Invited speakers

I001
UPPER AIRWAY DILATOR MUSCLE FUNCTION AND DYSFUNCTION IN CHILDREN
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Children have a smaller upper airway than adults, yet have less snoring and less obstructive apnea. This suggests the presence of protective upper airway neuromotor factors that help maintain upper airway patency during sleep. We will outline the evidence for protective upper airway reflexes during sleep in normal children, changes in upper airway function with development, and abnormalities of upper airway function in those children who develop obstructive sleep apnea syndrome (OSAS).

Normal infants and prepubertal children have active upper airway reflexes during sleep in response to stimuli such as subatmospheric pressure and CO2, which reflexes decline during puberty into adulthood, although with much individual variability. In prepubertal children with OSAS, structural upper airway factors such as adenotonsillar hypertrophy do not fully account for the increased upper airway collapsibility. These children have been shown to have blunted upper airway reflexes during sleep compared to age-matched controls. Abnormalities are most pronounced during REM sleep.

In addition to abnormal upper airway efferent responses, the afferent limb of the upper airway response is also abnormal in children with OSAS. Children with OSAS have abnormal upper airway sensation in response to stimuli such as two-point discrimination, and blunted respiratory-related evoked potentials, indicating abnormal central nervous system processing of afferent upper airway responses.

Few studies have evaluated adolescence, the transition between the pediatric and adult pattern of upper airway function. Obesity is now a major pathogenic factor in OSAS in adolescence. This talk will discuss new data on the relative contributions of upper airway structural factors (such as adipose tissue and lymphoid tissue) and neuromotor factors to OSAS in obese adolescents.

I002
COMMON FEATURES IN RESPIRATORY RELATED MOTOR CONTROL OF AIRWAY MUSCLES: IMPLICATIONS FOR UNDERSTANDING THE ROLE OF AIRWAY MUSCLES IN OSA
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The muscles of the human airway are innervated by a variety of cranial nerves, reflecting the varied functions of the airway. This raises the question: to what extent is respiratory motor control similar in muscles controlled by different cranial nerves? In addressing this question three features of airway muscles will be evaluated: the presence of pre-inspiratory activation, the range of different motor unit discharge patterns identified in muscles, and the effect of sleep onset. Inspiratory dilator muscles commonly show pre-inspiratory activation (genioglossus, styloglossus, hyoglossus – hypoglossal, tensor palatini – trigeminal, posterior cricoarytenoid, cricothyroid – vagus). Further, in those muscles in which single motor unit studies have been performed, it is motor units with a phasic inspiratory component that show pre-inspiratory activation. While not identical, there is a remarkable similarity between different muscles (genioglossus, tensor palatini, thyroarytenoid, cricothyroid) in the distribution of motor units with different discharge patterns. Finally, airway dilator muscles commonly decrease their activity at sleep onset as a consequence of the cessation of activity of motor units with phasic patterns of activity. In conclusion, while there are potentially important differences between muscles, one is struck by the similarity of respiratory motor control in different airway muscles.

