinese, 29% Malays, 8% Indians and 1% Eurasians] underwent PAP titration study. 76 (59%) had adentonsillectomy before the PAP titration study. The median (IQR) OAHI before PAP titration study was 11.3 (7.4–35.6). The mean (SD) BMI was 32.2 (9.6). The mean (SD) recommended PAP pressure was 9.9 (2.5) cmH2O. Between BMI and the optimal PAP pressure, there was a weak correlation (r = 0.29, p = 0.01) between BMI and the optimal PAP pressure. The results of this study show that age of the children, correlates with the BMI.

References
1. Clinical guideline for the manual titration of PAP in patients with OSA acknowledges the insufficient evidence for selecting a higher starting PAP for patients with higher BMI.
PAP pressure in children with Down syndrome (r = 0.289, p = 0.13). There was no correlation between the OAH and the optimal PAP pressure.

Conclusions: The results of this study show that the optimal PAP pressure for the treatment of OSA in children does have a weak correlation with their BMI. Selecting a higher starting pressure a priori, for PAP titration study for obese children with OSA, may not be recommended based on this study alone. Further large studies are required.

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DEMOGRAPHICS OF CHILDREN ATTENDING
A TERTIARY LEVEL SLEEP CENTRE
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Princess Margaret Children’s Hospital, WA, Australia

Introduction: The only public tertiary paediatric sleep centre in the state examined referral patterns and sleep study outcomes as part of a quality improvement audit.

Method: A prospective audit of all new outpatient referrals from September 2011 to April 2012.

Results: 296 new outpatient referrals were received, with 270 cases analysed. The largest number of referrals came from Paediatric Ear, Nose and Throat surgeons (30% overall), 28% from paediatricians and 18% from general practitioners. At least 4 referrals for children with Trisomy 21 were received and 3 for children with Prader-Willi commencing Growth Hormone. 74% of children who were referred had a PSG booked. 29% had OSA diagnosed, 46% had no OSA, 5% required a repeat PSG, 3% had another sleep disorder and 17% did not attend their PSG. Overall, only 21.4% of all referrals were diagnosed with OSA (58% mild, 14% moderate, 7% mild-moderate, 12% moderate-severe, 8% severe). Of the 18 patients who had future adeno-tonsillectomy at our centre, 3 had severe OSA, 5 had moderate-severe OSA, 1 had moderate, 4 had mild, 3 had no OSA and 2 had insufficient data to diagnose OSA (both had surgery without repeat PSG).

Conclusions: As expected, a large proportion of referrals came from ENT surgeons, but also a large number from paediatricians and general practitioners, which suggests that awareness of OSA and other sleep disorders is increasing, particularly in association with Trisomy 21 and Prader-Willi Syndrome. We had a large number of referrals from developmental paediatricians, commonly wanting to exclude OSA as a cause of behavioural symptoms. The prevalence of OSA diagnosed on PSG was less than 30%. It does not appear that PSG results unnecessarily influence decisions regarding future adeno-tonsillectomy, as children with normal sleep studies or insufficient information obtained from PSG had surgery regardless. Improved communication with ENT surgeons and clarification of indications for PSG and/or adeno-tonsillectomy may reduce the number of PSG performed which do not influence management. Sleep physicians should continue to raise awareness of sleep problems in children with syndromes and chromosomal disorders.

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COMPARISON OF OXYGEN DESATURATION INDEX (ODI) AND APNEOA HYPOPNOEA INDEX (AHI) IN LABORATORY POLYSOMNOGRAPHY (PSG) TO PREDICT UTILITY OF NOCTURNAL PULSE OXIMETRY
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Introduction: There is a growing need for simplified, easily accessible, inexpensive and reliable diagnostic modality outside of the laboratory setting to address the increasing prevalence and burden of obstructive sleep apnoea-hypopnoea (OSAH). We compared ODI and AHI in laboratory PSG to assess the utility of nocturnal pulse oximetry in the diagnosis of OSAH.

Methods: 906 consecutive overnight PSG for patients at risk of OSAH referred to a tertiary accredited sleep laboratory from January 2012 to April 2013 were included in this study. Data collected were time in bed with lights out (TIB), number of arterial oxygen desaturations (SpO2 ≥ 3% in sleep time and AHI. ODI was calculated as the number of ≥3% oxygen desaturations divided by TIB to reflect the measurement that would be obtained in a simplified monitor in the absence of a measurement of sleep time. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) at various ODI cut off points were calculated against AHI ≥ 30 (moderate-severe OSAH) and receiver operating curves were constructed.

Results: Using AHI as gold standard, ODI ≥ 16 showed a sensitivity of 0.90, specificity of 0.89, PPV of 0.80 and NPV of 0.95 against AHI ≥ 30. 10 false negative (ODI ≤ 16, AHI ≥ 30) and 14 false positive (ODI ≥ 16, AH < 30) studies were identified.

Discussion: This study shows that ODI ≥16 provides optimal sensitivity and specificity in screening for an at risk population of OSAH and can be replicated in home studies. ODI ≥16 has also been similarly validated in an earlier study (Chai-Coetzer CL et al. Thorax 2011). False negative results were mainly due to reduced sleep time (<3 hours on PSG). False positive results were mainly due to reduced REM sleep (<12.77 mean % TST), absence of supine sleep and periodic limb movements.

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IMPACT OF SCORING CRITERIA ON SEVERITY OF SLEEP DISORDERED BREATHING
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Background: Changes to scoring guidelines for apneas and hypopneas have been made in the latest AASM guidelines 2012.

Objectives: To investigate the impact of proposed changes in scoring respiratory events on the diagnostic outcomes and classification of Obstructive Sleep Apnea.

Methods: 56 sleep studies were independently scored using the 2007 AASM recommended guidelines and then the 2012 guidelines. The AHI and subsequent classification of the severity of OSA were then compared.
Results:

<table>
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<tr>
<th>Parameter</th>
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<th>Acceptable</th>
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<td>TST (min)</td>
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<td>308 ± 12.3</td>
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<td>Sleep latency (min)</td>
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<td>Sleep efficiency (%)</td>
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<td>N1%</td>
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<td>14.5 ± 1.8</td>
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<td>N2%</td>
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<td>48.9 ± 2.1</td>
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<td>N3%</td>
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<td>19.0 ± 1.7</td>
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<tr>
<td>R%</td>
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<td>18.0 ± 1.4</td>
<td>-0.9 ± 1.4</td>
<td>0.531</td>
</tr>
<tr>
<td>Arousal Index (hr)</td>
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<td>25.4 ± 2.2</td>
<td>-1.1 ± 1.8</td>
<td>0.531</td>
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<td>Interscorer reliability</td>
<td>0.74 ± 0.02</td>
<td>0.61 ± 0.05</td>
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<tr>
<td>Intrascorer reliability</td>
<td>0.75 ± 0.03</td>
<td>0.75 ± 0.02</td>
<td>-0.02 ± 0.03</td>
<td>0.950</td>
</tr>
</tbody>
</table>

Discussion: Overall there was very little difference between the two EEG montages in terms of sleep staging and EEG arousal scoring however the difference in interscorer reliability indicates the recommended EEG montage is the preferred option.

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THE IMPACT OF THE NEW AASM RESPIRATORY SCORING RULES IN PAEDIATRICS

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Introduction: The 2007 American Academy of Sleep Medicine (AASM) scoring guidelines and the 2011 ASTA/ASA addendum had key differences from old scoring systems including: absolute requirement for drop in airflow of >50% for hypopnoea under AASM rather than a “discernible decrease”; the addition of respiratory event related arousals (RERAs), events with less decrease in airflow that are omitted from the AASM obstructive apnoea hypopnoea index (OAHI); only cortical arousals ≥3 s are scored in association with a hypopnoea rather than sub-cortical arousals as previously. This study aimed to assess the magnitude of the impact of these changes in scoring guidelines.

Methods: Full in-lab PSG carried out prior to the change in scoring rules on 42 children (mean age 4.3 y, range 3.1–5.9 y, 16 female) were re-scored by a single scorer using the new rules. Respiratory indices were compared using paired Student’s t tests: old OAHI, the previous index using old rules. AASM OAHI, following the 2007 rules; and ORDI (obstructive respiratory disturbance index), the AASM OAHI plus RERAs (ASA/ASTA addendum compliant). OAHI severity was classified using each index into: primary snoring (PS): ≤1 event/h; mild OSA: >1–<5/h; moderate OSA: ≥5 and <10/h; severe OSA: ≥10/h.

Results: The AASM OAHI was significantly lower than the old OAHI (1.5/h vs 3.3/h, p = 0.006). OAHI severity was also lower, with 10 children (24%) being re-classified under the new rules: 3 from mild OSA to PS, 1 from moderate OSA to PS, 2 from moderate to mild OSA, 1 from severe to mild OSA and 3 from severe to moderate OSA. No difference was found between old OAHI and ORDI (3.3/h vs 3.0/h, p = 0.15). Using these indices to define severity, 3 children (7%) were reclassified: 2 from mild OSA to PS and one from PS to mild OSA. Clinically insignificant differences were seen between scoring guidelines for %respiratory arousals (22% vs 20%, p = 0.01), average SpO2 drop with events (3.4 ± 3.3, p = 0.03) and average pCO2 during sleep (44.6 ± 44.3 mmHg, p = 0.05).

Conclusion: The new AASM rules lead to under-scoring of events and OAHI severity compared to the previous rules. When RERAs are included in the index (ORDI), indices and severity of OSA were comparable. Given that morbidity has been demonstrated even in mild OSA in children, it makes little sense to raise the bar for diagnosis even higher.

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THE NEW AASM RESPIRATORY SCORING CRITERIA INCREASES THE APNOEA-HYPOPNOEA INDEX

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Introduction: The American Academy of Sleep Medicine released an update of the respiratory event scoring rules in October 2012. One of
the changes associated with this update was the hypopnoea scoring rules. The new AASM hypopnoea rule requires a 30% or greater decrease in flow amplitude with an associated 3% or greater SpO2 desaturations or an associated EEG arousal. The implications of this rule change have so far been unexplored.

Method: In this retrospective study thirty consecutive diagnostic polysomnograms (PSG) were utilised to examine the impact of the new AASM respiratory scoring criteria against previous scoring criteria. All subjects undertook a diagnostic PSG for the clinical suspicion of obstructive sleep apnoea (OSA). Subjects were excluded if there was suspicion of sleep hypventilation or any other sleep disorder. PSGs were de-identified and rescored according to the "Chicago criteria"; the 2007 AASM criteria with hypopnoea “A” rule (AASM A) the 2007 AASM criteria with hypopnoea “B” rule (AASM B), and the new updated AASM rule (New AASM). A p < 0.05 was considered significant. Subjects were mostly male (M : F 18:12), middle-aged (52 ± 3 years), obese (32.4 ± 3.2 kg/m2) and quite somnolent (ESS 13.3 ± 2.8).

Results: Subjects sleep was characterised as fragmented (Sleep efficiency 48.3 ± 2.1%) with increased proportions of N1 sleep (22.5 ± 2.7% of TST) and decreased proportions of N3 sleep (8.7 ± 1.4% of TST).

Discussion: Bland-Altman analysis of total AHI between AASM B (utilised by most Australasian Sleep Laboratories) and the new AASM reveal a bias of −4.5 ± 4.1* and an increased AHI of patients undergoing diagnostic PSG. This would likely increase the number of patients diagnosed with OSA as well as increase in the AHI of patients undergoing diagnostic PSG. This would likely increase the number of patients diagnosed with OSA as well as increasing the severity of those patients already diagnosed.

141 HOW HEALTHY WOMEN SLEEP IN LATE PREGNANCY; A VIDEO AND PORTABLE POLYSOMNOGRAPHY STUDY
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Introduction: The importance of maternal sleep in pregnancy has been inferred in previous stillbirth studies [1]. The purpose of this study was to 1) test patient recall and validate questionnaires on sleep in pregnancy, and 2) describe sleep patterns and physiology in normal late pregnancy, with particular reference to maternal position.

Methods: Women in late pregnancy (35–38 weeks gestation) underwent a L3 polysomnography (PSG) home assessment with infrared video and maternal-fetal heart rate (HR) monitoring. A researcher administered a brief sleep questionnaire the next morning.

Results: Data analysis has been completed on 13 participants. A complete data set (n = 30) will be presented, including fetal HR data. Unless otherwise stated, results are presented as median ± IQR. Most participants (10/13) accurately recalled position at sleep onset and, to a lesser degree, on waking (8/13). The number of times out of bed was very similar between self recall and video (mean difference 0.15 ± 0.07, range 1–3). Participants’ qualitative assessment of position changes over the night corresponded to the number recorded by video. All participants had an apnoea-hypopnoea index (AHI, 0.25 ± 0.4/hr) and BMI (28.9 ± 5.8) within the normal range, except one with a high BMI (42.0). This participant also demonstrated risk factors for stillbirth, including supine position at sleep onset and awakening and no position changes [1], in addition to observed flow restrictions, snoring and slightly increased AHI and ODI (3.9 and 15.6, respectively).

Discussion: Participants accurately recalled their position at sleep onset and at awakening, and the frequency of awakenings and position changes, these being aspects of sleep in late pregnancy deemed important by previous stillbirth studies [1]. Researchers can be confident of patient recall of these variables in late pregnancy. PSG data suggested that some women in normal pregnancy exhibit interesting responses to sleep, consistent with those previously related to stillbirth [1]. The response to these maternal observations will be presented with the full data set, including the fetal response to prolonged maternal supine position and high ODI.


ACTIGRAPHY ASSESSMENT OF MOTHERS’ SLEEP AT 6, 12 AND 18 WEEKS POSTPARTUM
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Introduction: Mothers’ sleep during the postpartum period is commonly characterised by bouts of sleep across the night, resulting in low sleep efficiency and daytime sleepiness. Understanding of the nature of mothers’ sleep disruption needs to incorporate indices of both sleep quantity and sleep quality, but objective assessment of sleep disturbance experienced during the first postpartum months has not been investigated in great detail. This longitudinal study aimed to objectively measure mothers’ sleep during the first 18 weeks postpartum, to ascertain the level of sleep disturbance experienced.

Method: Eleven mothers (Mean age = 29.82, SD = 4.45) from Australia wore Actiwatch-2 devices for up to 7 days and nights at 6, 12 and 18 weeks postpartum. For each night of recording, a number of sleep bouts were identified. Total sleep time (TST) was calculated as the total number of minutes across the night within these bouts. Sleep efficiency was calculated as the percentage of minutes across the night classified as being part of a sleep bout, with higher scores indicating higher efficiency. Sleep quality captured the efficiency of sleep within sleep bouts, and was calculated as the percentage of epochs classified as sleep within sleep bouts, with higher scores indicating higher sleep quality.

Results: At 6 weeks postpartum, mean total sleep time was 420.22 minutes (SD = 50.61). Total sleep time did not significantly differ across the assessment; however there was a trend towards an increase over time. Sleep efficiency increased across the time periods (F2,20 = 10.30, p = 0.001), with a significant increase between week 12 and week 18. At 6 weeks postpartum, mean sleep quality was 93.15% (SD = 2.68) and scores did not significantly change across the assessment periods. While there was no relationship between sleep efficiency and sleep quality during weeks 6 and 12, a significant positive relationship was observed at week 18, r² = .52, p = .013.

Conclusions: Within this sample, a low level of disruption was consistently shown within the mothers’ night time sleep bouts. However, overall sleep efficiency suggested a significant proportion of time spent awake between sleep bouts. While TST remained stable over time,
overall sleep efficiency improved, suggesting the mothers’ sleep was becoming more consolidated. A single sleep bout a night was not often experienced.

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ACOUSTIC BACKGROUND LEVELS IN SLEEP LABORATORY BEDROOMS: SHOULD THERE BE A STANDARD?

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Introduction: The Standard for Sleep Disorders Services (ISO 15189:2007), ASA/TSANZ Guidelines for Sleep Studies in Adults (2005), AASM Manual for Scoring of Sleep and Associated Events (2007) and the ASTA/ASA Commentary on the AASM Manual for the Scoring of Sleep and Associated Events (2010), all nominate broad technical specifications for snore sound recording purposes. However, all are silent on quantitative acoustic environment standards for sleep investigation facilities. This is surprising, since background noise has the potential to both disturb and/or prevent sleep and to seriously compromise acquisition of quantitative acoustic data (e.g. snoring recordings). The aim of the present study was to: 1) quantify background sound levels for one sleep laboratory facility, and 2) compare outcomes with established industry standards for other broadly comparable purpose-built sleeping environments, such as hotel bedrooms.

Methods: In a retrospective study, we analysed 15 minutes of sound level data (dBA; recorded in the lights out to sleep onset period) extracted from the digital records of 10 randomly selected routine diagnostic polysomnography studies, all performed at the Westmead Sleep Investigation and Research Centre (WSIRC) over a one-month period. Sound level recordings originated from 5 separate bedrooms and were measured using an in-room sound level meter (NL-20; Rion, Japan). Data were expressed as minimum dBA, maximum dBA and equivalent continuous sound pressure level (LAEq; 15 min average).

Results: Minimum sound background levels ranged from 28 to 37 dBA, with maximum values of 47 to 79 dBA. LAEq values ranged from 34 to 47 dBA; exceeding the AS/NZS 2107:2000 standard considered “satisfactory” (30 dBA) for hotel bedrooms in all studies and the “maximum” (35 dBA) level in 7 of 10 studies.

Conclusions: Background noise levels at WSIRC frequently exceed levels required of hotel bedrooms. Our data suggest that an acoustic environment standard is required to ensure sleep laboratory environments are optimised for sleep and to promote the acquisition of high quality, quantitative, acoustic data for clinical and research purposes.

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EXTENDED RECORDING OXYGEN SATURATION PROFILES IN HEALTHY INFANTS AGED 1 TO 24 MONTHS

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Aim: Existing reference ranges for oxygen saturation on pulse oximetry (SpO2) in infants provide summary statistics, which fail to capture clinically relevant trends and fluctuations which may provide characteristic information about the state of disease. In this study we aim to present reference SpO2 values of healthy term infants, using cumulative distribution function plots as previously proposed and performed in healthy pre-term infants (Harigopal S and others, Oxygen saturation profile in healthy preterm infants. Arch. Dis Child. Fetal Neonatal Ed. 2011; 96(5)).

Methods: A prospective cohort of 34 healthy infants underwent full overnight polysomnography with extended oximetry recording (Masimo Radical 7) at 2 weeks, 3, 6, 12 and 24 months of age. SpO2 cumulative distribution function (CDF) nomogram curves were generated for each study age, and these curves compared with previously published data in healthy pre-term infants.

Results: SpO2 CDF nomogram curves shift right by 1% between 2 weeks and 3 months, and did not vary between REM and non-REM sleep. There was a clear difference in nomograms generated for term infants compared with previously published healthy pre-term infants at two weeks gestational corrected age.

Discussion: The SpO2 CDF is a more comprehensive indication of an extended oximetry recording than conventional summary statistics. CDF nomograms provide a convenient and intuitive way of evaluating whether an individual’s nocturnal SpO2 distribution falls within the range of healthy age-matched infants.
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BEDSIDE RECORDING OF CARDIORESPIRATORY VARIABLES AT 36 WEEKS GESTATION OF PRETERM INFANTS: SCREENING TOOL FOR CHRONIC NEONATAL LUNG DISEASE

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Introduction: Significant advances in neonatal care have improved survival in preterm infants. However chronic neonatal lung disease (CNLD) continues to be a significant problem. There is very limited data in literature describing the cardiorespiratory variables at 35–36 weeks of infants who are born preterm.

Aim: To collect sleep pattern and normative cardiorespiratory data in preterm infants born under 31 week's gestation at corrected gestation of 35–36 weeks using a bedside limited channel polysomnography.

Methods: Using an in-house polysomnography system prospective data on respiratory effort using effort bands, pulse oximetry, actigraphy and visual scoring of sleep using video camera were collected in a cohort of preterm infants under 31 weeks gestation over a 6–10 hour period continuously. The respiratory effort was collected by respiratory inductance plethysmography and data analysed using Labchart software. Significant respiratory events – the central apnoeas were scored and central apnoea index was derived. The respiratory rate was also derived using the Labchart software. We are presenting heart rate, oxyhaemoglobin saturation and respiratory rate profile on 49 preterm infants.

Results: The mean heart rate with 5,95th centiles was 158 (130–186). The mean oxyhaemoglobin saturation with 5, 95th centiles was 95.3 (87.0–99.0). The lowest respiratory rate had significant variability between awake and sleep with the range between 32–100/min. The average respiratory rate was in the 50 s for this group of infants. Cumulative frequency curves constructed with the heart rate and oxygen saturations data provides us with reference ranges for this specific group of preterm infants.

Conclusion: The description of reference ranges for cardiorespiratory variables has provided us with objective data in management of CNLD infants and ascertaining home oxygen requirement. The ease of administration at bedside provides us with a simple feasible test that could be used in neonatal units as screening before discharge and enables us to indentify infants at risk or borderline for CNLD.

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COMBINING MULTIPLE ACTIGRAPH PLACEMENTS FOR SLEEP ASSESSMENT IN CHILDREN

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Introduction: Non-invasively measuring sleep and wakefulness is integral to monitoring sleep-breathing disorders outside of a specialised hospital setting. While actigraphy appears ideal for this application, there are known limitations that significantly impact its utility. In particular, actigraphy is currently unable to accurately detect wake after sleep onset. This may be due to the techniques that are currently employed to both capture and represent movements during sleep. Commercial sleep actigraphy systems are conventionally placed on the wrist. However, it is likely that movements corresponding to wake and sleep may manifest in different parts of the body, depending on an individual's sleeping posture. As such, this study aims to determine whether combining information from multiple accelerometer locations improves actigraphy performance.

Method: Twenty-two participants (18 male) aged 6–16 years (median: 9) with suspected sleep disordered breathing underwent a full overnight polysomnogram with simultaneous recording of motion from the left wrist and index finger, chest and left ankle and great toe using a novel continuous multi-site accelerometry system (CMAS). Movement from each location was quantified using several algorithms and the ability to detect sleep and wakefulness on a 30 second epoch-by-epoch basis (as defined by the polysomnogram) was compared. Sleep and wake stages were derived for combinations of algorithms and locations using quadratic discriminant analysis.

Results: Combining the wrist and ankle, and finger and ankle placements improved the sensitivity when compared to the conventional wrist placement (sensitivity: 64.4(8.4) % and 63.9(8.8) % respectively vs. 58.6(9.4) % at 80% specificity; and AUC: 84.8(2) % and 85.5(1.5) % respectively vs. 83(2.1) %).

Discussion: While combining the ankle placement with either the finger or wrist placements added valuable information relating to movement during sleep, combining with the chest or toe placements did not. This suggests that movements during sleep do indeed manifest in specific parts of the body. In particular, the combined finger and ankle locations gave the greatest discrimination.

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AUTOMATED INFANT SLEEP APNOEA DETECTION: A MULTI-MODAL APPROACH

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Introduction: In order to aid the early diagnosis of sleep apnoea hypopnea syndrome in infants, we present a study into the usage of minimally-invasive sensors, specifically electrocardiogram (ECG) and pulse oximetry recordings, as a means of automatically detecting and classifying sleep apnoea events in infants.

Method: An existing dataset of 408 overnight polysomnogram recordings was used to train and test the classifier. The study was limited to infants and young children, and included both healthy patients and subjects with pre-existing conditions. Pulse oximetry data and the raw ECG signals were extracted from each recording and time-aligned to 30 second epochs. Due to the noisy nature of the data, containing both sensor noise and periods of infant movement and parental interference, a comprehensive artefact removal stage was implemented and complemented by manual filtering based analysis of the comments and mark-up on the recordings.

Results: Features were extracted from both the ECG and the pulse-oximetry data and were then used alongside the scored arousal information to train a classification model based on linear discriminants. Performance of the classifier was evaluated using a leave-one-out cross-validation scheme and accuracy for detection of apnoea events of 68% was achieved, with a specificity of 68.6% and a sensitivity of 55.9%.
TRADITIONAL CHINESE MEDICINE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNOEA
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Introduction: A previous trial has demonstrated that acupuncture reduced the severity of Obstructive Sleep Apnoea (OSA). The same treatment was applied to all patients regardless of their Traditional Chinese Medicine (TCM) diagnosis and despite overall improvement across the group, several patients showed no improvement. There have been 4 TCM disease mechanisms suggested to underlie OSA identified in several case studies reported in China. This study aimed to identify the most common TCM pattern shown by OSA patients in an Australian sleep laboratory.

Method: Forty (40) patients undergoing polysomnographic (PSG) investigation for OSA were given a TCM diagnosis, based on presenting symptoms, and tongue and pulse characteristics, immediately prior to their PSG

Results: It was predicted that patients diagnosed with OSA through PSG investigation would be diagnosed with one of the proposed TCM patterns. Results showed that Spleen-Qi Deficiency with Phlegm-Dampness appeared concurrently with Liver-Lung Fire in 41.03% of cases, and concurrently with Yin-Deficiency-Fire in 17.95% of cases.

Discussion: Other combinations of the 4 TCM patterns were rare, as were cases with a single pattern diagnosis. The identification of these patterns suggests that in order for acupuncture treatment to be more clearly supported as an effective treatment for OSA, treatment protocols need to address the specific TCM patterns. A clinical trial of acupuncture treatment for OSA, designed to address the most common TCM disease pattern identified by the present study, is currently underway.

AN NIV LULLABY: A SLEEP NURSE’S PERSPECTIVE OF NON-INVASIVE VENTILATION IN PATIENTS WITH CYSTIC FIBROSIS
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Introduction: Cystic fibrosis (CF) is a recessive genetic disease that affects many organs, including skin, the digestive system and the lungs. Respiratory failure is responsible for the majority of symptom burden and ultimately death. Lung transplantation offers the hope of extended and improved quality of life.

Methods: Our centre cares for about 300 adult patients with Cystic Fibrosis (CF). This paper outlines the role of expert sleep nurses in assisting management of CF patients in the inpatient and outpatient setting. Non-invasive ventilation (NIV) is used for patients with CF at our centre in many ways including as an aid to physiotherapy, for acute respiratory failure, to optimise sleep and as a bridge to lung transplantation.

Discussion: Although NIV is usually initiated by physiotherapists or medical staff, experienced registered nurses from the Sleep Disorders Centre are asked to assist inpatients with exacerbations of CF and those awaiting lung transplantation. NIV is used during activities such as physiotherapy to assist airway clearance, and during and after exercise to increase exercise tolerance. Domiciliary NIV is also used to assist ventilation during rest and sleep as it decreases the work of breathing and decreases carbon dioxide retention. Domiciliary NIV may improve quality of life in those patients with prominent symptoms related to respiratory failure and can improve sleep quality. This is the subject of a separate abstract from our group which reviews outcomes of a cohort of 16 patients.

Results: Sleep nurses, in coordination with the patient, their family, treating physiotherapists and the medical team, assist with management NIV therapy. These include mask choice to ensure best fit, comfort and seal of selected masks; prevention and treatment of pressure injuries from masks; education; long term inpatient use and preparation for home NIV use. At our centre, the expertise of experienced sleep nurses assists in the management of patients with CF using NIV both during inpatient admission and in the outpatient setting.

A PILOT STUDY OF A NOVEL TONGUE RETAINER DEVICE FOR OBSTRUCTIVE SLEEP APNOEA (OSA)
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Introduction: The Tongue Retainer Device (TRD) is a novel oral appliance designed to treat OSA by holding the tongue forward during sleep. This study investigated the efficacy, safety and tolerability of the TRD.

Methods: Patients were selected for apnoea-hypopnoea index (AHI) ≥ 10 ≤ 60/hr, minimum oxygen saturation > 75%; and ability to tolerate the TRD for ≥4 hours for two consecutive days during a five day acclimation period. Patients completed the Epworth Sleepiness Scale (ESS) and the Functional Outcome of Sleep Questionnaire (FOSQ-10) prior to four weeks of treatment. Compliance and side effects were assessed through a daily diary. Patients underwent an end of treatment polysomnography (PSG) with the TRD, and the ESS and FOSQ-10 were repeated. Response to treatment was defined as: complete (AHI < 5/hr) or partial (>50% reduction in AHI and AHI > 5/hr).

Results: Twenty patients were screened. Ten patients completed the trial (8 males, 2 females), with mean baseline AHI of 24.31 ± 10.81/hr, mean age of 51.20 ± 11.22, and mean body mass index of 24.38 ± 4.47 kg/m2. AHI on treatment did not significantly differ from baseline (24 ± 17/hr to 15 ± 13/hr, p > 0.05). Reduction in AHI was observed in 6 patients and a treatment response was achieved in 4 patients. Of these, 2 patients achieved complete response and 2 patients achieved partial response. There was no significant change in ESS (11 ± 6 to 8 ± 6, p > 0.05) or FOSQ-10 (14 ± 3.02 to 15.72 ± 3.06, p > 0.05). An average of 3 device side effects occurred per patient with mild oral discomfort most commonly reported (7 of 10 patients). The average usage was 5.2 hours per night.

Conclusion: This study showed AHI reduction in 60% of patients and a therapeutic outcome in 40% of patients. Further work is required to enhance device tolerance and efficacy, and to identify patient phenotypes associated with therapeutic treatment outcomes.
DIFFERENTIATING NARCOLEPSY PHENOTYPES: MANAGEMENT IMPLICATIONS
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Introduction: Narcolepsy is an uncommon but important hypersomnia that has profound impact on an individual's quality of life. It is often categorized into two subtypes: (i) narcolepsy with cataplexy and (ii) narcolepsy without cataplexy. In addition, it is well established from previous studies that Cerebrospinal (CSF) hypocretin levels (Orexin) are often lower (< 110 pg/ml) in the cataplexy type compared to individuals without cataplexy suggesting a different underlying pathophysiology. This study examines if these differences in clinical classification and CSF hypocretin levels translates into differences in other objective and commonly measured parameters including Epworth Sleep Scale (ESS), multiple sleep latency test (MSLT), doses of commonly prescribed wake promoting agents (WPA) and demographics (Age, Gender).

Methods: This was a retrospective study of the case records from a sleep clinic. All individuals with a diagnosis of narcolepsy according to ICSD-2 criteria were identified. Data including age, gender, narcolepsy subtype, ESS, MSLT, WPA, WPA dose and comorbidities (sleep apnoea, restless leg syndrome, parasomnia) were recorded.

Results: A total of 97 subjects with narcolepsy were identified (33 with cataplexy and 64 without cataplexy). The median age was not statistically different (35.8 y with cataplexy vs. 34.4 y without cataplexy; p = 0.59). The ESS (16.25 with cataplexy vs. 14.89; p = 0.47) and MSLT (6.25 m with cataplexy vs. 6.48 m; p = 0.86) were similar in both groups. Of note, the cataplexy group were more often prescribed modafinil (66.67% vs. 46.9%) and had higher mean dosage prescribed (338.64 mg with cataplexy versus 260.19 mg; p = 0.04). There was higher prescription rates of dexamphetamine for patients with narcolepsy without cataplexy (39.06% vs. 24.24% with cataplexy) however dosage range was similar (26.25 mg vs. 25 mg with cataplexy; p = 0.84).

Discussion: This study shows that the two phenotypic types of narcolepsy are similar in terms of clinical presentation and screening/diagnostic tests of ESS and MSLT. In our clinical practice, patients with narcolepsy and cataplexy were more often prescribed modafinil and dosage was higher.
increased with time. The time from bilevel study to primary endpoint (death, transplant or cessation) was 203 days (SD = 183 days). There was no change in the average length of stay after initiating bilevel 17 days vs 16 days (p = NS).

Discussion: Bilevel PAP in CF is well tolerated in patients with very severe lung disease and established respiratory failure. Bilevel PAP did not change blood gas parameters in a single night and did not affect length of stay. Future research into benefits of earlier treatment and assessment of quality of life data are suggested.

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PREVALENCE OF, AND ASSOCIATIONS WITH, PERSISTENT HYPERCAPNIA DESPITE TREATMENT WITH NON-INVASIVE VENTILATION IN OBESITY HYPOVENTILATION SYNDROME

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Introduction: Obesity hypoventilation syndrome (OHS) is the most common indication for treatment with non-invasive ventilation (NIV) in New Zealand. Despite widespread use there is no clear consensus between centres (NOVANZs) and a paucity of guidelines outlining treatment goals especially with regard to normalisation of PCO2. We sought to quantify the proportion of our OHS population on NIV that had persistent hypercapnia and looked for factors that could explain this.

Method: Retrospective review of database of patients receiving NIV for OHS. Patient demographics, ethnicity, diagnosis, spirometry, ventilator pressures and average usage were compared with arterial blood gas (ABG) values when stable on treatment.

Results: The database contained 144 patients. 101 had a predominant diagnosis of OHS. Of these 40 had complete ABG and spirometry results. Of those 22 had a normal PCO2 (45 mmHg or lower) and 18 had a PCO2 of greater than 45 mmHg. With respect to the normal and abnormal PCO2 groups there were significant differences in pH, PCO2, PO2 and HCO3 as would be expected. There were no significant differences in age, BMI, IPAP, EPAP, ventilator usage, FEV1 or FEV1/FVC ratio. Those in the abnormal PCO2 group were more likely to have an additional respiratory diagnosis attached, predominantly obstructive airways disease.

<table>
<thead>
<tr>
<th>BMI</th>
<th>FEV1 %pred</th>
<th>FEV1/FVC</th>
<th>Usage (mins)</th>
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<td>46.51</td>
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<tr>
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<td>0.095</td>
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</tr>
</tbody>
</table>

Discussion: This study has shown that a significant proportion of our patients with OHS remain hypercapnic despite treatment with NIV. It does not appear to be linked to BMI, spirometric indices or ventilator usage. However, there were trends in all these variables and it could be that in combination they make persistent hypercapnia more likely. It was also noted that the persistently hypercapnic patients were more likely to have a physician diagnosis of obstructive airways disease. This may result in a further increase in the work of breathing over and above that of obesity alone and serve to promote hypercapnia.
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EVALUATION OF THE APNEA-HYPOPNEA INDEX DETERMINED BY THE AUTOSET CS, ADAPTIVE-SERVO VENTILATION DEVICE, IN HEART FAILURE PATIENTS WITH SLEEP DISORDERED BREATHING

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Introduction: Adaptive servo ventilation (ASV) is an effective treatment for sleep disordered breathing (SDB) in patients with heart failure (HF). In general, ASV devices provide information about residual respiratory events while on ASV. However, there are not data regarding evaluation of the apnea-hypopnea index (AHI) determined by the AutoSet CS (ACS), an ASV device to the AHI derived by polysomnography (PSG) in HF patients with SDB.

Methods: Consecutive patients with SDB who were titrated on ASV were included. The correlation between the AHI determined by manual scoring on polysomnography (AHI-P) and by ASV (AHI-ASC) during an overnight polysomnography on CPAP was assessed.

Results: Thirty HF patients with SDB (67% male, 68.8 ± 15.4 years) were enrolled. The mean AHI on the diagnostic study was 34 ± 19.3 events/hour including both obstructive and central events. During the titration, this device markedly suppressed the respiratory events (AHI-ASC 4.1 ± 4.2 events/hour). On the other hand, the AHI-ASC was 11.6 ± 7.1 events/hour. There was only a weak correlation between the AHI-P and the AHI-ASC (r = 0.36, p = 0.04). Brant-Altman plot indicates that ACS generally overestimated AHI (mean AHI difference, −7.3) and the limit of agreement ranged from −21.2 to 6.2.

Discussion: There was a modest correlation between the AHI-P and the AHI-ACS. Such discrepancy may be explained by the central respiratory events during wakefulness or by attenuations of flow signal amplitude without either arousal or desaturation, which were often observed in patients with HF. Nevertheless, clinicians may take such discrepancy into account when they assess residual AHI while on ASV.

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ASSESSMENT OF TRAINEE CONFIDENCE IN CONTEMPORARY ADULT SLEEP SURGERY

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Introduction: We invited latter year trainees of the Australian Society of Otolaryngology Head and Neck Surgery (ASOHNS) program to participate in a questionnaire, comprising 9 Likert scale questions and 3 sleep disordered breathing clinical scenarios pertaining to adult patients (age > 18 years old). The questionnaire is designed to assess trainees’ level of confidence in assessment of patients with snoring/OSA presentations. The aim of the questionnaire is to identify whether the current level of training for ASOHNS trainees is sufficient for competency in the appropriate surgical management of patients with snoring/OSA. In creating this questionnaire, we wish to test the hypothesis that ENT surgeons in training in Australia receive adequate training in sleep medicine and sleep surgery.

Methods: The questionnaire was emailed to ASOHNS trainees in years 4 and 5 of training and recent fellows of ASOHNS. The questionnaire was distributed to this population at the annual ENT registrars conference in July.

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AN EXPIRATORY POSITIVE AIRWAY PRESSURE VALVE APPLIED NASALLY (PROVENT™) IMPROVES POLYSOMNOGRAPHIC INDICES OF OBSTRUCTIVE SLEEP APNOEA SEVERITY IN A CLINICAL PRACTICE CASE SERIES

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Introduction: Expiratory Positive Airway Pressure (EPAP) valves have been used to treat mild to moderate obstructive sleep apnoea (OSA) as a treatment approach. However, there is little information regarding the effectiveness of EPAP in the clinical practice setting.

Methods: Patients who were offered EPAP (Provent™) as first line treatment for mild to moderate obstructive sleep apnoea (OSA) or as an alternative treatment in severe OSA who failed/refused CPAP were included. Following a 10 day minimum home trial, patients who tolerated the device were invited to confirm efficacy with PSG.

Results:

<table>
<thead>
<tr>
<th></th>
<th>Baseline PSG</th>
<th>EPAP PSG</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI</td>
<td>32 ± 5</td>
<td>9 ± 6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Lateral NREM AHI</td>
<td>18 ± 5</td>
<td>4 ± 7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Supine NREM AHI</td>
<td>43 ± 3</td>
<td>14 ± 5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Lateral REM AHI</td>
<td>25 ± 4</td>
<td>5 ± 8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Supine REM AHI</td>
<td>39 ± 3</td>
<td>18 ± 4</td>
<td>0.06</td>
</tr>
<tr>
<td>ODI 3%</td>
<td>10 ± 6</td>
<td>7 ± 6</td>
<td>NS</td>
</tr>
<tr>
<td>ESS</td>
<td>7 ± 10</td>
<td>6 ± 11</td>
<td>NS</td>
</tr>
</tbody>
</table>

Conclusion: EPAP showed a significant reduction in AHI, most effective for lateral sleep and least for supine REM. We failed to show a significant improvement in ODI or ESS. The reasons for the improvement in AHI, but not ODI require further exploration. Options include nasal EPAP being preferentially effective for mild obstructive events, or due to the inability of the custom fitted nasal recording cannula to accurately measure nasal airflow.

References
PTERYGOMANDIBULAR RAPHE ASSESSMENT ON MRI AND RELATIONSHIP TO MAS TREATMENT OUTCOME IN OSA
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Introduction: Mandibular Advancement Splints (MAS) increase upper airway size, particularly in the lateral dimension of the velopharyngeal region. Dynamic magnetic resonance imaging (MRI) investigation has shown mandibular advancement (MA) produces lateral airway expansion via a direct connection between the lateral walls and mandibular ramus. A prime candidate for this tissue connector is the pterygomandibular raphe (PmR), an aponeurotic structure joining the buccinator and superior pharyngeal constrictor muscles and absent in 36% of people. We hypothesised that absence of the PmR component of these pharyngeal muscles may alter lateral wall movement with MA and could relate to a failure to respond to MAS treatment. We aimed to assess velopharyngeal MRI scans for presence/absence of PmR in OSA patients to compare with known MAS treatment response.

Method: This was a retrospective analysis of MRI data of 69 OSA patients with MAS treatment outcome confirmed by polysomnography. T1-weighted axial images (3 mm slice thickness) of the velopharyngeal region were viewed to assess tissue appearance between the lateral walls and mandibular ramus as being continuous (no PmR) or having a more defined structure suggestive of a fascial component (PmR). Two observers independently graded each scan for PmR presence/absence blind to treatment outcome. Agreement between observers was assessed (Kappa measure of agreement). Categorical PmR presence/absence scores were compared between MAS Responders (MAS AHI < 10 hr⁻¹) and Non-responders (≥10 hr⁻¹) by Chi-square test.

Results: Overall observers agreed on classification in 68% of cases, with agreement on positive observations 76% and negative observations 54%. Cohen’s Kappa was 0.31 (fair). There was no significant relationship between PmR and MAS response (Chi-square = 2.4, p = 0.12). There was a non-significant trend for positive PmR observation to occur 20% more in responders.

Conclusion: MRI appearance of the PmR is not well described and assessment on 3 mm axial slices showed fair agreement between observers. A relationship between PmR and MAS treatment could not be confirmed, although inadequate imaging and potential under-powering may be an issue. However results suggest a weak signal for absence of PmR to occur more often in Non-responders, which may justify exploration with improved imaging in future studies.

ANATOMICAL BALANCE ASSESSED BY THREE-DIMENSIONAL IMAGING IN OSA PATIENTS WITH MANDIBULAR ADVANCEMENT SPLINT TREATMENT
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Introduction: Upper airway collapsibility may result from increased intraluminal tissue pressures resulting from an imbalance between the volume of soft tissue surrounding the airway and craniofacial bony enclosure size. Mandibular advancement splint (MAS) treatment acts to increase the upper airway volume by effectively increasing the size of the bony lower face enclosure. We hypothesised OSA patients with anatomical imbalance (more soft tissue for a given bony enclosure size) may not respond to MAS therapy as mandibular advancement would be insufficient to overcome the excess tissue. We aimed to assess 1) whether anatomical balance (ratio of upper airway soft tissue to bony enclosure volume) differs between MAS responders and non-responders and 2) whether the alteration in this ratio with MAS was related to treatment outcome.

Method: 69 OSA patients had magnetic resonance imaging of the upper airway without and with MAS in situ. Image analysis was performed to obtain upper airway soft tissue (ST) volume (tongue, soft palate, parapharyngeal fat pads and lateral walls). A maxillomandibular enclosure volume (MEV1) was calculated from 3D coordinates of bony landmarks of the mandible (bilateral condyle and gonion and menton) and the anterior nasal spine. A second volume (MEV2) was calculated to assess changes with MAS with lateral width set by maxillomandible enclosure volume) differs between MAS responders and non-responders and 2) whether the alteration in this ratio with MAS was related to treatment outcome.

Results: There was no difference in ST/MEV1 between Responders (0.96 ± 0.02, n = 36) and Non-Responders (0.98 ± 0.02, n = 33). With MAS in situ, airway volume increased (10.6 ± 4.7 vs. 11.5 ± 4.8 cm³, p < 0.05), ST volume did not change (177.2 ± 32.0 vs. 175.9 ± 29.8 cm³), MEV2 volume increased (309.3 ± 43.3 vs. 324.5 ± 43.8 cm³, p < 0.001) and ST/MEV2 decreased (0.57 ± 0.06 vs. 0.54 ± 0.06, p < 0.001). ΔST/MEV2 with MAS did not differ between responders and non-responders (−0.03 ± 0.02 vs. −0.03 ± 0.03).

Conclusion: We developed a method to assess anatomical balance in three-dimensions from MRI scans. However ST/MEV1 at baseline did not show an association with MAS treatment outcome. Although MAS reduced anatomical balance, there was no relationship between this measurement and treatment outcome.
TOTAL SLEEP DEPRIVATION AND TIME-OF-DAY INFLUENCES ON SIMULATED PRE-CRASH MANOEUVRES OF MOTORCYLISTS
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Introduction: Motorcyclists are particularly at risk of being injured or killed when involved in a road traffic accident. Emergency braking and/or crash avoidance manoeuvres on the left or on the right (as learned in motorcycle license practice tests) are currently performed to avoid such crashes. These manoeuvres require a high-level of perceptual and manipulative capabilities. However, vigilance impairment, which can be induced by sleep deprivation (SD) and/or time-of-day (TOD), is recognized to negatively affect the different components of executive functioning implied in motorcycle driving.