I003
ARTIFICIAL STIMULATION OF AN UPPER AIRWAY DILATOR MUSCLE FOR THE TREATMENT OF ADULT OSA
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The genioglossus is the largest, most studied and arguably the most important pharyngeal dilator muscle. A sleep-related reduction in its activity plays a key role in development of the repeated episodes of upper airway collapse that characterize obstructive sleep apnoea (OSA). Increasing activation of the genioglossus muscle during sleep presents a potential therapy for OSA by stiffening the pharynx, reducing pharyngeal collapsibility and improving pharyngeal patency. This can be achieved by application of a small electrical current to the muscle itself (either transcutaneously or via intramuscular electrodes) or to the hypoglossal nerve which innervates it. Results from early studies using either muscle or nerve stimulation techniques were promising, showing associated decreases in inspiratory flow limitation and severity of OSA. However translation of these findings to the clinical setting have yet to occur, mainly due to technical design challenges related to long-term use of implantable stimulating electrodes and their delivery leads. Recent technological advances have addressed these problems and the problem of detection of phase of respiration so that hypoglossal nerve stimulation can be reliably delivered in phase with inspiration, when the pharynx is most vulnerable to collapse. One such system currently being tested in an Australian multi-centre trial has shown improvements in severity of OSA and its symptoms at 3 and 6 months following device implantation. A European trial using another type of implantable hypoglossal nerve stimulation system is yet to release its results. The preliminary findings of the Australian study are encouraging and suggest a potential therapeutic role for hypoglossal nerve stimulation in the treatment of OSA.
Several previous studies have examined the electromyographic activity in the muscles of the upper airway. These studies have used both multi-unit and single unit recordings to characterise the neural drive to the upper airway muscles during wakefulness and sleep, in both healthy subjects and obstructive sleep apnoea patients. Other studies have examined changes in the calibre of the airway itself, using a range of imaging techniques. However, details of the motion and mechanical behaviour of the upper airway muscles has not been well studied.

SPAtial Modulation of Magnetism (SPAMM) is a magnetic resonance imaging technique that can apply a temporary magnetic grid to soft tissues, allowing the tissue motion and deformation to be followed using fast MRI techniques. Here, we present the results of a series of studies that have used SPAMM to quantify the motion of the upper airway in healthy human subjects and obstructive sleep apnoea patients.

In young, healthy subjects breathing quietly in the supine position while awake, the inferior posterior portion of the genioglossus dilates the airway during inspiration, relaxing back during expiration. The addition of inspiratory resistance increases lateral wall movement towards the midline, but reduces anterior motion of genioglossus. In healthy older adults, more of the genioglossus tends to be active, dilating the upper airway in a coordinated manner along its length. In obstructive sleep apnoea (OSA) patients, the motion of the genioglossus varies with disease severity, with less motion compared to age matched controls in mild OSA, uncoordinated motions in moderate OSA, and minimal motion in severe OSA patients. In some OSA cases, while the inferior oropharynx is dilated during inspiration, there is paradoxical motion of the most superior part of genioglossus, tending to narrow the airway near the soft palate.

Electrical activity in the upper airway muscles can result in a complex pattern of motion of the airway wall tissues. This motion pattern varies with age and OSA severity.

Sleep disturbance is a common factor in acute dental or orofacial pain, and practitioners commonly ask a patient about sleep disturbance during a routine acute pain history.

Chronic orofacial pain is more of a biopsychosocial pain (potentially) than acute pain, meaning that the aetiology and/or consequences of these chronic conditions are biological, psychological and social. Sleep deficits and sleep disturbance in chronic orofacial pain patients, are perhaps more common than anticipated. Dental practitioners less commonly, however, question a patient about sleep disturbance during a chronic orofacial pain appointment, which may result in the patient not being managed appropriately.

The presenter will present a review of current literature with respect to the relationship between chronic orofacial pain and resulting sleep disturbance, and whether sleep disturbance may result in the development of chronic facial pain conditions.

The presentation will also highlight why it is important to undertake a sleep history in a chronic facial pain patient, and present an overview as to role of the chronic orofacial pain practitioner in managing sleep disturbance.

The presenter will draw from over a decade of experience in managing chronic orofacial pain from a biopsychosocial perspective, using patient cases to highlight the literature findings.
**I009**

**SLEEP IN INFANCY – UNDERSTANDING THE RISKS FOR SIDS**

**R HORNE**

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**Introduction:** During infancy sleep is at a life time maximum and the development of sleep is one of the major physiological processes which occurs during the first year of life. Sleep has a marked effect on cardiovascular physiology and control in adults. During infancy cardiorespiratory control also undergoes significant maturation, and until this is mature the cardio-respiratory system is unstable, and this is particularly so during sleep.