Methods: 12 healthy male volunteers took part in 8 tests sessions, set up at 6 a.m., 10 a.m., 2 p.m., 6 p.m. after a night with or without sleep, in a random order. Subjects had to perform an emergency braking and a crash avoidance manoeuvre, both realized at 20 and 40 kph on a motorcycle dynamic simulator. For each task, the total distance necessary to perform the manoeuvre was recorded. When a significant effect was observed, reaction and execution times (considered as explanatory variables) were also analyzed.

Results: Considering emergency braking, an interaction effect was observed between ‘speed’ and ‘sleep condition’ (F1,11 = 12.25; p < 0.005). Performance at 20 kph remained unaffected. Regardless of TOD effect, SD severely affected the total distance necessary to stop the motorcycle at 40 kph (+1.57 m, i.e. +20.7%). This increase in stopping distance can be directly connected to the increased reaction time (+0.13 s, +21.4%) (F1,11 = 9.56, p < 0.01). In contrast, no effect was observed on the braking time.

Considering crash avoidance, only a ‘speed’ effect was observed (F1,11 = 10.33, p < 0.01). Subjects needed longer distance to perform the manoeuvre at 20 than at 40 kph (27.95 m vs 32.67 m). No influence of SD or TOD was observed.

Discussion: This study demonstrates for the first time the effects of SD and TOD on motorcycle driving capabilities in reference to emergency manoeuvres on a dynamic simulator. Our results confirm that sleep deprived motorcyclists better have to reduce their speed in case of braking. More complex tasks (crash avoidance) were not affected in this paradigm. Simulators are useful tools and future works may focus on prolonged motorcycle driving sessions to propose preventive countermeasures adapted to real-life routes.

SLEEP INERTIA IN SHIFTWORK SCHEDULES
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Introduction: Sleep inertia (SI) refers to a brief period of cognitive impairment typically experienced upon waking and is of concern to anyone required to perform safety-critical tasks during this period. This study investigated SI in fixed and rotating shift schedules.

Methods: Sixteen healthy subjects (ages 21–33, 8F) participated in a 9-day laboratory study with two baseline nights (BL1, BL2; 10 h time-in-bed (TIB), 2200 h–0800 h), four 24 h periods (Shift Days; SD1–4) of either a: 6 h on / 6 h off split sleep schedule (5 h TIB in off period; 10 h TIB per 24 h), or b: 8 h on / 8 h off rotating sleep schedule (6 h 40 min TIB in off period; 10 h TIB per 24 h) and two recovery nights (10 h TIB). At 2, 17, 32 and 47 min after scheduled awakening, subjects completed an 8 min test bout, which included a 3 min Psychomotor Vigilance Task (PVT-B) and the Samn-Perelli (SP) Fatigue Scale. A linear mixed effects model was used to assess the effect of schedules (6 h and 8 h), days (BL2, SD2, SD4) and time (2, 17, 32, 47 min) on SP fatigue scores, PVT-B lapses (reaction times > 355 ms) and PVT-B mean fastest 10% reaction times (F10RT).

Results: There was a significant effect of time for all variables (all p < 0.001) with subjective ratings of fatigue decreasing and objective performance improving between 2 min to 47 min after scheduled awakening. There was a significant effect of day on the magnitude of SI for SP Fatigue (p < 0.001) with subjects reporting higher SI fatigue across the shiftwork days. There was no main effect of day or interaction effects for lapses. There was a significant schedule × day interaction (p < 0.001) for mean F10RT, which revealed that in the 8 h schedule mean F10RT was similar on BL and SD2, but significantly worse on SD4. In the 6 h condition, however, mean F10RT was significantly worse on SD2 versus BL and SD4.

Discussion: SI effects were evident after a 10 h total TIB opportunity per 24 h, regardless of immediate prior TIB opportunity (i.e. 10 h on BL, 5 h in the 6 h schedule, and 6 h 40 min in the 8 h schedule), but the magnitude of SI varied dynamically over days depending on shift type.
Introduction: Research has shown that driver sleepiness is a leading cause of road accidents. The purpose of this laboratory based study was to determine whether the positive relationship between subjective sleepiness and driving performance observed in civilian populations was the same in Australian Army drivers.

Methods: Six participants (1 female, mean age 36.3 years) from the Australian Army took part in the pilot study. All participants held a private and military driver’s license and performed on average 100 km per week of military driving. The study involved driving in a high fidelity simulator for two hours in the afternoon (13.00 h until 15.00 h). The task simulated a monotonous, daytime, multi-truck convoy drive. Participants’ sleep was not controlled, but measured using actigraphy during the night before the drive. As multiple participants were tested at the same time they were asked not to speak unless necessary for data collection. Verbal Karolinska Sleepiness Scale (KSS) ratings were taken at 300 sec intervals during the drive and continuous standard deviation of lane position from the centre of the road (LD) was binned into the same time periods as KSS for analysis. Repeated measures ANOVA examined change in LD and KSS during the 2 hour drive. Bivariate correlations were performed between total sleep time, mean KSS and mean LD.

Results: Subjects were sleep restricted, sleeping on average only 287±11 ± 57.52 min the night before the drive. A relationship was found between KSS and LD (r (4) = 0.76, p = 0.041), but total sleep time was not related to either KSS (r (4) = 0.08, p = 0.449) or LD (r (5) = 0.37, p = 0.272). A repeated measures ANOVA determined that neither KSS (F (10.69, 53.45) = 1.94, p = 0.056), although there was a strong trend, or LD (F (3.93, 15.72) = 0.81, p = 0.533) differed significantly across the driving session.

Conclusions: In this small study of sleep restricted Australian Army drivers, a relationship was found between driving performance and self-report sleepiness, although neither driving performance nor sleepiness significantly deteriorated during the afternoon driving session.

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development of obesity when sleep is restricted. Shift workers in particular may be at increased risk of obesity as they often report short sleep durations and fatigue. The current study examined the diet of shift workers and included sleep duration and subjective fatigue as predictors of dietary intake and composition.

**Methods:** Data were collected from 131 shift workers (age: 41 ± 10.5 years, m ± SD). Average daily energy intake (KJ) and macronutrient distribution (% of daily energy intake) were derived from a validated Food Frequency Questionnaire developed by The Victorian Cancer Council. Predictors of dietary intake, including sleep duration, fatigue (general tiredness and lack of energy regardless of sleep obtained or hours worked), shift schedule, gender and age, were measured using a modified version of the Standard Shiftwork Index.

**Results:** Mean daily energy intake was 8065 (KJ) ± 2998 (SD) and was distributed in the following way: 37% consumed from fat (including 15% from saturated fat), 42% from carbohydrate and 21% from protein. For this cohort of participants, sleep duration and fatigue were not correlated, and neither sleep duration nor fatigue predicted energy intake. However, both sleep and fatigue did affect the composition of the diet. A higher percentage of energy intake from fat was predicted by higher levels of fatigue and longer sleep durations (p < 0.05). In contrast, shorter sleep durations yet lower levels of fatigue predicted a higher percentage of energy intake from carbohydrate (p < 0.05).

**Discussion:** It is recommended that individuals consume between 20–35% energy from fat and no more than 10% of energy should be derived from saturated fat. When shift workers in the current study were more fatigued, their diet was more likely to be higher in fat. Diets high in saturated fat have been linked to a range of health disorders. Consequently, shift workers who are fatigued may be more at risk of developing adverse health conditions. Future research should investigate if these findings also apply to day workers.

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SLEEP, NOCTURNAL FOOD INTAKE AND PHYSICAL ACTIVITY IN AUSTRALIAN HEALTHCARE WORKERS

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**Introduction:** To date, several investigations have examined individually the effects of shift work on sleep, food intake and exercise behaviour. However, there has been no study that assesses the sleep pattern, nocturnal eating and exercise habits in Australian workers, particularly in healthcare workers as a group. This study was designed to explore the sleep, nocturnal eating patterns and physical activity of nurses and paramedics in Australia.

**Methods:** Permanently employed workers in the nursing and paramedic industry (aged 18 to 65 years) were invited to complete an online survey, comprising questions relating to their sleep quality (Pittsburgh Sleep Quality Index questionnaire, PSQI), nocturnal eating behaviour, and physical activity (International Physical Activity Questionnaire, IPAQ).

**Results:** Data from 385 respondents (32 day, 280 rotating, and 73 night workers) were analysed. All worker groups had poor sleep quality as indicated by total PSQI scores of greater than 5, however, rotating and night shift workers slept poorer (p < 0.05) than day workers. Night workers, compared to day workers, slept less (p < 0.05), and had greater usage of sleep medication (p < 0.05). Energy expenditure (as estimated by the IPAQ) was nearly twice higher (p < 0.05) in night than in day workers, although body mass index was not significantly different between the two groups. Furthermore, shift workers had higher nocturnal food intake (p < 0.05) than daytime workers. No significant group differences were found for exercise habit or physical activity level.

**Discussion:** Poorer sleep quality and an increased incidence of nocturnal food intake in rotating and night workers, and a greater usage of sleep medication in the night worker group suggest that these shift work behaviours may contribute to long-term health consequences which may bear significant implications for work performance.

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INFLUENCES OF SLEEP DEPRIVATION AND TIME-OF-DAY ON DIFFERENT COMPONENTS OF EXECUTIVE FUNCTIONING

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**Introduction:** Executive functioning implies different components of attention which are not impaired similarly by sleep deprivation (SD). According to the two-process model, psychomotor performances are characterized by a circadian process, evolving between maximal and minimal values on a 24-hour rhythm, which interacts with a cumulative process from awakening to sleep onset. Due to the different cortical structures involved in the tasks proposed for executive functioning evaluation, some components should be more influenced by each process respectively. However, the circadian process is rarely taken into account and the relative effects of SD are only evaluated once in a day.

**Methods:** 20 healthy male subjects voluntarily took part in 8 test sessions, set up at 6 a.m., 10 a.m., 2 p.m., and 6 p.m., following a night with or without sleep, in a random order. The test battery included measurement of Oral temperature, Epworth Sleepiness Scale, Signal cancellation test, Simple reaction time, Go/NoGo, Incompatibility and Motor-coordination.

**Results:** Some performances evolved according to the rhythm of temperature and/or vigilance (Signal cancellation test) with low values at 6 a.m. and while progressing throughout the day to reach significantly higher levels in the end of the afternoon (simple reaction time, motor coordination). As for higher-level components of attention (Go/NoGo, incompatibility), no diurnal fluctuation was observed. SD impaired some measurements (temperature, sleepiness, simple reaction time, incompatibility), particularly in the morning (after 24 and 28 waking hours). In the afternoon, the effects of circadian rhythmicity allowed for compensatory mechanisms and/or a more important investment of the subjects in the task. In contrast, tasks which were more demanding or more complex (motor coordination) would be less sensitive to the lack of sleep. The progressive increase in sleep pressure involved a fall in performances recorded after 32 hours without sleep only.

**Discussion:** Our results confirm that some components of executive functioning can be particularly affected whereas others resist to the noxious effects of SD. This confirms the necessity to evaluate the effects of SD at various levels of analysis and at different times of the day.
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FINAL YEAR PHARMACY STUDENTS’ AWARENESS ABOUT THE APPLICATION OF CHRONOTHERAPEUTIC PRINCIPLES IN PRACTICE

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Introduction: Significant developments in the field of circadian rhythms and chronotherapy have taken place during the last decade. It was believed until quite recently in clinical circles that evidence for this concept was in equipoise. As a result, the concept is not covered in depth in clinical pharmacy courses. A deeper understanding of the concepts underpinning chronotherapy and emerging applications in pharmacy practice would be an important addition in the learning scope of future graduates.

Objective: To assess the knowledge about chronotherapy and understand final year students’ willingness to use these principles in practice.

Method: A comprehensive literature review was conducted and informed the development of a questionnaire entitled “Chronotherapeutic principles in pharmacy practice – does time of administration matter?” This self administered instrument consists of sections on general demographics, knowledge about (n = 13 items formatted as Multiple Choice Questions, maximum score 13) and attitude towards (n = 12 statements ranked 1–5, maximum score 60) circadian rhythms and chronotherapy. This questionnaire was administered to all fourth year pharmacy students enrolled in Semester 1, March 2013, at the University of Sydney, after ethics approval. The data collected are being analysed using SPSS predictive analytics software version 21.

Result: A total of 215 students completed the questionnaire of a possible n = 216. Seventy eight percent of the students are currently employed as pharmacy staff in pharmacies. The mean score for knowledge based and attitude questions were 6.5 ± 2.0 (out of maximum possible value of 13) and 47.5 ± 7.4 (out of maximum possible value of 60).

Discussion: Final year students showed an average knowledge but quite positive attitudes toward the application of circadian rhythms and chronotherapy. This finding points to the need for including content in the pharmacy course to enhance awareness about the field of circadian rhythms and chronotherapy.

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AN ASSOCIATION BETWEEN CHANGES IN THE INTESTINAL MICROBIAL FLORA AND THE ALTERATION OF SLEEP IN CHRONIC FATIGUE SYNDROME: A PILOT OPEN LABEL TRIAL WITH USE OF THE ANTIBIOTIC ERYTHROMYCIN

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Introduction: Chronic Fatigue Syndrome (CFS) is a multisystem illness, associated with disabling fatigue, cognitive dysfunction and sleeping disturbances. Recent discoveries suggest that CFS symptoms may be associated with imbalances in the gut flora (dysbiosis). There is some suggestion that gut dysbiosis can profoundly affect multiple aspects of sleep, mood and cognitive function. To date, there has been no systematic study to explore real world improvements to both sleep and daytime functioning with antibiotic treatment in people who suffer CFS. This pilot study aims to determine whether patients with CFS who, at baseline, are colonized predominantly with gram-positive faecal organisms (determined by stool analysis) and respond to antibiotic treatment exhibit significant improvements in objective and subjective sleep parameters.

Methods: To date, 8 patients with CFS, diagnosed according to the Canadian criteria, have completed a 22-day open-label trial. Stool sample analysis was performed at the start of the trial to determine eligibility, and again at the end of the trial. Throughout the whole study, actigraphy and sleep diaries were used to monitor sleep patterns, symptoms and mood. During week 1, baseline measures of sleep and mood were recorded; during week 2 each of the 8 patients was administered erythromycin 400 mg b.d.; post-intervention changes were assessed during week 3.

Results: Preliminary results indicate that average weekly total sleep time was increased during the intervention week and sustained the following week (baseline: 390.3 mins; intervention: 408.2 mins; post: 405.9 mins). Sleep efficiency also improved across the 3 weeks (baseline: 72.2%; intervention: 74.8%; post: 79.3%). The total number of daytime naps decreased from 1.50 naps at baseline to 1.25 naps during the intervention week.

Discussion: The aetiology of CFS is unknown, but the implication of gut dysbiosis in the pathophysiology of CFS is encouraging. The outcomes of this pilot are hoped to quantify improvements and understanding of the underlying mechanisms in relation to sleep. This is an important outcome that hopes to reduce the symptoms suffered by patients with CFS.

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EFFECTS OF AGE, GENDER, AND HEALTH STATUS ON SLEEP QUALITY: RESULTS FROM THE MELBOURNE LONGITUDINAL STUDY ON HEALTHY AGING (MELSHA)

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Introduction: Poor sleep quality has been reported in older people including difficulties in initiating sleep, early morning awakening, and non-restorative sleep. Whether these changes in sleep quality are part of aging, or are secondary to other comorbidities that arise with aging is unclear. This study examined the effects of age, gender, and health status on subjective sleep quality in older people.

Method: A prospective cohort study was conducted (1994–2006) in a regionally representative sample of 1000 non-institutionalised older Australians age 65 + years (47% men). Self-reported sleep quality was collected from the baseline cohort in face-to-face interviews and analysed as cross-sectional data. Sleep quality was rated on a 4-point scale (most of the time, sometimes, rarely, never) for the frequency of 3 sleep variables: (1) trouble falling asleep, (2) troubled by waking during the night (3) feeling rested in the morning. Associated factors examined included: socio-demographics, medical conditions, mobility and psychological well-being. Stepwise multiple logistic regressions were used to determine significant predictors of sleep quality.

Results: Significantly more women reported trouble falling asleep (29% vs. 12%), reported trouble waking during the night (33% vs. 27%), and significantly less women reported feeling rested in the morning (72% vs. 80%, p < 0.05 for all). Stepwise multiple logistic regression revealed
that trouble falling asleep was associated with age, female gender, self-perceived health, heart problems, depression, pain and living alone (p < 0.05 for all). Similarly, trouble waking during the night was associated with self-perceived health, pain, low energy, restlessness and living alone (p < 0.05 for all). Reporting feeling not rested in the morning was associated with more psychological problems, poor appetite, lack of energy, feeling discontented, under strain and worn out and persistent pain (p < 0.05 for all).

Discussion: Self-reported difficulty in falling asleep is more common in older women compared with older men. In addition, perceived sleep quality in older people is associated with measures of pain, psychological well-being and living arrangements.

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SLEEP RELATED DISORDERS IN REGIONAL, REMOTE AND ABORIGINAL AND TORRES STRAIT ISLANDER PATIENTS

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Introduction: Management of sleep related disorders in regional and remote Australia, and particularly in Aboriginal and Torres Strait Islander peoples, is poorly understood. Anecdotal experience would suggest these conditions are under diagnosed and variably managed. This study aimed to investigate the burden, nature, risk factors and outcome of people with sleep related disorders in a northern and central Australian setting and to compare and contrast management in Indigenous and non-Indigenous Australian patients.

Methods: A retrospective cohort study of 200 subjects: 50 Aboriginal and/or Torres Strait Islander people and 50 non-Indigenous Australians in northern Queensland and Central Australia. Subjects were consecutive eighteen years or older patients with a diagnosed sleep disorder. Retrospective data collected from patients’ medical records included: demographics; co-morbidities; assessment of upper airway obstruction; BMI; fatigue score; referral source and management details for 12 months following diagnosis. Follow up included the number of reviews booked and number of reviews attended.

Results: Indigenous patients were more likely to be female, younger and living in a very remote location compared with non-Indigenous patients. Co-morbidities and obesity were far more prevalent in Aboriginal and/or Torres Strait Islander patients reflecting the greater burden of these conditions. Aboriginal Australians in Central Australia were less likely to have a sleep study compared with non-Aboriginal patients (6.9 sleep studies/100 000/year compared with 16.1 /100 000/year in non-Indigenous Australians). Overall this was lower than the national average of 308 sleep studies/100,000/year in non-Indigenous Australians). Aboriginal patients were also twice as likely not to attend follow up appointments in the 12 months following their diagnostic study (53%, 95% CI 40–66 compared with 27%; 16–40 – p < 0.05).

Discussion: Sleep related disorders are a significant issue for regional, remote and Aboriginal and/or Torres Strait Islander patients. Potential barriers and enablers to care in this setting will be discussed including the development of management pathways that reflect the realities of regional and remote Australia and the needs and beliefs of Aboriginal and Torres Strait Islander peoples.


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SLEEP POSITION AND SLEEP IN LATE PREGNANCY

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Introduction: Recent studies have reported that maternal sleep position may be associated with increased risk of Intra Uterine Growth Restriction and stillbirth. The suggested mechanism for this is compression of the inferior vena cava (which runs down the right side) by the uterus, particularly when the mother is supine. This in turn may result in reduced blood flow to the placenta, and a concurrent reduction in oxygen to the foetus. Thus, simply asking pregnant women to sleep on their left side may assist in the prevention of negative birth outcomes. The current study aimed to investigate the practicalities of asking women in late pregnancy to sleep on their left side.

Methods: Thirty women (16–25 y = 27%; 26–30 y = 47%; 31–40 y = 27%, first baby = 70%; other children = 30%) in their third trimester participated in at-home sleep monitoring for three nights using sleep diaries and video (total nights = 90). Participants also completed a questionnaire about their typical sleep habits, and their sleep during pregnancy. A subgroup wore wrist actigraphs (n = 17). Women were instructed to sleep on their left side.

Results: Left side was reported among typical sleep positions for 43%, and among sleep positions since pregnant for 93% of the sample; with 53% agreeing that sleep on their left was comfortable (neutral = 27%; disagree = 20%). Video analysis indicated that an average of 59% (SD = 17%) of time in bed was spent on the left, with 17% (SD = 15%) spent supine. Individual differences in time on the left ranged from 11% to 98%. Those who included the left side among their typical sleep positions had a significantly higher amount of reported sleep during the study (7.81 h compared to 7.14 h, F1,28.2 = 4.19, p < 0.05). Actigraph analysis (n = 17) indicated an average Total Sleep Time (TST) of 6.6 h (SD = 1.4 h), with a sleep efficiency of 80% (SD = 11%). Participants overestimated actigraphically-determined TST by an average of 44 mins (SD = 92 mins).

Discussion: Results suggest that for some women, sleep on the left will not be comfortable, and even when instructed to sleep on the left side, women in late pregnancy will likely still spend time supine or on their right. Given the importance of sleep during pregnancy, and the difficulties associated with obtaining sleep during this time, investigating the potential impact of maternal sleep position for the foetus, and for the sleep of the mother, is important.

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SLEEP HEALTH AND NEUROCOGNITIVE FUNCTION IN DOCTORS AND MEDICAL STUDENTS OF AN AUSTRALIAN TERTIARY HOSPITAL

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Introduction: Chronic sleep restriction and impaired sleep quality is a common problem in Australia and is increasingly being recognised as a contributor to poorer health outcomes. Little is known about the sleep patterns of Australian hospital doctors and medical students.

Aims: To compare sleep patterns in medical students, junior and senior doctors, and to evaluate the effect of sleep restriction on measures of sleep health and neurocognitive function.
Methods: 51 doctors and medical students from St Vincent’s Hospital Melbourne were recruited. They completed a sleep diary and actigraphy for 1 week, questionnaires including the Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), and Functional Outcomes of Sleep Questionnaire (FOSQ). Neurocognitive function was assessed using the Beck Depression Inventory-II (BDI-II), the Beck Anxiety Inventory (BAI) and the Computerised Tests of Information Processing (CTIP). Subjects were defined as being non-sleep restricted (>7.5 h/night), mildly sleep restricted (6–7.5 h/night), moderately sleep restricted (<4–6 h/night), or severely sleep restricted (<4 h/night).

Results: The mean ± SD of sleep duration was 7.08 ± 0.87 h/night. 35 subjects (73%) were sleep restricted over 1 week. Sleep duration did not appear to be affected by age, gender, position, specialty, social situation, rostered or un rostered work hours, commute time or caffeine consumption. Consultants had the lowest sleep duration (6.8 ± 0.45; p = 0.28), however were less subjectively sleepy (mean ± SD ESS 3.7 ± 2.9; p = 0.04). Medical students and junior doctors had a trend towards worse FOSQ and PSQI scores (p = 0.10 and p = 0.08 respectively), and had higher anxiety (p = 0.008) and depression scores (p = 0.01). There was no significant association between degree of sleep restriction and measures of sleep health or neurocognitive function.

Conclusion: 73% of subjects in this Australian tertiary hospital were sleep restricted, however this had no effect on measures of sleepiness, sleep quality, functional outcomes or neurocognitive function.

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QUALITY OF LIFE (QOL) IS REDUCED FOR OBSTRUCTIVE SLEEP APONEA (OSA) PATIENTS IRRESPECTIVE OF DISEASE SEVERITY

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Introduction: Decreased quality of life (QOL) is a frequent complaint for patients presenting for investigation of sleep disordered breathing and is particularly well documented for those with severe obstructive sleep apnoea (OSA). However, less is known regarding QOL in patients with mild-moderate OSA.

Methods: Seventy patients, referred to our sleep service for investigation of possible OSA, were administered the Functional Outcomes of Sleep Questionnaire (FOSQ). Neurocognitive function was assessed using the Beck Depression Inventory-II (BDI-II), the Beck Anxiety Inventory (BAI) and the Computerised Tests of Information Processing (CTIP). Subjects were defined as being non-sleep restricted (>7.5 h/night), mildly sleep restricted (6–7.5 h/night), moderately sleep restricted (<4–6 h/night), or severely sleep restricted (<4 h/night).

Results: The mean ± SD of sleep duration was 7.08 ± 0.87 h/night. 35 subjects (73%) were sleep restricted over 1 week. Sleep duration did not appear to be affected by age, gender, position, specialty, social situation, rostered or un rostered work hours, commute time or caffeine consumption. Consultants had the lowest sleep duration (6.8 ± 0.45; p = 0.28), however were less subjectively sleepy (mean ± SD ESS 3.7 ± 2.9; p = 0.04). Medical students and junior doctors had a trend towards worse FOSQ and PSQI scores (p = 0.10 and p = 0.08 respectively), and had higher anxiety (p = 0.008) and depression scores (p = 0.01). There was no significant association between degree of sleep restriction and measures of sleep health or neurocognitive function.

Conclusion: 73% of subjects in this Australian tertiary hospital were sleep restricted, however this had no effect on measures of sleepiness, sleep quality, functional outcomes or neurocognitive function.

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EFFECTS OF BODY MASS INDEX (BMI) AND AGE ON SLEEP STUDY RESULTS AND CEPHALOMETRIC MEASUREMENTS

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Background: Severity of OSA is known to worsen with increasing BMI and age. Little is known regarding the interaction of BMI and age on sleep study results and its influence on cephalometric measurements. This study aims to address these questions.

Method: Retrospective analysis of patients who presented with symptoms of OSA between January 2008 and December 2012. Forty-nine patients with complete sleep study results and cephalometric CT were identified. Cephalometric measurements were obtained from the CT. AHI is used as surrogate markers for the severity of the OSA. Relationship of the variables were analysed with linear regression analysis and Pearson’s correlations.

Results: The mean age of the patients are 45.1 ± 11.3 years old, with BMI of 29.2 ± 4.0 kg/m2. Increasing BMI correlates significantly with worsening AHI (p = 0.028). Our model suggests that every point increase in BMI, results in an increase of 7.3 events/ hours in AHI (95% CI 0.8–13.7). This effect of BMI is seen more significantly amongst female patients (coefficient = 11.9) than male patients (coefficient = 4.0). Age has good correlation with RDI (p = 0.013). Increasing BMI also results in significant increase in the height and length of the tongue (p = 0.007), as well as the distance between the hyoid and mandible (p = 0.019). No correlations were noted between BMI and bony measurements, or other soft tissue measurements, including soft palate or airway size at nasopharynx, oropharynx or hypopharynx.

Conclusion: Increasing BMI and age results in worsening sleep study results. This effect is more pronounced amongst the female patients, than the male patients. Increasing BMI correlates mostly with the soft tissue cephalometric measurements within the oral/oropharyngeal region.

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PREVALENCE OF OSA AND UTILITY OF THE STOP-BANG QUESTIONNAIRE AS A SCREENING TOOL IN A CARDIAC OUTPATIENT COHORT
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Background: OSA is highly prevalent in patients with coexisting cardiac disease and untreated OSA is associated with increased cardiovascular morbidity and mortality. There is a need for a simple screening tool to assist cardiologists in identifying patients at risk of OSA who might benefit from a sleep study. The STOP-Bang questionnaire has been validated as a screening tool in the surgical outpatient setting, but there are no studies validating its utility in the cardiac outpatient setting.

Aims: To determine the prevalence of OSA in a cardiac outpatient population and to determine the clinical utility of the STOP-Bang questionnaire in identifying those at risk of OSA.

Methods: Prospective observational study of patients from cardiology outpatient clinics. Patients not currently treated for sleep disordered breathing and over 18 years of age will be eligible to undergo Type 2 unattended polysomnography in the home. Participants complete additional health and clinical information including the STOP-Bang questionnaire. Prevalence and severity of SDB will be assessed according to standard criteria. Sensitivity and specificity of the STOP-Bang questionnaire will be evaluated with a STOP-Bang score of 3 or greater, which has been validated to predict risk of OSA in surgical outpatients.

Results: n = 17. M: F = 8:9, (mean +/- SD) age = 68.4 ± 9.7 yrs, BMI = 26.6 ± 3.6, ESS = 6.2 ± 4.0, RDI = 15.7 ± 13.0. Prevalence of OSA with RDI ≥ 5 was 76% (mild 24%, moderate 35%, severe 18%). Sensitivities of STOP-Bang at RDI greater than 5, 15, 30 were 62%, 56% and 100% respectively. Specificities were 25%, 25% and 43% at the same thresholds.

Conclusions: OSA is highly prevalent in a cardiac outpatient setting. The STOP-Bang questionnaire has excellent sensitivity for severe OSA, but is not as accurate in predicting mild to moderate OSA. Low specificity at all thresholds of OSA indicates that a negative score does not exclude OSA. The predictive parameters of the STOP-Bang in cardiac outpatients may be different to a surgical outpatient setting in which this questionnaire has been validated. Further data is required to confirm these findings in a larger cohort.

TIME ON TASK FATIGUE MAY CONTRIBUTE TO DEFICIENT OVERNIGHT MOTOR SKILL LEARNING IN OBSTRUCTIVE SLEEP APNOEA (OSA) PATIENTS
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Introduction: Improvements in motor skill performance as measured by the Sequential Finger Tapping Task (SFTT) have been shown to occur after sleep. Recent findings suggest that patients with Obstructive Sleep Apnoea (OSA) do not benefit from such sleep related improvements. Studies finding improvements after a short rest period have suggested a time-on-task effect reducing pre-sleep performance. This may more adequately explain the performance improvements seen after sleep. However, performance after a short rest period before sleep has not been investigated in OSA patients.

Method: Patients presenting for a diagnostic sleep study for suspected OSA were recruited. In the evening patients completed 12 training trials of the SFTT following by 3 test trials separated by a 10 min rest period. This rest period was utilized as it has been previously shown to reduce time on task related fatigue on this specific task, and hence allow the examination of this time-on-task effect. Patients performance was once again retested in the morning following PSG recorded sleep in order to assess sleep related improvement.

Results: Preliminary data comprising 14 patients diagnosed with OSA and 10 clinical “control” patients without OSA symptoms (AHI < 5) reveal significantly increased motor performance on the SFTT following the pre-sleep rest period for both clinical control patients (22.91%, t = 5.92, p < .001) as well as OSA patients (10.82%, t = 2.59, p = .02). The extent of this improvement was greater for controls (22.91%) compared to OSA patients (10.82%). Following sleep both groups showed significantly reduced performance on awakening (OSAs -13.18%, t = 2.37, p = 0.034; Controls -17.50%, t = 3.51, p = 0.007). For both groups post sleep performance did not significantly differ from evening pre-rest period performance (OSA t = 82, p = 0.42, Controls: t = -1.82, p = .859).

Discussion: The results of the current study, although preliminary, suggest that OSA patients may be more susceptible to time-on-task fatigue. Moreover motor skill performance did not show sleep-related improvements in both clinically presenting groups. Forthcoming data from age and education matched healthy controls as well as patients who are being treated with CPAP will further explore these findings.

EFFECT OF ADJUNCTIVE RAMELTEON THERAPY OF CONTINUOUS POSITIVE AIRWAY PRESSURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA-REPORT OF 2 CLINICAL CASES-KANAKO MORIMOTO2, TAKATOSHI KASAI1, SATOMI KASUGA1,2, YASUHIRO TOMITA1,2, HISASHI TAKAYA1, KEN-ICHI MAENO1, SATOSHI KASAGI1, TARO ADACHI1, FUSAE KAWANA1,2, YUKA KIMURA1,2, SUGAO ISHIWATA2, KOJI NARUI1
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Introduction: Continuous positive airway pressure (CPAP) is an established therapy for obstructive sleep apnea (OSA) although adherence to CPAP is an issue. Indeed, we experienced two OSA cases whose nightly usage of CPAP was short due to difficulty to initiate sleep. Ramelteon, a melatonin analogue has been found to improve objective sleep onset latency without worsening of OSA severity. Thus, we investigated whether adjunctive ramelteon therapy of CPAP can improve their nightly usage of CPAP in association with improved initiation of sleep.

Methods: Case 1: 48-year-old man with moderate OSA (apnea-hypopnea index [AHI], 20.5), who have a difficulty to initiate sleep before starting CPAP. Case 2: 47-year-old man with severe OSA (AHI, 35.7), who also have a difficulty to initiate sleep before starting CPAP. Using data downloaded from CPAP device, we evaluated a percentage of days on CPAP and nightly usage of CPAP before and after administration of ramelteon 8 mg per day.
Results: In case 1, ramelteon therapy increased both percentage of days on CPAP and nightly usage of CPAP (from 71.9% to 90.6% and from 1 hr and 36 min to 4 hrs and 47 min, respectively). Similarly, in case 2, ramelteon increased percentage of day with CPAP (from 88.6% to 96.7%).

Discussion: Adjunctive ramelteon therapy induced marked improvements of adherence to CPAP probably due to the improvement of difficulty to initiate sleep in these two particular cases.

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OBESITY HYPOVENTILATION SYNDROME (OHS): THE PRESENTATIONS AND OUTCOMES OF 79 INPATIENTS
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Introduction: There is little known about the natural history of OHS. This study was conducted to assess how patients are diagnosed and the implications that this has on their management and health outcomes.

Methods: This is a retrospective observational study. Patients were identified as those given a diagnosis of OHS (diagnostics group E662) on discharge from hospital between 1st January 2008 and 31st December 2010. A review was made of clinical notes, laboratory results and investigations performed as routine care for these patients. Data was collected on demographics, investigations, management and follow-up outcomes (mortality, cause of death, number of readmissions and length of stay).

Results: 79 patients were identified with a diagnosis of OHS – 44 were new presentations and 35 had a diagnosis made on average 34.3 months earlier. Mean age was 46.8 years (range 24–74) with an average BMI of 52.9 (range 31.4–97). There was a predominance of Maori (26.6%) and Pacific (53.2%) patients. The majority had type 2 respiratory failure during their index admission for which 43 (54.4%) required the use of acute non-invasive ventilation (NIV). Two patients died during the index admission and a further 8 died during follow-up. By the end of follow-up 39 were on continuous positive airway pressure (CPAP) for co-existing OSA, 8 were on home NIV, 26 required home oxygen. Kaplan Meier curves showed: i) home oxygen use was associated with a higher mortality (p value = 0.0074) and ii) home ventilation (either CPAP or NIV) was associated with better survival (p value = 0.0024). Cox regression analysis with adjustment for sex, age and status of diagnosis at presentation showed these associations persisted as i) home oxygen use had a hazard ratio of 5.9 (p value of 0.049) and ii) home ventilation a hazard ratio of 0.058 (p value = 0.014).

Discussion: OHS is associated with significant morbidity and mortality. Survival may be improved in those receiving home ventilation although this is not a randomised study. The results are in keeping with the findings of others. More studies are required in the management of this patient group.

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THE RELATIONSHIP BETWEEN FUNCTIONAL HEALTH LITERACY AND OBSTRUCTIVE SLEEP APNEA AND ITS RELATED RISK FACTORS AND COMORBIDITIES IN A POPULATION COHORT OF MEN
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Introduction: The relationship between functional health literacy (FHL) and obstructive sleep apnea (OSA), its diagnosis, related risk factors and comorbidities is unknown.

Methods: Participants included men aged ≥40 years with OSA (n = 626) identified by self-report (previously diagnosed, n = 183) or with an abnormal home polysomnography (undiagnosed, n = 443) undertaken in a randomly selected subset (n = 837) of participants in the Men Androgen Inflammation Lifestyle Environment and Stress (MAILES) Study. Assessment of health literacy was with the Newest Vital Sign in 88% of participants. Full in-home unattended polysomnography ( PSG, Emblettta X100) was scored by 2007 AASM (alternative) criteria.

Results: FHL was adequate in 75.3% (n = 122) of previously diagnosed and 68.3% (n = 261) of undiagnosed OSA. Under-diagnosis was independently associated with inadequate FHL (odds ratio (OR) 2.84, 95% confidence interval (CI): 1.25–6.45), workforce participation (OR = 2.04, 95%CI = 1.01–4.00) and inversely associated with previously snoring (OR = 0.48, 95%CI = 0.20–0.81), obesity (OR = 0.35, 95%CI = 0.15–0.81), and cardiovascular disease (OR = 0.45, 95%CI = 0.24–0.85). In men undergoing polysomnography, inadequate FHL was independently associated with undiagnosed OSA (OR = 2.43, 95%CI = 1.40–4.20). In men with undiagnosed OSA, inadequate or at-risk FHL was independently associated with sedentary lifestyle (OR = 2.42, 95%CI = 1.36–4.29), current smoking (inadequate FHL: OR = 2.87, 95%CI = 1.21–6.84) and depression (OR = 2.50, 95%CI = 1.20–5.00) and inversely associated with previous snoring (OR = 0.48, 95%CI = 0.20–0.81), obesity (OR = 0.35, 95%CI = 0.15–0.81), and cardiovascular disease (OR = 0.45, 95%CI = 0.24–0.85). In men undergoing polysomnography, inadequate FHL was independently associated with undiagnosed OSA (OR = 2.43, 95%CI = 1.40–4.20). In men with undiagnosed OSA, inadequate or at-risk FHL was independently associated with sedentary lifestyle (OR = 2.42, 95%CI = 1.36–4.29), current smoking (inadequate FHL: OR = 2.87, 95%CI = 1.21–6.84) and depression (OR = 2.50, 95%CI = 1.20–5.00). The depression association was attenuated after additional adjustment for comorbidities and general health (OR = 2.04, 95%CI = 0.93–4.49, p = 0.076). In men with previously diagnosed OSA, inadequate or at-risk FHL was independently associated with cardiovascular disease (OR = 2.76, 95%CI = 1.09–7.01).

Discussion: Limited FHL was independently associated with OSA, OSA diagnosis, lifestyle risk factors and comorbidities, highlighting the importance of developing and promoting national disease-specific health literacy policies.

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VALIDATION OF TWO DEPRESSION SCREENING INSTRUMENTS IN A SLEEP DISORDERS CLINIC
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Introduction: Depression is prevalent in sleep disorder clinics and complicates medical conditions; yet screening instruments have not been validated in this setting. We aimed to validate the Hospital Anxiety and Depression Scale (HADS) and the Beck Depression Inventory – Fast Screen (BDI-F5) with the ‘gold standard’ Mini International Neuropsychiatric Interview (MINI) in patients with suspected obstructive sleep apnea (OSA).

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The aim of the present study was to assess the correlation of degree of nasal congestion to decide which mask interface to use. Previous research has shown that objective measures performed.

Results: The point prevalence of depression and an anxiety disorder were 29.7% and 28.7% respectively. Generalised anxiety disorder was present in 21.8% and panic disorder in 16.8% of participants, indicating that a significantly greater flow differential between the 2 nasal airways is more restricted than the other. All patients then underwent anterior rhinomanometry to determine their nasal airflow as indicated by total inspiratory flow at 150 kPa. The individual flow via each nasal airway was also recorded. Data was subjected to linear regression analysis and to Sensitivity & Specificity analyses, with ROC analyses also performed. Using a gold standard assessment method, depression and anxiety had a high prevalence in a sleep clinic population. The HADS and BDI-FS are accurate screening instruments with high validity for identifying depression and, in the case of HADS, anxiety in a sleep disorders clinic. We suggest that the use of these screening instruments is valuable and may be used to optimise management in these patients, aiding clinicians in identifying at-risk patients who require further psychiatric evaluation and treatment.

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PATIENTS’ SELF ASSESSMENTS OF NASAL CONGESTION DO NOT CORRELATE WITH OBJECTIVE MEASUREMENTS OF NASAL FLOW

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Introduction: Previous research has shown that objective measurement of nasal flow, such as rhinomanometry, is a useful tool for selection of the type of mask for CPAP therapy. However, patients and CPAP suppliers tend to rely on the patient’s own perception of the degree of nasal congestion to decide which mask interface to use. The aim of the present study was to assess the correlation of patients’ perception of their nasal congestion with rhinomanometry measurements.

Method: 94 patients (53 male, 41 female) completed a visual analogue scale (VAS) to indicate their own perception of the degree of nasal congestion. Each patient also recorded whether a particular nasal airway was more restricted than the other. All patients then underwent anterior rhinomanometry to determine their nasal airflow as indicated by total inspiratory flow at 150 kPa. The individual flow via each nasal airway was also recorded. Data was subjected to linear regression analysis and to Sensitivity & Specificity analyses, with ROC analyses also performed.

Results: There was no significant (p > 0.05) relationship between the baseline nasal flow as measured by rhinomanometry and the patients’ subjective impression of nasal congestion via the VAS, with a correlation coefficient (R) of 0.04 and a coefficient of determination (R²) of 0.002. A total of 34 patients had a flow differential greater than 1.5 indicating that a significantly greater flow differential between the 2 sides, compared to a total of 43 patients reporting that one nasal airway was significantly more blocked than the other. This gave a sensitivity of only 0.56 and a specificity of 0.6, thus giving a Positive Predictive Value (PPV) of 46% and a Negative Predictive Value (NPV) of 44%.

Discussion: As expected, patients’ perception of their nasal congestion is not a reliable measure of the true nasal flow. Similarly, patients are not very accurate in identifying the difference in airflow via each nasal airway. These findings have implications for those involved in choosing the mask interface for anyone starting on CPAP therapy. Further studies are needed to determine if rhinomanometry measurements provide a better predictive accuracy in mask selection and acceptance in CPAP therapy and whether it can be incorporated as standard practice in prescribing the mask interface in CPAP therapy.

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PREVALENECE OF SLEEP DISORDERED BREATHING IN PATIENTS WITH CHRONIC NOCTURNAL NASAL CONGESTION

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Introduction: Subjects with symptoms of chronic nocturnal nasal congestion (CNNC) often complain of disturbed sleep and snoring but objective data are lacking.

Methods: We studied 91 community volunteers, who reported symptoms of CNNC and poor sleep. Subjects underwent home polysomnography (PSG) and were excluded if they had severe obstructive sleep apnoea (OSA; AH1 > 30 events/hr). All subjects then underwent in-lab overnight PSG (Compumedics E series), including quantitative sound measurement (for snoring) using a sound level meter (Model NL-31, Rion, Japan). Anthropometric data were recorded. Sleep studies were scored according to American Academy of Sleep Medicine 2007 Scoring Manual. Sleep indices are presented as mean ± SD.

Results: We studied 69 subjects (46 males; age: 48 ± 15 yrs, BMI: 29.0 ± 5.3 kg/m²). Sleep efficiency was 80.3 ± 10.6%, with 8.9 ± 4.1% stage N1 sleep, 48.1 ± 7.0% stage N2 sleep, 23.3 ± 7.4% stage N3 sleep and 19.6 ± 4.2% REM sleep. The Respiratory Disturbance Index (RDI) was elevated at 19.8 ± 12.5 events/hr, with most events scored as Respiratory Effort Related Arousals (RERAs: 15.7 ± 9.9 events/hr). Using an RDI > 5 events/hour to define mild OSA, 93% of this group had at least mild sleep disordered breathing. Snoring was also common with 40.8 ± 27.9% of sleep epochs spent snoring, and with 87% of the group snoring for > 10% of total sleep epochs.

Conclusion: We conclude that in this group of subjects with CNNC and disturbed sleep, there is a high prevalence of snoring and sleep disordered breathing, manifesting predominantly as RERAs. Our data suggest that subjects with CNNC symptoms without overt symptoms of OSA should be tested for sleep disordered breathing. Supported by GlaxoSmithKline.
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HEARING IMPAIRMENT IN SNORERS IS NOT RELATED TO THE LOUDNESS OR DURATION OF SNORING

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Introduction: Noise-induced hearing loss is one of the most common causes of permanent hearing impairment in the community. Snorers are chronically exposed to nightly noise levels than can reach peaks of over 90 decibels (dBA). We hypothesised that habitual snorers might have acquired hearing loss directly related to their overnight snoring sound intensity levels.

Methods: Patients attending the Westmead Sleep Investigation and Research Centre for assessment of sleep disordered breathing were invited to undergo a hearing test. Exclusion criteria included a history of medically diagnosed hearing impairment, significant chronic noise exposure and ototoxic drug exposure. Snoring history (duration and intensity) was quantified using an in-house Westmead Snore History Questionnaire (WSHQ). All subjects underwent overnight laboratory polysomnography, including quantitative sound measurement using an in-room microphone (Model NL-31, Rion, Japan). Pure-tone audiometry (air conduction) testing (MADSEN Itera II, Otometrics, Denmark) was performed for each ear immediately prior to sleep. Subjects were considered to have hearing impairment (assessed for frequency bandwidths from 125 Hz to 8 kHz) if they had a hearing threshold level (dBA) that exceeded predicted levels for 95% of the otologically healthy population (corrected for age and gender; ISO 7029) in at least one ear, and for at least one bandwidth.

Results: Fifteen men and 15 women (age: 54 ± 11 yrs [mean ± SD]; BMI: 33 ± 8 kg/m²; apnoea hypopnoea index: 22 ± 28 events/hr) agreed to participate. Nineteen subjects (63%) met our criteria for HI. WSHQ scores for HI [7(2) arbitrary units (au)] were not significantly different to those for NHI [8(2) au; P = 0.39]. Similarly, LAeq values did not differ between HI [42.9(6.7) dB] and NHI [42.4(3.8) dB; P = 0.97].

Conclusion: There was a high prevalence of HI in this group of habitual snorers, which was not related to their snoring severity. We conclude that hearing loss in habitual snorers likely arises from factors other than the loudness and duration of their snoring.

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STRATIFYING TRIAGE OF SLEEP CLINIC REFERRALS BY INCORPORATING PATIENT REPORTING OF SYMPTOMS INTO THE PROCESS

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Introduction: Increasing recognition of sleep related symptoms and pathology from primary care doctors and medical specialties has lead to an increase in new referrals over the recent years. In our institution demand for services has resulted in a waiting list of more than 2300 patients. Clinical information required to sufficiently triage patient urgency is often inadequate. We report our novel system of re-triage incorporating patient’s reporting of symptoms to better stratify the referral process.

Method: At receipt of referral all patients are provisionally triaged based on a state-wide protocol with the clinical information provided. A questionnaire (and repeat if no response after 1 month) was distributed to the patient assessing driving, perceived impact of the sleep problem, Epworth sleepiness scale and Berlin questionnaire for sleep apnoea. On receipt of this information the referral is re-triaged according to the same protocol. Non responders and their referring doctor are sent a letter indicating a clinic appointment won’t be made. A retrospective audit assessing how this new information changed triage category and demand for new appointments was performed. Patients with insufficient time to respond to the questionnaire were excluded from the analysis. 430 patients were posted questionnaires.

Results: 77% of patients responded confirming they required an appointment, 18% did not respond and a further 5% indicated they did not wish to attend sleep clinic. Of those patients responding, the additional information resulted in an increased urgency by 1 category in 30% of patients and by 2 categories in 15%. 6% of patients had their referral urgency decreased. Demand for new case appointment decreased by 23%.

Conclusion: Gaining additional clinical information from the patient to supplement that of the referring doctor can help to target those at higher priority for assessment. This model can reduce demand for new case appointments.

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AUDIT OF WARD BASED ACUTE NIV SERVICE IN A TERTIARY, UNIVERSITY HOSPITAL AND COMPARISON WITH BRITISH THORACIC SOCIETY NIV AUDIT 2012

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Introduction: Provision of efficient Acute ward based NIV services requires 24/7 access to well- resourced and trained units, with clear up-to-date protocol, ensuring evidence based selection of patients and appropriate access to critical care services. In our tertiary centre, University teaching hospital we conducted an audit of patients requiring acute ward-based NIV treatment over a 4-month period and compared the results with the British Thoracic Society NIV audit 2012.

Methodology: Using a modified BTS Adult NIV Data Collection sheet, audit data was collected prospectively over a 4-month period. At the end of the 4 month period data collected was compared with published national audit by the British Thoracic Society NIV audit 2012.

Results: Patient characteristics and Outcome data were compared in 29 patients from our institute requiring NIV over 4 months. Our audit showed an improved NIV success rate of 83% compared to 69% (BTS NIV Audit 2012) and a shorter median length of Hospital stay 7 days c.f. 10 days. Our audit also had a fewer number of patients with chest x-ray evidence of consolidation 7% c.f. 40% and more patients had a plan to proceed to intubation 45% c.f. 17% on BTS audit.
Discussion: Our NIV audit showed a better success rate of NIV probably due to lower number patients selected with pneumonia and higher median pH (7.31 compared to 7.25). Appropriate selection of patients and backup ICU services are critical to effective provision of ward based acute NIV services.

Conclusion: Appropriate patient selection may improve outcomes in patients referred to ward-based NIV.

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PREVALENCE OF RETINAL PATHOLOGIES IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA (OSA): IS THERE A NEED FOR FURTHER INVESTIGATION?

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Introduction: Recent review articles suggest associations between OSA and a number of ocular diseases, including retinopathies and optic neuropathies (e.g.: glaucoma). We studied 134 subjects (89 males; age: 23–80 yrs), all with no history of retinal disease. AHI ranged from 0 to 104 events/hr, OSA was defined as present (apnoea-hypopnoea index [AHI] ≥ 5 events/hr) or severe (AHI ≥ 30 events/hr). Data were expressed as prevalence levels for each retinal pathology detected (percent patients with abnormality present in at least one eye). Risk factors (age, gender, OSA status) were assessed using logistic regression.

Methods: Digital photographic images of both retinas were obtained using a fundus camera (Models CR6-45NM, CR2-Plus, Canon, Japan), while overnight laboratory polysomnography (PSG) was used to characterise SDB. Retinal images were examined by an experienced operator, who identified and classified retinal abnormalities using established criteria. OSA was defined as present (apnoea-hypopnoea index [AHI] ≥ 5 events/hr) or severe (AHI ≥ 3 events/hr) or severe (AHI ≥ 3 events/hr). Surface wrinkling retinopathy (2%), cellophane reflex (4%), retinal neuropathies (e.g.: glaucoma) (McNab AA. Sleep Medicine Reviews 2007; 11:269–276). In an exploratory study, we used retinal photography to determine the prevalence of undiagnosed retinal pathologies in patients referred for assessment of sleep-disordered breathing (SDB).

Results: We studied 134 subjects (89 males; age: 23–80 yrs), all with no history of retinal disease. AHI ranged from 0 to 104 events/hr, OSA was present in 70% and was severe in 21%. At least one retinal abnormality was identified in 65% of patients. Eight potentially pathogenic abnormalities were identified: diabetic retinopathy (2%), retinopathy (7%), surface wrinkling retinopathy (2%), cellophane reflex (4%), retinal emboli (0.8%), optic disc drusen (0.8%) and large cup (8%). The most common finding was peripapillary atrophy (PP Atr; 49%). The only surface wrinkling retinopathy (2%), cellophane reflex (4%), retinal neuropathies (e.g.: glaucoma) (McNab AA. Sleep Medicine Reviews 2007; 11:269–276). In an exploratory study, we used retinal photography to determine the prevalence of undiagnosed retinal pathologies in patients referred for assessment of sleep-disordered breathing (SDB).

Discussion: The overall estimated SL in the patients was significantly longer than measured, although there was significant individual variability. There were no identified factors that influence SL estimation. Subjective estimation of SL should be interpreted with caution.

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COMPARISON OF ESTIMATED AND MEASURED SLEEP LATENCY DURING HOME POLYSOMNOGRAPHY AMONG PATIENTS WITH SUSPECTED OBSTRUCTIVE SLEEP APNOEA

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Introduction: Home polysomnography (PSG) is an alternative method for the diagnosis of obstructive sleep apnoea (OSA). Types 3 and 4 home PSG do not monitor sleep and so rely on the patient’s estimated sleep latency (SL) in the calculation of total sleep time, used to calculate the apnoea-hypopnoea index (AHI). The aim of this analysis was to compare patients’ estimated SL with objective measures in patients who underwent type 2 home PSG for diagnosis of OSA.

Methods: The subjects were 536 consecutive patients of one of the authors completed between November 2006 and January 2013. A standard questionnaire was completed by the patients the morning after the home PSG, which recorded the time of lights being turned off and estimated time to sleep onset and estimated sleep offset time. Estimated SL was derived from these two values. Measured SL on home PSG was scored based on the guidelines of the American Academy of Sleep Medicine.

Results: Only 530 patients were included in the analysis due to incomplete data in 6 patients. Median estimated SL was 20 minutes compared to 10 minutes for measured SL (p < 0.0001). 223 (42%) patients estimated their SL to be within (±) 10 minutes of measured SL. 43% of patients over-estimated their SL, while 15% underestimated it. Bland-Altman analysis showed mean difference of 13 minutes with wide limits of agreement (95% limits of agreement: −89 and 116 minutes). There were no significant correlations between estimated SL and age, Epworth Sleepiness Scale score, body mass index, AHI and sleep efficiency.

Discussion: The overall estimated SL in the patients was significantly longer than measured, although there was significant individual variability. There were no identified factors that influence SL estimation. Subjective estimation of SL should be interpreted with caution.

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PHYSICAL PHENOTYPE OF OBSTRUCTIVE SLEEP APNOEA BY AGE AND GENDER IN A CLINICAL POPULATION

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Introduction: Obstructive sleep apnoea (OSA) is strongly associated with central obesity and increased neck fat. Fat distribution is known to vary across age and gender. The aim of this study was to examine age and gender differences in the associations between the severity of OSA and measures of obesity in a sleep clinic population.

Methods: Demographic and diagnostic polysomnograph data from 1777 patients aged > 18 years (66% male) were reviewed. Inclusion criteria included total sleep time > 4 hours and apnoea hypopnoea index (AHI) > 5 events/h. Stepwise linear regressions were performed to identify significant predictors of AHI. Body mass index (BMI), waist circumference, waist-hip ratio, neck circumference, and Epworth Sleepiness Score (ESS) were examined according to gender and age (median split) to describe the physical phenotype of patients identified as having OSA.

Results: When comparing age, women had a significantly lower AHI than men over the two age groups (Median (IQR), Younger: 62 © 2013 The Authors
15.5 (9.3–39.2) vs. 22.2 (11.4–54.2) events/h. Older: 18.5 (10.0–36.3) vs. 26.3 (15.1–47.8) events/h, p < 0.05 for both). Across all patients, significant independent predictors of AHI were BMI (β = 0.22), neck size (β = 0.21), ESS (β = 0.05) and gender (β = 0.06) (Model R² = 0.15, p < 0.001). Predictors of AHI in younger men were BMI (β = 0.37), WHR (β = 0.08) and ESS (β = 0.08) (Model R² = 0.18, p < 0.001) whilst in older men neck circumference (β = 0.23) and BMI (β = 0.15) predicted AHI (Model R² = 0.12, p < 0.001). Predictors of AHI in younger women were BMI (β = 0.20) and neck circumference (β = 0.20) (Model R² = 0.14, p < 0.001) whilst in older women neck circumference (β = 0.27) and waist circumference (β = 0.12) predicted AHI (Model R² = 0.11, p < 0.001).

Discussion: In this clinical data set, both BMI and neck circumference influence severity of OSA in men and women although to different degrees. Severity of OSA in the older men and women was strongly associated with neck circumference, whilst severity of OSA in the younger men and women was strongly associated with BMI.

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THE ORIGINS OF PREGNANCY COMPLICATIONS: HOW DOES SLEEP FIT IN?

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Combined, three the most serious complications of pregnancy, pre-eclampsia, intrauterine growth restriction and pre-term birth, affect an estimated 13–27% of all pregnancies worldwide. These complications significantly increase fetal and maternal morbidity and mortality and continue to negatively impact on the health of both the mother and child later in life.

Despite advances in our understanding of the pathophysiology of these serious complications, their origins remain elusive and it is still not possible to predict all pregnancies that are at risk. A variety of risk factors have been identified that pre-dispose women to the development of these complications.

Sleep or sleep disturbance is one factor given little attention however, several recent studies have found an association between sleep disordered breathing (SDB) or new onset of snoring in pregnancy and adverse pregnancy outcomes, particularly pre-eclampsia. Intriguingly, mechanisms associated with SDB share many similarities with mechanisms proposed to explain the origins of pre-eclampsia, including roles for oxidative stress, hypoxia, inflammation and endothelial dysfunction.

It is currently unclear whether SDB contributes to the development of pre-eclampsia or is merely associated with pre-eclampsia due to shared underlying mechanisms that lead to the development of both conditions. If SDB is proven to be a risk factor for the development of pregnancy complications, particularly pre-eclampsia, it has potential to provide a novel treatment target to improve maternal and fetal outcomes in pregnancy pathologies.

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ETHNIC DIFFERENCES IN SLEEP ACROSS PREGNANCY: A COHORT STUDY

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Changes to maternal sleep during pregnancy are a well recognised and widely reported phenomenon. In general, the first trimester is marked by increased total sleep time, decreased sleep quality and greater daytime sleepiness. In the second trimester sleep duration returns to pre-pregnancy levels, before reducing again in the third trimester. The prevalence of symptoms associated with Obstructive Sleep Apnoea, Insomnia and Restless Legs Syndrome also increase during pregnancy. Despite growing evidence of ethnic and socioeconomic inequalities in sleep health in both child and adult populations, there has been little scientific attention paid to investigating inequalities sleep across pregnancy and the implications of this for the future lives of the women and their children.

The E-Mee, Maa: Maternal Sleep and Health in Aotearoa/New Zealand study is a questionnaire-based longitudinal study hosted by the Sleep/Wake Research Centre (Massey University, Wellington). The cohort was designed to enable an examination of inequalities in sleep health between Maori (indigenous New Zealanders) and non-Maori women in particular to investigate sleep changes across the perinatal period and the relationship with maternal health and mood. Cohort members (n = 1,193) completed comprehensive questionnaires about sleep health and mood between 35–37 wks gestation and at 12 wks postpartum. Retention rates were above 90% for both Maori and non-Maori across each data collection wave. Clinical data related to the participants’ birth event is also linked to the cohort.

This presentation will summarise evidence of ethnic differences in sleep habits (e.g. sleep duration, quality, nature and frequency of disturbances) and sleep disorders across the perinatal period, identify the factors that contribute to these disparities and consider the implications for infant sleep, health and wellbeing. It will also explore some emerging areas of inquiry and consider how the theoretical and methodological approach underlying our programme of longitudinal research can increase scientific and public understanding of the importance of sleep for mother and child health and wellbeing.

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EFFECTS OF SEDATIVES ON UPPER AIRWAY MUSCLES AND AIRWAY PATENCY

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Sedative use continues to increase in the general population. Almost 5% of those under 60 y, and >9% of those over 60 y report using sleeping pills within the previous month. Obese individuals take sleeping pills more than non-obese. Given that obesity and ageing are key risk factors for obstructive sleep apnoea (OSA), it is crucial to understand the effect of sedative medications on the upper airway and breathing during sleep.

Despite the high rates of sedative use in our community there have been few human studies investigating their effects on the upper airway muscles, airway collapsibility, and breathing during sleep. One major class of commonly prescribed sedatives (benzodiazepines) is likely to worsen OSA, especially in those who do not wake easily from upper airway obstruction during sleep. However, we now know that the causes of OSA vary substantially between patients. New evidence indicates that other sedatives may actually reduce the frequency of sleep-disordered breathing in OSA patients who arouse easily in response to upper airway obstruction during sleep.

This presentation reviews our current understanding of the role of sedatives on the upper airway muscles and airway patency. The potential for some OSA patients to benefit from certain sedatives versus the potential for OSA severity to worsen in others according to underlying pathophysiology and drug type will be covered. Finally, an update of our on-going research in this area will be discussed.
EFFECTS OF OPIOIDS AND OTHER DRUGS ON SLEEP, BREATHING AND VENTILATORY CONTROL

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Understanding the inter-relationship between pharmacological agents, ventilatory control, and their consequent effects on sleep-disordered breathing may provide options to avoid respiratory adverse events and new directions to targeted drug therapy.

Sleep apnea has complex phenotypes in ventilatory control which vary between patients in responding to drugs. Over the years we tested the effect of several drugs on awake ventilatory chemoreflexes and breathing during sleep. We reported significant central sleep apnea in chronic methadone users and found that plasma methadone concentration was the best predicting variable for the variance of central apnea index. Those patients had significantly blunted central chemosensitivity but augmented peripheral chemosensitivity. The imbalance in ventilatory control may contribute to the breathing instability. We also investigated the role of baseline chemoreflex parameters in characterizing obstructive sleep apnea (OSA) response to temazepam, a mild respiratory depressant. As predicted, 10 mg of temazepam improved OSA in some and worsened OSA in others with no overall difference. However, acute use of the centrally acting sedative worsens sleep-disordered breathing mainly in those with heightened chemosensitivity while awake.

In another study investigating the effect of a mild dose of oral morphine on OSA, we found a plasma concentration related drug effect on CO2 ventilatory recruitment threshold during awake which is associated with changes in hypoxemia during sleep. In another study from our group, testosterone modulated CO2 ventilatory response recruitment threshold in obese OSA patients which may underlie short-term worsening of sleep-disordered breathing.

In summary, the influence of various drugs on respiratory control and sleep apnea is complex. Many of the existing studies are limited in sample size or comprehensive methodology. At times, the presence of paradoxical findings highlights the complexity of drug effect on OSA. The existing studies also highlight the importance of considering inter-individual pharmacokinetics and underlying causes of sleep apnea in interpreting drug effects on sleep-disordered breathing. Practical ways to assess an individual’s ventilatory control and how it interacts with upper airway physiology is required for future targeted pharmacotherapy in sleep apnea.

INTERRELATIONSHIP BETWEEN SLEEP, PAIN, ANALGESIA AND BREATHING

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Opioids continue as the mainstay for management of moderate to severe acute pain and other strongly sedative agents such as the gabapentinoids that potentiate opioid effects, both wanted and unwanted, are also now seeing widespread use as part of multimodal analgesia regimens. However, concerns rightly remain about their potential adverse effects on ventilation. The term “respiratory depression” only describes part of that risk. Opioid-induced ventilatory impairment (OIVI) encompasses opioid-induced central respiratory depression (decreased respiratory drive), decreased level of consciousness (sedation) and upper airway obstruction, all of which, alone or in combination, may result in decreased alveolar ventilation and increased arterial carbon dioxide levels. Deaths and morbidity related to opioid administration in the acute pain setting continue to be reported and risks are often said to be higher in patients with obstructive sleep apnoea. However, the tendency amongst anaesthesia providers and researchers to use the term ‘obstructive sleep apnoea’ to encompass the much broader spectrum of sleep- and obesity-related hypoventilation syndromes introduces significant problems in the understanding of opioid-related effects in the acute pain setting. Opioids given for management of acute pain must be titrated to effect for each patient. However, the now widespread strategies aiming for better pain scores alone (the so-called “Fifth Vital Sign”), without highlighting the need for appropriate monitoring of OIVI, are leading to increased adverse events. Therefore, all patients must be monitored appropriately for OIVI so that it can be detected at an early stage and appropriate interventions triggered. (adapted from Macintyre PE, Loadsmans JA, Scott DA. Opioids, ventilation and acute pain management. Anesth 39(4):545–58)

OVERNIGHT OXIMETRY AS A DIAGNOSTIC TOOL IN PAEDIATRIC OSA- EVIDENCE AND PRACTICAL ISSUES

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The cardinal symptom of OSA is snoring. Approximately 35% of children snore- over one million children in Australia- but only about 10% of snoring children (1–3% of the population) will have OSA. Formally defining the presence of OSA in a snoring child requires polysomnography, a technically challenging and expensive (about $1000 each) test only available in paediatric tertiary referral hospitals. Such facilities could never meet the demand if all snoring children were referred. Simple alternatives that are acceptable to young children are extremely attractive for parents, clinicians and the health budget. An abnormal overnight oximetry has been demonstrated to have a high positive predictive value for the presence of OSA, but has a low negative predictive value. This presentation will outline the evidence for the use of overnight oximetry as a diagnostic tool in children with suspected obstructive sleep apnoea. It will also discuss the practical issues associated with this test, including its use as part of a tertiary paediatric sleep service and outside those services.
A standard attended Polysomnogram (PSG) is required to confirm a clinical diagnosis of OSAHS in children, but PSG is a time and labour intensive procedure.

There is an overall growth in the Australian paediatric population; an increased incidence of obesity; a growing awareness of OSAHS and it’s consequences in the community resulting in a corresponding escalation of referrals for the investigation of SDB. 

Approximately 12% of children snore and require PSG investigation to reveal the 1–5 % of children with OSAHS. Standard PSG is too labour intensive to meet the growing demand, resulting in increasing waitlists. Increasing pressures on the health budget demand accountability when investigating SDB.

Specific outcomes of a study comparing home and attended sleep studies in 47 children will be presented. Home Type 2 PSG was performed successfully in these children whilst maintaining accuracy of diagnosis for OSAHS. Home studies were no more likely than standard studies to require repetition. These findings are couched within well defined practice protocols that will be outlined.

When used for the right indication, home type 2 PSG can provide an effective alternative to standard PSG. Their use has enabled the diversification of patient management and diagnosis strategies to create an economical service that will be described including ambulatory Type 2 PSG and or attended Type 1 PSG as appropriate.

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“I CAN GET NUDIE FOR YA”. PRACTICAL CONSIDERATIONS FOR HOME PSG FOR RESEARCH
SARAH BIGGS
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It is well accepted that recording sleep in a laboratory environment is unlikely to be a true reflection of naturalistic sleep, particularly in children who are sensitive to environmental change. Technology now allows for sleep studies to be done in the home, enabling the measurement of more naturalistic sleep. Increased sleep duration, sleep efficiency, deep sleep and reduced awakenings have been reported in home-based studies when compared to laboratory studies indicating better sleep quality in the home environment. However, moving the PSG from the controlled laboratory environment to the unpredictable home environment can be fraught with complications. This session will present some practical considerations for conducting home PSG’s in children to ensure maximal data collection and quality. The session will cover, but won’t be limited to, issues such as bunk beds, electric blankets, curious siblings, protective pets and over-enthusiastic parents.

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ARE WARD BASED AND ABBREVIATED SLEEP STUDIES THE BLACK SHEEP OF THE FLOCK? PRACTICAL CONSIDERATIONS FOR SLEEP STUDIES IN A HOSPITAL WARD
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The clinical demand for paediatric sleep studies is rising faster than many specialist centres are able to fund or accommodate laboratory based attended PSGs. The need to increase capacity and reduce waitlist times can be the drive behind the use of unattended and abbreviated sleep studies. Our paediatric sleep medicine service in Auckland New Zealand has restricted access to laboratory based attended PSGs, and the majority of children referred for investigation live in other parts of the country making consideration for home based studies problematic. This presentation discusses our experience of undertaking sleep studies in a hospital ward; using trolley based portable equipment and nursing observations. Data will be presented on technical/equipment failures, data loss, environmental and staffing issues and the need for repeat studies. The problems faced interpreting the studies and the effectiveness of unattended and abbreviated studies to change management will be discussed. The potential negative impact on laboratory and staff accreditation is highlighted.

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“FLY-IN-FLY-OUT” PRACTICAL CONSIDERATIONS FOR PSG IN REMOTE COMMUNITIES
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This topic explores the practicalities of performing paediatric attended sleep studies in remote regional hospital locations in Western Australia (WA).

There is increased demand for the investigation of Sleep disordered breathing (SDB). This is confounded by increasing obesity and the overall population growth. SDB affects children from birth to adolescence.

A standard attended Polysomnogram (PSG) is required to confirm a clinical diagnosis of OSAHS in children.

Approximately 12% of children snore and require PSG investigation to reveal the 1–5 % of children with OSAHS. Standard PSG in Australia is generally conducted in sleep laboratories within the main teaching hospitals.

WA is a large state with scattered remote communities. The increasing demand for PSGs contributes to growing waitlists. A specialist sleep service has been established for people living in rural and remote towns and communities. A high proportion of indigenous people who have a high burden of chronic disease were reached.

The service conducted in Regional Hospitals provides specialist diagnostic services closer to home for regional families and can be linked to existing outreach services including respiratory, cardiology and ear, nose and throat to ensure improved service delivery for patients with sleep disordered breathing.

We will present our experience from the setting up of a fly-in-fly-out paediatric sleep medicine service, and discuss specific challenges encountered along the way.
THE ROLE OF SLEEP DIFFICULTIES IN THE DEVELOPMENT OF DEPRESSION AND ANXIETY IN A LONGITUDINAL STUDY OF YOUNG AUSTRALIAN WOMEN

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Introduction: In Australia, depression is the leading cause of morbidity in young women. There is growing evidence that patients with insomnia who are not depressed have an increased risk of developing depression 1–2 years later. This association has not been examined in young women, who are particularly vulnerable to depression and insomnia, or over longer time periods. This study examined relationships between sleeping problems and depression and anxiety in a large community sample of young Australian women.

Methods: Data from a 9-year longitudinal cohort study (Australian Longitudinal Study on Women’s Health) on 9,683 young Australian women were analysed. Information on mental health status, medication use and self-reported sleeping difficulties was obtained from 4 questionnaires mailed to participants in 2000 (aged 21–25 years), 2003, 2006 and 2009. Generalized estimating equations with multiple imputations were used to calculate the likelihood of women who reported sleeping difficulties “never”, “rarely”, “sometimes” and “often” in the last 12 months in 2000 to report a diagnosis of depression (excluding postnatal depression) and/or anxiety at subsequent surveys. Women who reported in the year 2000 a diagnosis in past 4 years or symptoms in past 12 months of depression/anxiety, or who used antidepressants were excluded. Adjusted models were fitted to account for variables that were associated with sleeping difficulties (binge drinking, history of abuse, body weight dissatisfaction and qualification level, in 2000).

Results: Women who reported sleeping difficulties “often” in 2000 had an increased risk of having a diagnosis of depression (2003: OR [95% CI] = 2.38 [1.50–3.78], 2006: 4.21 [2.82–6.28], 2009: 3.94 [2.49–6.22]) and anxiety (OR = 2003: 1.48 [0.65–2.65], 2006: 2.13 [1.18–3.86], 2009: 2.58 [1.45–4.59]) at subsequent surveys. A dose-response relationship was also observed for the frequency of sleeping difficulties in 2000 and risk of depression diagnosis at each subsequent survey.

Discussion: Self-reported chronic sleep difficulties in women aged in their early twenties strongly predicted the development of depression over the next decade. This increased risk was higher than that found previously in other age groups. Addressing sleep difficulties of young women should be seen as a strategy for the prevention of poor mental health.

SLEEP DISTURBANCE AS A MODERATOR OF THE EFFECT OF WEB-BASED ANXIETY TREATMENT

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Introduction: Sleep disturbance is a common occurrence in depression and anxiety, and is often a residual symptom even after successful treatment. The current study aimed to test whether pretreatment sleep disturbance moderated program effects on social anxiety symptoms in a web-based generalized anxiety program.

Methods: 374 Australian adults aged between 18 and 30 with subclinical symptoms of GAD, but not meeting diagnostic criteria for GAD, Social Phobia or Panic Disorder, were randomly assigned to either a 10-week web-based GAD program based on CBT (‘ecouch’) or a web-based attention-matched control condition. Participants were recruited from the compulsory Australian Electoral Roll. Pretreatment sleep disturbance was measured using an item from the CES-D capturing the number of days per week participants experienced restless sleep, and social anxiety symptoms were assessed at screen, posttest and 6-month follow-up using the Social Phobia Inventory (SPIN).

Results: Social anxiety symptoms reduced significantly from pre-to posttest for participants with and without sleep disturbance. However, a significant three-way interaction between time, condition and sleep disturbance indicated that this effect was only maintained at 6-month follow-up for those participants without initial sleep disturbance who received the CBT intervention. At 6-month follow-up, these participants showed significantly lower social anxiety symptoms than participants with sleep disturbance in the active condition or participants with and without sleep disturbance in the control condition based on an Intention To Treat analysis (t (236.8) = −2.4; p = 0.016).

Discussion: Web-based CBT targeting generalized anxiety appears to have lasting effects on social anxiety symptoms but only for those without sleep disturbance. This may indicate that sleep disturbance interferes with treatment and that best results might be achieved through specifically targeting sleep-related symptoms.

INSOMNIA PATIENTS’ INFORMATION SEEKING BEHAVIOURS ON THE INTERNET

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Introduction: Initiating various self-help strategies whilst delaying medical help is a common phenomenon reported among insomnia patients. Anecdotal evidence suggests that self-help strategies are often first sought by insomnia patients through the Internet. However, little is known about how patients find and use this information. This study aims to explore patterns of Internet use for health information seeking by those with insomnia.
Method: An online survey about sleep health information seeking on the Internet was circulated to Australian consumers registered on the database of a commercial market research company. The questionnaire was comprised of several sections (demographic variables, medical history, Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16) and Internet usage variables). Inclusion criteria for this study included participants ≥18 years of age; with adequate English comprehension; experiencing insomnia or insomnia symptoms and, used the Internet. Sampling continued until at least 1000 complete responses were obtained.

Results: 1013 participants completed the questionnaire. Equal numbers of male and female subjects participated (mean age 45.0 (SD ± 16.0) years). Mean ISI score was 12.33 (SD ± 4.0) and mean DBAS-16 score was 3.3 (SD ± 0.6). The Internet was used by 41.5% of participants to search for insomnia specific health information. ‘Insomnia’ (26.4%), ‘Sleep Disorders’ (12.9%) and, ‘Sleep Problem’ (11.8%) were the most frequently used search terms. Key information sought by these consumers was related to insomnia treatment options, causes of insomnia and insomnia symptoms. All participants accessed fewer than 10 websites for a given search and less than one quarter of participants (21%) discussed online information with their healthcare provider. However, 80 % of participants’ decisions about seeking medical help and/or medication usage were influenced by Internet based information.

Discussion: Users of sleep health information on the Internet appear to be in the early course of their sleep complaint with sub-threshold ISI and DBAS-16 scores. Abbreviated insomnia therapies are also the most effective in this patient sub-group. Coupled with their existing patterns of Internet use, the case for developing and investigating the feasibility of interactive web-based insomnia interventions in Australia is compelling.

210 EFFECTS OF ACUTE PARTIAL SLEEP RESTRICTION ON MEASURES OF AFFECT AND IMPULSIVITY IN YOUNG ADULTS

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Introduction: Young adults may habitually experience daytime sleepiness as a consequence of their educational, vocational and social commitments impacting on sleep opportunity. Young adulthood is often characterised by highly affective arousal, impulsivity and risk taking. The way in which sleepiness contributes to these behaviours is underacknowledged. The present study assessed whether acute partial sleep restriction could cause sleepiness sufficient to de-regulate affective and executive inhibitory control mechanisms, resulting in a worsening of subjective affect, increased reactivity to negative stimuli, and increased impulsivity.

Method: Eight males and 12 females aged between 18 and 24 years (M = 20.2 ± 2.1) with habitual late bed-time (after 22:30 h) and wake-time (after 06:30 h) completed the Psychology Experiment Building Language (PEBL) Perceptual Vigilance Task (PPVT), Karolinska Sleepiness Scale (KSS), Positive and Negative Affective Schedule (PANAS), Emotional Go/No-go Task and the PEBL Balloon Analog Risk Task (PBAR). Testing was on two occasions, one week apart, once at 05:00 h while “sleepy” (following 04:00 h wake-time), and once at 09:00 h while “not-sleepy”, with counterbalanced order of condition.

Results: Participants were significantly more “sleepy” at 05:00 h than 09:00 h as evinced through slower PPVT mean reaction time (05:00 h, M = 411.9 ± 180.0, 09:00 h, M = 374.0 ± 110.6, p < .05, partial η² = .241) and KSS responses (05:00 h, M = 6.8 ± 1.4, 09:00 h, M = 4.9 ± 2.0, p < .001, partial η² = .533). A repeated measures MANOVA revealed a significant main effect of condition on the cognitive and affective dependent variables, F (7, 11) = 4.330, p = .019, partial η² = .734 (large effect). Follow-up univariate analyses showed a significant decrease in positive but not negative affect on the PANAS, and an increase in burst balloons and cost-benefit ratio on the PBART. Reactivity to negative No-go stimuli was not altered.

Discussion: The results suggest that acute sleep restriction may cause changes in affective experiences and increase impulsive behaviour. The degree of sleep restriction imposed was mild, and might be easily achieved in everyday life. The implications for an association between sleep restriction, risk behaviour, physical and social consequences for young adults need to be better understood.

211 RECOVERY OF MOOD FOLLOWING SIMULATED SPLIT SLEEP SCHEDULES

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Introduction: Shift work can lead to circadian misalignment and sleep deprivation, resulting in increased negative mood during and after periods of shift work. The aim of the present study was to explore recuperation of mood following four 24 h periods on an 8 h on / 8 h off rotating shift schedule, compared to a 6 h on / 6 h split shift schedule.

Methods: As part of an ongoing study, sixteen healthy subjects (N = 8 per condition; ages 21–33; 8 f) participated in a 9-day laboratory study. The study involved 2 baseline days (BL1, BL2, 10 h time in bed (TIB) per day, 2200 h–0800 h), 4 days on either a 8 h on / 8 h off rotating shift schedule (SS4) with 6 h on / 6 h off shift schedule during each ‘off’ period, or a 6 h on / 6 h split shift schedule with 5 h TIB during each ‘off’ period; and 2 recovery days (R1, R2, 10 h TIB per day, 2200 h–0800 h). Subjects all achieved 10 h TIB per 24 h in total, across both shift schedules. A battery of measures included the Positive and Negative Affect Scale (PANAS) which was administered approximately every 2 h during scheduled wakefulness. Negative Affect scores derived from the PANAS were compared between shift schedules, and between BL, SS4, R1 and R2 days using linear mixed effects ANOVA.

Results: No significant main effect of shift schedule was found for Negative Affect. However, there was a significant main effect of shift day, with Negative Affect on SS4, R1 and R2 days significantly higher than at BL, F(3,321) = 7.60, p < .001. A significant shift day interaction was also found F(3,321) = 3.90, p = .009, which revealed that in the 6 h on / 6 h off schedule Negative Affect was similar on R1 and R2, but significantly lower than on SS4. In the 8 h on / 8 h off schedule Negative Affect was similar on SS4, R1 and R2.

Discussion: There was an increase of Negative Affect over the simulated shift schedules, which remained after two nights of recovery sleep. These findings suggest that more than 2 nights of 10 h TIB recovery sleep may be required for mood to recover after an 8 h on / 8 h off rotating shift schedule or a 6 h on / 6 h split shift schedule.
COMMUNITY MISPERCEPTIONS OF THE 'SHAPE' OF ADULT SLEEP AS A FUNCTION OF AGE
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Introduction: It has been reported that about 70% of young and middle aged adults believe that sleep is an unbroken U shape across the night (Lack, 2007). Respondents plotted the shape of sleep across a typical night's sleep, showing lighter and deeper sleep as well as possible awakenings. The current study explored perspectives on the shape of healthy adult sleep in one's own age cohort and other age groups.

Method: All participants plotted the sleep of a healthy 18 year old and a healthy 65 year old (plot age), with participants being both younger adults (n = 113, aged 18–25 years) and older adults (n = 110, aged 60 + years) (age group). Plots were scored as ratings of sleep depth (0 = awake and 3 = very deep sleep) across 15 time periods.

Results: The average of all 434 plots was found to be a clear U shape. A two way mixed MANOVA found a significant main effect for plot age (F(1,215) = 51.2, p = .000) but not for age group (F (1,215) = .374, p = .541), indicating a deeper U shape for the sleep plots of an 18 year old compared to a 65 year old, regardless of the age of the respondent. Frequency counts were then conducted of plots that were (i) U-shape (ii) non-U shape with no wake, and (iii) non-U shape with wake shown. As found by Lack (2007) about 70% of all plots were U shaped. Importantly, more than nine out of ten younger adults and about three quarters of older adults believe that healthy sleep includes no awakenings, whether a sleeper is 18 or 65 years old. Chi Square analyses confirmed this as a significant difference across age group (and not plot age).

Discussion: While it was recognised that younger sleep is deeper than older sleep, major misconceptions about the 'shape' of sleep across both younger and older members of the community were found, as well as a widespread mistaken belief that healthy sleep does not include awakenings. Education for adults of all ages about the 'roller-coaster' nature of sleep across the night and the normality of awakenings throughout the adult lifespan may lead to less anxiety about sleep fragmentation and improved sleep quality.


A QUALITATIVE SCORING SYSTEM FOR AWAKE NASOPHARYNGOSCOPY TO ASSESS AIRWAY CHANGES WITH MANDIBULAR ADVANCEMENT
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Introduction: Presently, there is no reliable method to predict mandibular advancement splint (MAS) treatment outcome in OSA patients. We have previously used quantitative measurement of nasopharyngoscopic images and found reduced simulated airway collapse (Muller manoeuvre) in MAS treatment responders compared to non-responders. However, to be clinically useful nasopharyngoscopic assessment of the airway response to MAS must be quick and subjectively assessed. We aimed to develop a qualitative scoring system for awake nasopharyngoscopy to assess changes with mandibular advancement (MA).

Methods: OSA patients (AHI > 10/hr) commencing MAS treatment were recruited. A customised bite block set to 100% maximal protrusion was used to induce MA. A scoring sheet with schematic diagrams was developed to assess: 1) changes in airway diameter (lateral and anteroposterior) with MA during tidal breathing, 2) amount of airway collapse during the Muller manoeuvre at baseline and with MA. Assessments were made at 3 airway levels (velopharynx, oropharynx and hypopharynx). Observations were scored as 1) <50%, >50% increase or no change in airway diameters 2) <50% or >50% collapse during the Muller manoeuvre, as well as pattern of airway wall collapse (lateral, anteroposterior or concentric).

Results: Nasopharyngoscopy is complete in 23 patients (age 56.52 ± 10.55 years, BMI 25.17 ± 4.72 kgm2; AHI 28.03 ± 14.03 hr−1). During tidal breathing, MA was observed to increase upper airway diameter more frequently in the lateral than anteroposterior dimension in all three airway regions. When the Muller manoeuvre was performed, significant collapse (>50%) was reported in the majority of patients in the velopharynx (87%), oropharynx (74%) and hypopharynx (36%). With MA, significant airway collapse reduced in the velopharynx (26% of patients), oropharynx (31%) and hypopharynx (13%). The pattern of collapse, both without and with MA, was predominantly from the lateral airway walls.

Conclusion: Subjective nasopharyngoscopic assessment with MA showed reduced collapse in all airway regions. Increases in diameter were predominantly observed in the lateral dimension. Work is ongoing to assess the intra- and inter-observer reliability of the procedure, with the view to use this to observe patterns of upper airway changes with MA between MAS treatment responders and non-responders.

SHORT TERM OUTCOMES FOR OBSTRUCTIVE SLEEP APNOEA PATIENTS TREATED WITH HYPOGLOSSAL NERVE STIMULATION
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Introduction: Novel modes of treatment for OSA are sought by patients and clinicians for whom CPAP tolerance may be problematic. We report the findings of a randomised controlled trial of hypoglossal nerve stimulation (HGNS). This trial was conducted in 22 centres worldwide and was prematurely closed by the company (Apnex Medical) in January 2013 following a negative interim analysis. We report here the 6 month results from our centre.

Methods: Participants with an apnoea hypopnoea index (AHI) of 20–80 and had failed usual treatment options were enrolled. Recruitment, surgical procedure, device activation and titration have been previously described (ASA 2012). Participants were randomly allocated on a 2:1 basis to have the device activated 1 month or 7 months post-implantation. Outcome assessment at 6 months post randomisation included sleep measures and behavioural outcomes as below. Responders were a priori defined as achieving an AHI < 20 with at least 50% reduction from baseline.
Results: All data are mean (SEM). The device was implanted in 4 females, 17 males, mean age 54.3 (1.7) years. There was a significant improvement in AHI, arousal index and depression (BDI) in the active group, but the only inter-group difference at 6 months was in the Beck Depression Index (BDI). Using logistic regression, responder status was predicted by ODI4%, not group, and there was an association with obesity (BMI).

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>6 months</th>
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<tbody>
<tr>
<td></td>
<td>Active (n = 14)</td>
<td>Control (n = 7)</td>
</tr>
<tr>
<td>AHI</td>
<td>34.1 (3.5)</td>
<td>40.9 (6.5)</td>
</tr>
<tr>
<td>4% ODI*</td>
<td>10.8 (2.5)</td>
<td>22.2 (4.3)</td>
</tr>
<tr>
<td>Arousal Index</td>
<td>37.2 (3.2)</td>
<td>33.2 (6.9)</td>
</tr>
<tr>
<td>ESS</td>
<td>11.1 (3.6)</td>
<td>13.6 (2.0)</td>
</tr>
<tr>
<td>BDI</td>
<td>14.0 (2.7)</td>
<td>13.6 (3.4)</td>
</tr>
<tr>
<td>Responders (%)</td>
<td>7 (50)</td>
<td>2 (28.6)</td>
</tr>
</tbody>
</table>

P < 0.05: *Active vs Control, baseline; †change from baseline; #Active vs Control, 6 mths

Conclusion: Further research is warranted into this potentially promising therapy.

MODAFINIL AND ARMODAFINIL IMPROVE DAYTIME SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: A SYSTEMATIC REVIEW

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Introduction: This systematic review aims to collate all reliable evidence for the use of modafinil and armodafinil in patients with obstructive sleep apnea.

Methods: A keyword search was performed on Scopus, Pubmed and the Cochrane Register and an abstract search of key respiratory and sleep conferences back to 2000 was combined with authors’ knowledge. The identified articles were then systematically assessed until the sample included only randomised, placebo-controlled trials of modafinil or armodafinil in adult OSA patients lasting ≥ 2 weeks.

Results: 244 articles were identified after duplicates were removed. 11 trials met inclusion criteria. An overview of those trials is shown in the table below.

<table>
<thead>
<tr>
<th>Study, year, medication (M/A)</th>
<th>n</th>
<th>ESS</th>
<th>MWT</th>
<th>MSLT</th>
<th>FOSQ</th>
<th>CGI</th>
<th>PVT</th>
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<td>*</td>
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<tr>
<td>Pack 2001/</td>
<td>157</td>
<td>*</td>
<td>+</td>
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<td>+</td>
<td>+</td>
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Key: * ns • symbols indicate a significant, non-significant and not tested effect, respectively

Conclusion: Modafinil and armodafinil appear to improve both subjective and objective measures of daytime sleepiness in patients with OSA.

INFLUENCE OF CRANIOFACIAL SIZE ON THE RELATIONSHIP BETWEEN WEIGHT LOSS AND OSA IMPROVEMENT

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Introduction: Obesity is the major reversible risk factor for OSA. Obese men with OSA undertook a 6 month sibutramine-assisted weight loss program. Upper airway CT scans performed at baseline were used to obtain 3-dimensional coordinates of cephalometric landmarks of the maxillomandibular complex (left and right condyle and gonion, menton and anterior nasal spine) from axial image slices. Mandibular enclosure volume (MEV) was calculated as the polyhedral volume between these six cephalometric points. A
multivariate regression model was used to investigate whether association between weight loss (%Δkg) and OSA improvement (%ΔAHI) depends on craniofacial size (MEV).

Results: Craniofacial analysis is complete in 45 men (age 47.2 ± 9.4, baseline AHI 46.8 ± 23.9, BMI 34.0 ± 2.8) with an average weight loss of −7.4 ± 4.4 kg. %Δkg was only a weak predictor of %ΔAHI (r² = 0.12, p = 0.021). Regression analysis to determine moderation using interaction of the two predictors (%Δkg × MEV) improved the fit of the model for %ΔAHI, effectively doubling the explained variance (r² = 0.25, p = 0.007). The interaction between %Δkg and MEV was significant (β ± SE: −0.12 ± 0.05, p = 0.02).

Conclusion: %Δkg was only modestly related to OSA improvement in these obese males. Interaction of %Δkg and craniofacial size (MEV) doubled the strength of the model in predicting %ΔAHI. However these variables still only explained 25% of the variance in %ΔAHI after a weight loss intervention. Further work is needed to investigate the relationship between weight loss and OSA.

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TREATMENT PROVIDES LONG TERM IMPROVEMENT IN THE QUALITY OF LIFE IN PRESCHOOL CHILDREN WITH SLEEP DISORDERED BREATHING

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Introduction: Sleep disordered breathing (SDB) is a common disorder in preschool children, and is known to have an adverse impact on the child’s quality of life. To date, there are scant data on the effect of treatment on quality of life in this age group. Therefore this study aimed to assess the effect of treatment on the quality of life in preschool children with SDB, 3 y following initial diagnosis using the OSA-18 questionnaire.

Method: These are preliminary data from 43 children (33 SDB, 10 non-snoring controls; 6–8 y) with parent-completed OSA-18 questionnaires at the baseline polysomnography (PSG) study. All subjects underwent repeat overnight PSG 3 y later and a second OSA-18 was completed. The OSA-18 is a validated, sleep specific, quality of life survey consisting of 18 questions in five domains: sleep disturbance (snoring, apnoeas, choking/gasping and restless sleep), physical symptoms, emotional symptoms, daytime function, and caregiver concerns. Subjects were assigned to control (n = 10; ORDI ≤ 1 no history of snoring), treated (n = 19; ORDI > 5, n = 10; ORDI 1–5, n = 4; ORDI 6–10, n = 5) or not treated (n = 14; ORDI 1–5, n = 4; ORDI 6–10, n = 10) groups. Domain and total scores were compared between the baseline and follow-up studies using two way repeated measures ANOVA.

Results: At follow-up the treated group had significantly improved nocturnal symptoms of SDB (decreased sleep disturbance subscale (p < 0.01)), that was not evident in the children who were not treated. In addition, reduced physical symptoms and caregiver concerns were reported (p < 0.01 for both). However, treatment had no effect on improving measures of daytime behaviour, concentration or mood (emotional symptoms and daytime behaviour subscores).

Conclusion: Preliminary data indicate that 3 y following treatment, preschool children with SDB had reduced symptoms of SDB, indicated by a decreased sleep disturbance subscore. That is, a reduction in the amount of snoring, apnoeas, choking, gasping and restless sleep occurring during sleep, whereas the children who were not treated, still had significant sleep disturbance. Treatment also had a positive effect on physical symptoms and caregiver concerns. This preliminary analysis indicates that treatment has lasting effects on improvement of quality of life in preschool children with SDB.

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CAN SLEEP EDUCATION IMPROVE PRE-ADOLESCENT SLEEP?

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1Health and Use of Time Group, University of South Australia, Adelaide, South Australia, Australia, 2Appleton Institute, Central Queensland University, Adelaide, South Australia, Australia

Introduction: From puberty, adolescents appear to obtain inadequate sleep and have therefore largely been targeted for sleep education programs. These programs aim to improve sleep hygiene and in turn increase sleep duration. It is unknown what impact sleep education may have on improving sleep behaviour in pre-adolescents before they reach puberty and associated sleep problems. The current study aimed to assess the effectiveness of a sleep education program on sleep behaviour changes in pre-adolescents.

Method: In a randomised controlled trial (RCT), one Year 6/7 class from 12 South Australian schools participated, with half randomly allocated to the intervention group (N = 75) and half to the control group (N = 74). The study employed a 2 (group: intervention and control) × 3 (time: baseline (T1), immediately post-intervention (T2, 6 weeks post-baseline) and follow up (T3, 18 weeks post-baseline)) mixed model design. Intervention schools received four classroom lessons about sleep and completed a sleep-focused research project. Sleep hygiene (SH) was measured at each time point using the Sleep Hygiene Index. Sleep quantity was measured with seven days’ actigraphy at each time point. Primary outcome measures obtained were total sleep time (TST), time in bed (TIB) and SH.

Results: At baseline participants’ average TST was 8.11 h, and SH scores were normal (M = 31.5, SD = 7.02). Mean and SD scores remained consistent for both groups over the three assessments for all outcome measures. Repeated measures ANOVA analyses revealed no significant interaction between group and time for school night TIB (p = 0.56), weekend TIB (p = 0.83) or SH (p = 0.61). TST yielded similar results to TIB, and results were similar when boys and girls were analysed separately.

Discussion: This was the first time pre-adolescents have been assessed in a RCT on sleep education. Relative to Controls, there were no changes in the Intervention group in mean SH, TIB or TST across assessments. Sub-group analyses will clarify if behaviour change has occurred in specific groups. Perhaps, as participants had good SH and were sleeping well at T1, they felt no need or desire to change sleep behaviour. Alternatively, the knowledge-based intervention may have been insufficient to generate behaviour change (as seen in other health education programs), or a longer and more intense stimulus may be necessary for behaviour change.
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SLEEP QUALITY, EXECUTIVE FUNCTIONING AND BEHAVIOR IN CHILDREN AND ADOLESCENTS WITH TYPE 1 DIABETES
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1UniSA, South Australia, Australia, 2WCH, South Australia, Australia

Discussion: The sleep of children with Type 1 Diabetes (T1D) tends to be restless and more fragmented while their daytime functioning is characterised by mild cognitive deficits with elevated levels of problem- atic internalised behaviours such as depression and anxiety. The objec- tives of the study were twofold: first, to examine the relationship between sleep, and neurocognitive and behavioural functioning in chil- dren and adolescents with T1D; and second, to test whether sleep deficit mediates the relationship between diabetes and daytime functioning.

Method: Participants included 47 children and adolescents with T1D (recruited from a hospital diabetic clinic) and 49 healthy controls (recruited from hospital advertisements and friends of children with T1D) (age range = 5–16 y). A posted survey containing the Sleep Dis- turbances Scale for Children, Behavior Rating Inventory of Executive Functions, and the Behavior Assessment System for Children-Revised was completed by parents. Diabetic parameters were collated from medical records.

Results: Compared to controls, children with T1D reported more prob- lems with daytime sleepiness, and sleep initiation, maintenance and transition. They also had a higher frequency of internalised problematic behaviours (e.g. depression, etc.) and greater problems with behavioural regulation. By contrast, they were not more likely to report externalised problematic behaviours (e.g. hyperactivity, etc.) and problems with metacognition. Medialional analyses revealed that sleep quality fully mediated (1) metacognitive capacity and both (2) externalised and (3) internalised problematic behaviour, but not behavioural regulation.

Discussion: Children with T1D have a higher frequency of sleep prob- lems, and are more likely to report mild deficits in executive and behavioural functioning. Much of the neurocognitive and behavioural deficits in children with T1D can be explained by the impact of diabetes on sleep rather than the direct impact of diabetes on daytime functioning itself.

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DUMMY USE IN INFANTS DOES NOT INCREASE SPONTANEOUS AROUSABILITY DURING SLEEP IN EITHER THE PRONE AND SUPINE SLEEPING POSITION
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Background: The underlying mechanism for the Sudden Infant Death Syndrome (SIDS) is thought to involve impaired arousal from sleep. A major risk factor of SIDS is prone sleeping and epidemiological studies have shown that dummy use decreases the risk of SIDS, even in prone sleeping infants. It has been suggested that dummy use may increase arousability; however previous studies have shown conflicting results. We aimed to determine the effects of dummy use on spontaneous arousability in infants slept prone and supine over the first 6 months of life. We hypothesised that spontaneous arousals would be increased in dummy users, particularly in the prone position.

Methods: Twenty healthy term infants were studied with daytime polysomnography at 2–4 wks (n = 20), 2–3 mo (n = 19) and 5–6 mo (n = 18) postnatal age (3 studies were excluded due to poor EEG quality). Infants were divided into dummy users (2–4 wks n = 7, 2–3 mo n = 11, 5–6 mo n = 8) and non-users (2–4 wks n = 13, 2–3 mo n = 8, 5–6 mo n = 10) at each study. Spontaneous cortical (CA) and sub-cortical (SCA) arousals were scored according to the international guidelines and converted into frequency per hour of sleep to account for sleep duration variability between infants. Data were tested for normal- ity and transformed where necessary. The effects of dummy use and sleep position with sleep state (active sleep: AS-supine, AS-prone; quiet sleep: QS-supine, QS-prone) on spontaneous arousals at each age were analysed with a two-way ANOVA.

Results: A total of 787 arousals (dummy users n = 345, non-users n = 442) were scored. At all three ages there was no effect of dummy use on total sleep or wake time or the number of spontaneous awakenings. In addition, there was no effect of dummy use on the frequency or duration of the total number of arousals or on SCA or CA. Although not significant, there was a consistent trend whereby the highest number of arousals occurred during AS-supine, then AS-prone, followed by QS-S, with the least arousals in QS-P.

Conclusions: Dummy use did not increase total spontaneous arousability in infants at any of the three ages studied, in either the prone or supine sleeping position. These findings suggest that the preventative effect of dummies for SIDS may be through physiological mechanisms other than increased arousability.

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SAFE SLEEP PRACTICES AND AN ASSESSMENT OF POPULATION SUDI RISK
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Introduction: While population-wide interventions to prevent Sudden Unexpected Death in Infancy (SUDI) have shown success, the rates in New Zealand remain high by international comparison. The control group of a large infancy intervention to prevent excessive weight gain provided an opportunity to examine infant safety during sleep at the population level.

Aims: To describe safe sleep practices related to SUDI prevention mes- sages and establish a risk score based on best practice recommendations.

Methods: Within the 4-arm trial (n = 803), 209 families did not receive any extra antenatal or postnatal education in regard to sleep, feeding and activity (control group). Participants gave information antenatally and at 3, 7, 11, 15, 19 and 23 weeks after birth and we now report data on sleep position, place of sleep, smoking, pacifier use and breastfeeding.

Results: In relation to best practice recommendations, 90% of infants were sleeping in the safest position (supine) at 19 weeks, 89% were receiving ‘any breastfeeding’ at 2 months, 19% were using a pacifier at 19 weeks and at 3 weeks 81% were adhering to the combined recommen- dation of no bedsharing and no smoking during pregnancy. Room sharing in a cot or bassinette at 3 weeks was common practice (65%) and transition to sleeping in a separate room increased over time. Bed sharing was practiced in 13% of participants at 3 weeks of age, reducing by almost half at 7 weeks and remaining relatively stable up to 19 weeks of age. Published meta-analyses were used to calculate individual risk scores. The risk ratio’s used were: prone or side sleeping at 19 weeks (RR = 6.91), no pacifier use at 19 weeks (RR = 1.41), no breastfeeding at 2 months
PREDICTING SIGNIFICANT OBSCURTIVE SLEEP APNOEA IN CHILDREN FROM CLINICAL MEASURES

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Introduction: Formally defining the presence of obstructive sleep apnoea (OSA) in a snoring child requires polysomnography (PSG), a test with limited availability. Specialist PSG facilities could not meet demand if all snoring children were referred and so effective risk assessment tools are needed. In this study we aimed to examine which combination of clinical factors, oximetry and actigraphy measures provide the most effective model for prediction of moderate-severe OSA (MS OSA).

Methods: Children referred for PSG for possible OSA were recruited prospectively and underwent clinical investigations including: OSA-18 questionnaire, physical examination, and home overnight oximetry with concurrent actigraphy. Variables assessed for inclusion in the predictive model were: age, gender, OSA-18 total score and sleep disturbance sub-scale score, BMI, tonsil size, Mallampati score, Friedman pharyngeal score, Angle’s dental malocclusion score, oximetry parameters (SpO2 nadir; dips below 90%/h, dips of 4%/h), pulse rate (PR) standard deviation and PR increases of 15 bpm/h, and movement fragmentation index from actigraphy. The primary outcome variable dichotomised the obstructive respiratory disturbance index from PSG into < 5/h (primary snoring/mild OSA) and ≥ 5/h (MS OSA). Stepwise forward elimination logistic regression was used to define significant variables (p < 0.1) and a model was then developed to predict MS OSA.

Results: 68 children (30F; mean ± SD age 5.5 ± 2.7 y) with full PSG results were included. 29 had MS OSA. Dental malocclusion score and SpO2 nadir were the only significant predictor variables identified and the model was developed on these two parameters, using SpO2 nadir divided into tertiles. Results indicate a 9-fold increase (95 CI 0.57 to 447, p = 0.008) in children classified as MS OSA in the lowest SpO2 nadir tercile compared to the highest tercile. ROC analysis gave an area under the curve of 0.76 using this model, with sensitivity 62%, specificity 74%, positive predictive value 62% and negative predictive value 74%. 69% of children were correctly classified using this system.

Conclusion: Preliminary results suggest that development of a clinical risk score using simple screening tests is possible in children. Dental malocclusion was identified as a significant predictor and highlights the role of craniofacial variables in OSA in childhood.

DOES A SLEEP ARCHITECTURAL PHENOTYPE EXIST FOR CHILDREN WITH DOWN SYNDROME?

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Introduction: Evidence suggests that whilst the high prevalence of obstructive sleep apnoea (OSA) in children with Down Syndrome (DS) likely contributes to sleep fragmentation, their poor sleep is only partly attributable to the presence of OSA. We hypothesised that a sleep phenotype exists for DS, which would be independent of OSA and evident across childhood.

Methods: A retrospective study of sleep architecture in children with DS together with controls matched for age, gender, year of study and severity of OSA. All subjects underwent baseline polysomnography between January 1985 and January 2013 at the University of Michigan Sleep Disorders Centre. In each subject the percentage of total sleep time spent in each sleep stage (N1; N2; N3 (slow-wave); rapid eye movement (REM)) and the apnoea hypopnoea index (AHI) was calculated, the latter defined as the number of apnoeas or hypopnoeas per hour of total sleep time. As sleep architecture is affected by both age and puberty, case-control pairs were compared according to age group, using the Wilcoxon-Signed rank test.

Results: Sleep characteristics were compared in 130 DS subjects with a median age of 5.8 years (range 0–17.8 years) and AHI of 7.4 events/hour (range 0–133 events/hour), and 130 matched controls. Body mass index z-scores were similar between cases and controls (p < 0.05 for both). Children with DS exhibited increased N1 sleep at 2–6.9 years, 7–11.9 years and 12–17.9 years (p < 0.05 for all) as well as reduced REM sleep percentage, significant at 7–11.9 years (p < 0.05). Children with DS exhibited increased N1 sleep at 2–6.9 years but decreased N1 sleep at 12–17.9 years compared to controls (p < 0.05 for both).

Conclusions: Children with DS exhibit altered sleep architecture when compared to non-DS children of similar age and OSA severity. Notably, reduced REM sleep and increased slow-wave sleep was seen independent of OSA in children with DS over two years. Amounts of both REM and non-REM sleep may have important implications for learning, memory and behaviour, all the more significant in this population with baseline neurocognitive impairment.
HOW CHILDREN'S SLEEP PATTERNS CHANGE FROM 0–9 YEARS: AUSTRALIAN POPULATION LONGITUDINAL STUDY

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Introduction: The first three biennial waves of the nationally-representative Longitudinal Study of Australian Children, comprising two independent cohorts recruited in 2004 at ages 0–1 years (n = 5107) and 4–5 years (n = 4983). Participants: Children with analyzable sleep data for at least one wave. Measures: At every wave, parents prospectively completed 24-hour time-use diaries for a randomly selected week or weekend day. ‘Sleeping, napping’ was one of 26 pre-coded activities recorded in 15 minute time intervals. Results: From 0–9 years of age, 24-hour sleep duration fell from a mean peak of 14 (SD 2.2) hours at 4–6 months to 10 (SD 1.7) hours at 9 years, mainly due to progressively later mean bedtime with age from 8 pm (SD 75 minutes) to 9 pm (SD 60 minutes), and declining length of day sleep from 3.0 (SD 1.7) hours to 0.3 (SD 0.2) hours. Number and duration of night wakings also fell. By elementary school, wake- and bed-times were markedly later on weekend days. The most striking feature of the percentile charts is the huge variation at all ages in sleep duration, bed-time and, especially, wake-time in this normal population.

Conclusions: Parents and professionals can use these new percentile charts to judge normalcy of children's sleep. In future research, these population parameters will now be used to empirically determine optimal child sleep patterns for child and parent outcomes like mental and physical health.

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UPPER AIRWAY MUCOSAL SURFACE TOPOGRAPHY IN OBSTRUCTIVE SLEEP APNOEA (OSA) PATIENTS SHOWS INCREASED PRINCIPAL CURVATURES WHEN COMPARED WITH HEALTHY SUBJECTS

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Introduction: Upper airway (UA) anatomy plays a role in the pathogenesis of OSA, with OSA patients tending to have a longer UA with a smaller lumen. We have suggested that UA lumen morphology is influenced by factors (e.g. posture, lung volume) that alter local UA wall topography through a redistribution of local peripharyngeal tissue pressures. In the present study we used MRI imaging and surface curvature analysis to determine if local UA mucosal surface topography also differs between healthy subjects and OSA patients.

Methods: We studied 10 healthy (6 male, age: 33.7 ± 8.6 yrs [mean ± SD], BMI: 25.2 ± 3.1 kg/m²) and 11 OSA subjects (9 male, age: 50.6 ± 10.6 yrs, BMI: 32.9 ± 6.7 kg/m², apnoea-hypopnoea index [AHI]: 35.1 ± 15.1 events/hr). In each subject, we obtained awake, supine, head/neck position controlled, gated (end expiration), T2 weighted axial MRI images of the velopharynx (VP, nasal choanae to base of uvula; 2 mm slices). VP lumen surfaces were segmented (Amira), allowing 3-dimensional models of the mucosal surface terrain to be constructed (Rhinoceros). These reconstructions, we measured VP airway length, mean cross sectional area (CSA) and mean circumference (Circ). Absolute values (i.e. curvature direction not considered) for average principal curvatures (κmax, κmin, maximum and minimum curvature, respectively) were also computed for each 2–5 mm² of surface area and then expressed as an average value for the entire VP. Data were expressed as group mean ± SD values and compared with a Mann Whitney or unpaired t test as appropriate.

Results: VP was significantly longer in the OSA subjects (healthy: 23.4 ± 6.5 mm; OSA: 29.3 ± 4.5 mm; p < 0.05), with a smaller mean CSA (healthy: 101.1 ± 31.6 mm²; OSA: 52.0 ± 19.6 mm²; p < 0.001) and mean Circ (healthy: 46.2 ± 7.6 mm; OSA: 30.6 ± 5.0 mm; p < 0.0001). In the healthy group, mean absolute value for κmax was 0.169 ± 0.035 mm⁻¹ and for κmin 0.320 ± 0.066 mm⁻¹. OSA group values were significantly greater (κmax 0.247 ± 0.066 mm⁻¹, κmin 0.476 ± 0.129 mm⁻¹; both p < 0.005).

Conclusion: Compared with healthy subjects, VP in OSA patients is not only longer with a smaller CSA, but also has surface topographical features that have smaller curvature radii (i.e. more sharply defined). We found increased principal curvatures when compared with healthy subjects.

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COMPARING UPPER AIRWAY COLLAPSIBILITY DURING ANAESTHESIA AND NREM SLEEP IN PATIENTS WITH AND WITHOUT OSA

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Introduction: The increased upper airway (UA) collapsibility during sleep evident in obstructive sleep apnoea (OSA) is thought to relate to interaction between pharyngeal anatomy and neuromuscular activity. It is difficult to isolate contributions of passive mechanical from neuromuscular factors during sleep due to presence of UA reflexes and variable muscle activity. General anaesthesia permits study of UA mechanical properties devoid of neurogenic influences (i.e. a hypotonic airway). The aim of this study was to compare UA collapsibility during anaesthesia and sleep in humans with and without OSA.

Methods: Six subjects (4 males), 3 with OSA, were recruited. UA collapsibility was determined from pressure-flow relationships where applied UA pressure was manipulated to elicit variable degrees of inspiratory flow-limitation and collapsing pressure (Pcrit) was determined. Care was taken to obtain Pcrit measurements while the head was
in a neutral posture during anaesthesia (surgical depth) and sleep (non rapid eye movement, NREM).

**Results:** Patients with OSA (n = 3) had similar Pcrit during sleep and anaesthesia (~1.61 ± 2.0 (mean ± SD) and 2.1 ± 2.6 cmH2O respectively) whereas control subjects had a significantly more negative Pcrit during sleep than anaesthesia (~11.89 ± 8.6 vs -0.84 ± 1.5 cmH2O respectively (p < 0.05)) indicating a less collapsible airway. Pcrit was not significantly different between OSA and control subjects during anaesthesia, but was significantly more negative (p < 0.05) in controls during sleep (RM ANOVA).

**Conclusions:** 1) In control subjects the UA is significantly more collapsible under anaesthesia than sleep, likely due to preserved muscle tone during NREM sleep which is abolished with anaesthesia. 2) In OSA this tonic neuromuscular compensation appears insufficient to prevent increased collapsibility with sleep-related loss of phasic activation of upper airways dilators, presumably because of unfavourable anatomical predispositions.

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**REDUCTION IN THE SURFACE TENSION OF THE UPPER AIRWAY LINING LIQUID (STUAL) UNFOLDS THE VELOPHARYNGEAL MUCOSAL SURFACE IN OBSTRUCTIVE SLEEP APNEA (OSA) SUBJECTS**

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**Introduction:** Lowering the surface tension of the upper airway (UA) lining liquid decreases both UA collapsibility and OSA severity through unknown mechanisms. We examined effects of lowering STUAL on UA lumen size and mucosal fold formations in healthy subjects and OSA patients.

**Methods:** Subjects were studied awake and supine. Gated (end expiratory), head/neck position controlled (Frankfort plane perpendicular), T2 weighted MRI images of the UA (nasal choanae-larynx, 2 mm contiguous slices) of 10 healthy (6 males, age: 33.7 ± 8.6 yrs [mean ± SD]; BMI: 25.2 ± 3.1 kg/m2) and 9 OSA subjects (6 males, age: 52.2 ± 10.1 yrs; BMI: 33.1 ± 7.4 kg/m2; AHI: 34.4 ± 16.2 events/hr) were acquired before and after exogenous surfactant administration (2.5 ml oral spray, Beractant). STUAL was measured (pull-off force technique) as the average of values of 0.2 μl UAL samples from the posterior pharyngeal wall before and after each image acquisition. Axial UA mucosal contours were segmented (Amira), and velopharyngeal (VP, nasal choanae-base of uvula) and oropharyngeal (OP, tip of uvula-larynx) contours analysed separately (Rhino) for: average cross sectional area (CSA), circumference (Circ), and mucosal fold number (Folds). Folds were: 1) convex deviations from baseline curvature with respect to the lumen; 2) detected by algorithms for the extraction of apnea-specific information from the brain. Technical details behind these capabilities have already been published2,3,4,5. AutoMateZ is also capable of reading routine PSG, MSLT and MWT data and graphically displaying them on an epoch-by-epoch basis, and analyse them using our algorithms. The package has been developed in MATLAB programming language. It can also be available as a Microsoft Windows® standalone application. An enhanced version of AutoMateZ is also capable of analysing snoring sounds in diagnosing sleep apnea. In the conference, we will demonstrate our toolbox and illustrate its uses in sleep research.

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**A TOOLBOX FOR EEG ANALYSIS IN SLEEP APNEA RESEARCH**

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In this paper we demonstrate a software package (AutoMateZ) developed by the Sleep and Respiratory Systems Engineering Group (SRSE)3 at The University of Queensland, for the analysis of sleep EEGs. AutoMateZ comes with a convenient Graphical User Interface facilitating its use in clinical research. The software package implements several mathematical algorithms developed by members of our research group over the last decade. The capabilities of the toolbox includes: (i) algorithms for quantifying daytime sleepiness using only a single channel of EEG, (ii) tools for the automatic estimation of Macro-Sleep-Architecture using one channel of EEG, (iii) algorithms for the objective estimation of Sleep Fragmentation via the weighted-sleep-fragmentation index, and, (iv) algorithms for the extraction of apnea-specific information from the brain. Technical details behind these capabilities have already been published2,3,4,5. AutoMateZ is also capable of reading routine PSG, MSLT and MWT data and graphically displaying them on an epoch-by-epoch basis, and analyse them using our algorithms. The package has been developed in MATLAB programming language. It can also be available as a Microsoft Windows® standalone application. An enhanced version of AutoMateZ is also capable of analysing snoring sounds in diagnosing sleep apnea. In the conference, we will demonstrate our toolbox and illustrate its uses in sleep research.

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**DOES THE LEVEL OF CO2 AFTER AROUSAL AFFECT UPPER AIRWAY DILATOR MUSCLE ACTIVITY ON THE RETURN TO SLEEP?**

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**Introduction:** A large ventilatory response to arousal in Obstructive Sleep Apnea (OSA) is thought to predispose to further obstruction, by

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inducing hypocapnia and a subsequent reduction in upper airway dilator muscle activity on return to sleep. However, studies have not found reduced dilator muscle activity following arousal. A limitation of prior studies is that CO2 was not consistently reported or measured. As hypocapnia is central to the arousal model, we aimed to determine whether reduced CO2 following arousal is associated with reduced dilator muscle activity on the return to sleep.

Method: To date, four mild to severe OSA patients have been instrumented with EEG, EOG and EMG electrodes; epiglottic pressure catheter (Pepi), partial pressure of end-tidal CO2 (PetCO2) and intramuscular genioglossus electrodes (EMGgg). The participants slept without any OSA treatment. Post-study, all NREM arousals were categorized by the level of PetCO2 on the last breath of the arousal immediately before the return to sleep, relative to waking baseline PetCO2. Arousals were classified as “low” if they were 1–3 mmHg less than waking PetCO2 and “high” if they were 1–3 mmHg greater than waking PetCO2. The respiratory and muscle data on return to sleep was compared using a two-way repeated measure ANOVA (Breath- first five breaths of sleep onset) x (PetCO2 group- low vs. High).

Results: There were a total of 87 arousals in the low condition and 75 arousals in the high condition. By design, PetCO2 on the last breath of arousal was significantly less in the low condition than the high condition (38.6 ± 2.5 vs. 41.4 ± 2.3, p = .01). There were no significant main effects of PetCO2 group or interaction effects for any of the respiratory or muscle measures. There were significant main effects of breath for PIF and Vi, with both variables declining across the breaths of sleep onset. There were no significant breath effects for Pepi, RUA, EMGgg Peak and EMGgg Tonic.

Conclusions: If these results persist, it would suggest that low CO2 levels following arousal do not reduce dilator muscle activity as is suggested by the current model of arousal.

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IDENTIFICATION OF SUB-TYPES OF SLEEP DISORDERED BREATHING (SDB) USING SPECTRAL ANALYSIS OF OVERNIGHT PULSE OXIMETRY
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Introduction: Overnight pulse oximetry (OPO) is commonly used to screen for SDB and normality is characterised by stable oxygenation without periodicity in the signal. Spectral analysis of OPO has been shown to be predictive of obstructive sleep apnoea (OSA), however we hypothesized that such analysis may be useful in identifying other forms of SDB.

Methods: Oximetry data was extracted at a rate of 1 Hz from polysomnography (PSG) and analysed to reveal frequency spectra using last Fourier transform. 33 PSG results were selected to represent normal, OSA and central sleep apnoea (CSA) and differences in the spectra were identified with a focus on variability of the spectra, amplitude of peaks and amplitude of the long period data to identify best predictors of each disease subgroup. Analyses were performed using STATA v12.1 software.

Results: Frequency spectrum in non-SDB was characterized by a flat spectrum without distinguishable peaks and low amplitude at long periods. In contrast, spectra in OSA showed increased amplitude in the 30–70 s period range with multiple peaks and high variability. CSA was identifiable by a sharp spike in the spectra in the range 20–100 s, with low variability outside of this peak. The cumulative area under the curve at 15 s and 1000 s (A15 and A1000 resp.) were markers that provided best separation of the disease states, as shown in the figure.

Discussion: This novel method of analysis of pulse oximetry data appears capable of separating normality from SDB, and also in identifying OSA and CSA. This technique provides an exciting opportunity to extract much more information from a simple, home-based screening test, which may assist in rapid and more effective triage of patients waiting for diagnostic PSG.

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THE ASSOCIATION OF QUALITY OF LIFE WITH SLEEP DISORDERED BREATHING, SLEEPINESS, SLEEP QUALITY AND MOOD IN MEN: A POPULATION COHORT STUDY
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Introduction: The effect of obstructive sleep apnea (OSA), sleepiness and sleep quality on quality of life in unselected population samples is not described.

Methods: Full in-home unattended polysomnography (Embletta X100) were completed in 837 randomly selected men from the Men Androgen Inflammation Lifestyle Environment and Stress Study (240 yrs, n = 1869) without a prior diagnosis of OSA. Multiple linear regression
models estimated the effect of AHI on SF-36 Physical (PCS) and Mental (MCS) component summary scores and standardised SF-36 scale z-scores adjusted for major comorbidities, BMI and Pittsburgh Sleep Quality Index (PSQI) or Epworth Sleepiness Scale (ESS) scores.

**Results:** Unadjusted mean PCS, MCS and all scale scores except mental health, were significantly reduced in men with OSA (AHI ≥ 10), PSQI ≥ 6 or ESS ≥ 11. Modest but significant (p < 0.05) decrements per event increase in AHI occurred in PCS (unstandardised B coefficient = −0.05), MCS (−0.05), and physical functioning (−0.004), role physical (−0.006), general health (−0.005), and social functioning scale (−0.005) z-scores, after adjusting for ESS/PSQI scores and comorbidities. Additional adjustment for depression attenuated these associations (coefficient p = 0.06). Change from AHI < 10 to AHI ≥ 10 reduced PCS and MCS scores by 2.4 (SE = 1.0) and 1.9 (SE = 0.9) units respectively (p < 0.05). This effect was not observed with a change from AHI < 10 to AHI ≥ 10. PSQI scores were significant predictors of PCS (−0.73, SE = 0.08), MCS (−0.67, SE = 0.08), and all scale scores, except physical functioning. Similarly, ESS scores were significant predictors of PCS (−0.21, SE = 0.08), MCS (−0.22, SE = 0.07) and all scale scores except physical functioning. Mean oxygen saturation, but not total arousal index, was independently and positively associated with PCS (0.36) and general health scale (0.06) score increments.

**Conclusion:** Severe OSA, sleepiness, poor sleep quality and mood/depression are major contributors to quality of life reductions in community dwelling men. The consideration of sleep quality in addition to sleepiness, and depressive disorders may positively impact on quality of life.

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**SLEEP APNEA PREDICTS ALL-CAUSE MORTALITY, STROKE AND CANCER INCIDENCE AND MORTALITY OVER 20 YEARS IN THE BUSSELTON HEALTH STUDY COHORT**

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**Objective:** To ascertain whether objectively measured obstructive sleep apnoea (OSA) independently increases the risk of all-cause death, cardiovascular disease (CVD), coronary heart disease (CHD), stroke or cancer.

**Design:** Community-based cohort.

**Setting and Participants:** 400 residents of the Western Australian town of Busselton.

**Measures:** OSA severity was quantified via the respiratory disturbance index (RDI) as measured by a single night recording in November-December 1990 using the MESAM IV device, along with a range of other risk factors. Follow-up for deaths and hospitalisations was ascertained via record linkage to the end of 2010.

**Results:** We had follow-up data in 397 people and then removed those with a previous stroke (n = 4) from the mortality/CVD/CHD/stroke analyses (7358 person-years of observation) and those with cancer history from the cancer analyses (n = 7). There were 77 deaths, 103 cardiovascular events (31 strokes, 59 CHD) and 125 incident cases of cancer (39 cancer fatalities) during 20 years follow-up. In fully adjusted models moderate-severe OSA was significantly associated with all-cause mortality (HR = 4.2, 95%CI 1.9, 9.2), cancer-mortality (3.4;1.1, 10.2), incident cancer (2.5;1.2, 5.0) and stroke (3.7;1.2, 11.8), but not significantly with CVD (1.9; 0.75, 4.6) or CHD incidence (1.1; 0.24, 4.6). Mild sleep apnoea was associated with a halving in mortality (0.5; 0.27, 0.99), but no other outcome, after control for leading risk factors.

**Conclusions:** Moderate-to-severe sleep apnoea is independently associated with a large increased risk of all-cause mortality, incident stroke and cancer incidence and mortality in this community-based sample.

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**PHYSICAL ACTIVITY IN OBESITY HYPOVENTILATION SYNDROME**

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**Aim:** To document physical activity levels in people with newly diagnosed obesity hypventilation syndrome (OHS) and describe relationships with disease severity and quality of life.

**Methods:** Physical activity was measured objectively over one week using a Sense Wear Armband (SWA). Baseline measures of PaCO2 and body mass index (BMI) were collected. Health-related quality of life was measured using the SF-36v2.

**Results:** 21 participants (11 female) with a mean age of 53 (SD 10) years were included. The mean body mass index (BMI) was 53 (11) kg.m−2 and PaCO2 58 (11) mm Hg. SWA wear time was excellent, with a mean of 82% (11%) of awake time. The median (interquartile range) time spend in sedentary behaviours (<1.5 METs) was 1205 (1190 to 1366.5) minutes per day, which represented a mean (SD) of 5.8 (0.9) days for 1361 (66) minutes per day. The median (interquartile range) time spend in sedentary behaviours (<1.5 METs) was 1205 (1190 to 1366.5) minutes per day, which represented a mean of 5.8 (0.9) days for 1361 (66) minutes per day. The median time spent in moderate and vigorous physical activity (MVPA, >3 METs) was 10 (2.5 to 23) minutes per day. There was no relationship between MVPA and PaCO2 (r = −0.062, p = 0.791) or BMI (r = −0.236, p = 0.304). On the SF-36v2, those with lower MVPA levels had worse physical function domain scores (r = 0.549, p = 0.010).

**Conclusions:** People with newly diagnosed OHS are markedly inactive, across the spectrum of disease severity. These extremely low levels of MVPA may contribute to morbidity and mortality risk in OHS.

**Supported By:** The ResMed Foundation
EEG SLOWING DURING BASELINE SLEEP REFLECTS GREATER VULNERABILITY TO PERFORMANCE DEFICITS AFTER 24 HOURS AWAKE IN PATIENTS WITH SLEEP APNEA

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Introduction: Patients with untreated obstructive sleep apnea (OSA) experience varying degrees of sleepiness and impaired cognition which can lead to increased accidents and poor work performance. Factors thought to mediate these problems include sleep fragmentation and repetitive hypoxemia. Standard polysomnographic (PSG) metrics of disease severity are inconsistently or weakly correlated with neurobehavioural outcomes. Abnormal EEG slowing in REM sleep has been observed in OSA but its relationship with performance deficits is unknown. The aim of this study was to investigate quantitative electroencephalogram (qEEG) markers of baseline sleep as correlates of neurobehavioural impairment and sleepiness after 24 hours (h) of extended wakefulness in OSA patients.

Methods: Patients with untreated moderate to severe OSA (n = 8, male, age 44.6 ± 8.4 yrs, BMI 32.6 ± 5.3 kg/m2) and healthy controls (n = 9, 8 male, age 27.8 ± 3.7, BMI 23.4 ± 3.1) underwent overnight polysomnography at baseline and recovery with 40 h of wakefulness inbetween. During wake, neurobehavioural assessments of simulated driving, psychomotor vigilance task (PVT) and subjective sleepiness were repeated every 2 h. We performed EEG spectral analysis of baseline sleep (C2/M1) and explored the relationships between EEG slowing (a higher ratio of slower frequencies [0.5–8.0 Hz] to faster frequencies [8.0–32.0 Hz]) and neurobehavioural impairment after 24 h awake.

Results: At baseline, greater EEG slowing in REM sleep was associated with a greater decline in performance after 24 h awake relative to baseline levels in OSA (AusEd steering deviation: r = 0.738, p = 0.037; PVT mean reciprocal reaction time: r = −0.738, p = 0.037). EEG slowing in REM was related to worse OSA severity (minimum oxygen saturation: r = −0.81, p = 0.015). Increased slow-frequency EEG waves in NREM sleep were also associated with worse neurobehavioural performance in OSA patients.

Conclusion: Quantitative analysis of the sleep EEG recorded during routine overnight PSG provides promising brain-activity based biomarkers of performance deficits after extended wakefulness in OSA patients. It is possible that sleep EEG markers may better reflect individuals vulnerable to the deleterious effects of untreated sleep apnea.

PREFERENCE FOR HIGH FAT OR HIGH FIBRE FOOD IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Obstructive Sleep Apnoea (OSA) has a strong association with excess weight and obesity, and reduction in weight can improve indicators of OSA severity. Achieving and maintaining weight loss is a significant challenge, and it has been associated with psychological factors including motivation and self-efficacy. Sleep disruption might also specifically influence aspects of satiety and food preference. This study aimed to investigate intention to consume high-fat foods in patients with OSA, and to estimate the relationship between food preference and indices of OSA severity.

Method: Patients with clinical indications of OSA attending a public sleep service completed measures on the evening of their diagnostic sleep study including standardized measures of food preference (Fat and Fibre Liking), attitudes towards food, Stage Of Change for diet, and self-efficacy. The respiratory disturbance index (RDI) was determined with standard polysomnography, and body mass index (BMI) objectively measured.

Results: Of the 255 patients who agreed to participate, 206 provided fully completed questionnaires. For Stage Of Change for diet, the ‘Action’ stage represented the largest category (47%), then ‘Maintenance’ (18%), ‘Contemplation’ (14%), and finally the ‘Pre-contemplation’ and ‘Preparation’ stages (11% respectively). The relationship between liking for high fat foods and the RDI was tested with hierarchical regression. Gender and BMI explained a significant 20% of the variance in RDI, F(1,150) = 21.13, p < .000, Fibre Liking accounted for an additional 6% of the variance in RDI, F(1,149) = 12.25, p = .001 (a negative relationship), and Fat Liking accounted for a further 3.6% of RDI variance, F(1,148) = 7.80, p = .006. In combination, the four predictors explained 31% of the variance in RDI, F(4,152) = 21.56, p < .000.

Conclusions: Almost half of this patient sample reported that they were actively attempting to reduce their dietary fat consumption. An independent relationship between RDI and liking for high fat foods (and disliking of high fibre foods) may be consistent with a two-way interaction between sleep disruption and food choice. There is an important role for psychologically informed dietary change in the management of OSA.
WORK OF BREATHING IS INCREASED DURING SLEEP DISORDERED BREATHING IN HEART FAILURE PATIENTS

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Introduction: Central and obstructive sleep apnoea (CSA and OSA) are common in chronic heart failure (CHF) yet their impact on work of breathing (WOB) is unknown.

Method: Ambulatory patients with CHF (n = 7) underwent polysomnography with oesophageal manometry and precise ventilatory flow measurements. Representative samples of stable breathing as well as complete ventilatory cycles (ventilatory period plus apnoeic period) of OSA and CSA were selected. Using pressure-volume curves (Campbell diagram) the elastic and resistive inspiratory WOB were calculated on a breath by breath basis and then used to determine the WOB/minute. Pressure-time product (PTP), a marker of efficiency of oxygen utilization and fatigue, was also calculated to allow estimation of respiratory effort when no flow was present during OSA.

Results: Table 1: WOB & PTP did not vary significantly between sleep stages.

<table>
<thead>
<tr>
<th>Stable Sleep Stage</th>
<th>Awake</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>REM</th>
</tr>
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<tbody>
<tr>
<td>Events</td>
<td>11</td>
<td>8</td>
<td>13</td>
<td>9</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Elastic WOB (J/min)</td>
<td>5.6 ± 1</td>
<td>6.6 ± 4</td>
<td>4.9 ± 1</td>
<td>5.4 ± 2</td>
<td>4.6 ± 2</td>
<td>5.5 ± 2</td>
</tr>
<tr>
<td>Resistive WOB (J/min)</td>
<td>3.0 ± 1</td>
<td>4.9 ± 4</td>
<td>2.6 ± 1</td>
<td>3.2 ± 2</td>
<td>2.8 ± 1</td>
<td>3.2 ± 1</td>
</tr>
<tr>
<td>PTP (cmH2O)</td>
<td>26.6 ± 18</td>
<td>27.5 ± 18</td>
<td>25.6 ± 9</td>
<td>25.7 ± 13</td>
<td>18.7 ± 9</td>
<td>27.6 ± 11</td>
</tr>
</tbody>
</table>

Table 2: WOB was significantly higher in CSA compared to stable sleep periods. PTP was higher in OSA and lower in CSA compared to stable sleep.

<table>
<thead>
<tr>
<th>CHF Stable (n = 63)</th>
<th>CHF CSA (n = 18)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic WOB (J/min)</td>
<td>5.3 ± 2</td>
<td>9.4 ± 4</td>
</tr>
<tr>
<td>Resistive WOB (J/min)</td>
<td>3.2 ± 1.9</td>
<td>5.5 ± 3</td>
</tr>
<tr>
<td>PTP (cmH2O)</td>
<td>25.0 ± 11.5</td>
<td>16.9 ± 10</td>
</tr>
</tbody>
</table>

PTP in OSA (32.3 ± 15) was significantly different (p < 0.02) to both CSA and stable sleep.

Conclusion: In CHF, although CSA is associated with increased WOB, this is undertaken with reduced energy cost (i.e. greater efficiency). In contrast, OSA is associated with increased energy costs. This study underpins the important clinical differences between OSA and CSA and highlights importance of accurate differentiation.

THE DEVELOPMENT AND GROWTH OF ASTA: FROM INK TO GIGABYTES

TEANAU ROEBUCK

ASTA’s first meeting was held in 1988. ASTA began with the assistance and enthusiasm of Helen Bearpark.

Developments have included organising independent scientific meetings, introduction of the BRPT examination into Australia, Australasian scoring guidelines, involvement in the Sleep Service Accreditation process and importantly the growth of membership.

ASTA’s continued success is due to the interest and dedication of its membership. ASTA members play a key role in the diagnosis and management of Sleep Disorders in New Zealand and Australian Society. In the future, plans are to formalise this role with registration of professionals as Clinical Physiologists.

At the time of inception of the society, our membership had ink stained fingers and could hear when a patient entered REM from the sound of the pens. They had strong biceps from carrying boxes of paper around, were happy to sit up nights and watch snorers desaturate (if they didn’t go below 80%, it was mild) whilst soldering the equipment back together. To start a patient on CPAP required a visit to a prosthetic technician, and attachment of some pool filter hosing to the spa pump which had some modifications made by the fitters and turners in the Engineering Department. Now our membership have their heads in a cloud (of data), ink has been replaced by touch sensitive screens, whilst the psychology of improved CPAP adherence is their concern and they compose business plans built around Medicare item numbers.

The relationship between ASTA and ASA has been an important and mutually beneficial one. It has been over 10 years since the two societies have been successfully holding joint meetings. This partnership is a direct reflection of what happens in the workplace and the research lab i.e. clinicians and scientists working together to achieve the goal of improved healthcare delivery to our communities.

ASTA is proud of its past but has many items on the agenda to facilitate future improvement.
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