Sudden Infant Death Syndrome (SIDS) is the sudden death of an infant less than 1 year of age that remains unexplained after a complete autopsy, death scene investigation, and a review of the clinical history, and is presumed to occur during sleep. Although the underlying mechanisms involved in SIDS remain unclear, impaired cardiovascular control during sleep together with an impairment in arousal from sleep are thought to be a likely mechanisms. In support of this hypothesis, future SIDS victims have been found to have altered or impaired cardiovascular control in the weeks to months before death and reduced arousability from sleep. In addition, the major risk factors for SIDS such as the prone sleeping position, maternal smoking and prematurity all have significant negative effects of cardiovascular control and arousability.

**Methods:** From nap PSG undertaken on preterm infants selections of the nasal pressure trace from Quiet Sleep (QS) and Active Sleep (AS) in prone and supine were analysed in Labview to determine inspiratory onsets (I) and calculate I-I intervals and the R wave on the accompanying ECG trace was used to measure RI intervals. Measures of respiratory variability related to the I-I interval histogram were assessed including the presence of cardioventilatory coupling (CVC). As a measure of constancy of the relationship between R waves and inspiratory onset, the RLI interval (time between inspiration and the immediately preceding R wave) dispersion was measured using proportional Shannon Entropy of the RLI interval (SHRI), to provide a quantitative measure of CVC. The 95th centiles and 95% cumulative frequencies of I-I inter vals were calculated for each sleep state (SS) and statistical analysis to assess for outlier inter-breath intervals was undertaken to define an upper range for normal I-I intervals.

**Results:** All measures of respiratory variability, including CVC, varied with SS but not position. Mean Shannon entropy values correlated negatively with mean oxygen saturation suggesting a possible physiological role for cardioventilatory coupling. I-I intervals were longer in QS and mean values for the top of the upper range varied with the method of calculation.

**Conclusions:** SS has a marked affect on respiratory variability in preterm infants and probably explains the beneficial effects on ventilation reported previously as related to prone positioning. This has implications for monitoring for apnoea in this age-group and also for the analysis of sleep studies undertaken on preterm infants prior to neonatal discharge.

**I011**

**CPAP USE IN CHILDREN: ADHERENCE AND NEURODEVELOPMENTAL OUTCOMES**

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In children, the primary treatment for the obstructive sleep apnea syndrome (OSAS) is adenotonsillectomy. However, CPAP is the usual treatment for those children with persistent OSAS following surgery, or for children with contraindications to surgery. CPAP use in the pediatric population has increased in recent years due to the increasing prevalence of pediatric obesity.

Positive airway pressure use in children is restricted by the limited amount of age- and size-specific devices and interfaces available. Behavioral modification programs are often needed to optimize CPAP adherence in children.

Studies show that CPAP is highly effective in treating subjective symptoms of OSAS and in normalizing polysomnographic findings. Side-effects in children are usually minimal. However, CPAP use in children is limited by poor adherence. Adherence is not affected by the mode of positive pressure applied. Preliminary data indicate that the most important factor in predicting CPAP adherence in children is maternal education. Children who are older, sleepier or of African American race are less likely to be adherent. Adherence does not correlate with severity of apnea, pressure levels or baseline child behavioral characteristics.

Effective CPAP use is associated with an improvement in measures of behavior, sleepiness and quality of life. The degree of improvement correlates with the number of hours of CPAP usage per night.

**I012**

**LABORATORY AND ON-ROAD INVESTIGATIONS OF DRIVING PERFORMANCE IN OSA**

**A VAULKIN**

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Obstructive sleep apnoea (OSA) is a common sleep disorder linked to poor driving performance and increased motor vehicle accident (MVA) risk. Driving is a complex, multifactor task that relies on continuous attention, vigilance, motor and visual coordination. Technological advances in the last 25 years have enabled the development of complex driving simulators that more closely mimic the real driving environment. Also, some researchers have recently taken the next step from driving simulation and have utilised dual control, instrumented vehicles to examine real on-road driving in OSA patients. However, on-road driving assessment and advanced driving simulators, while more realistic are costly and in the case of on-road assessment, potentially dangerous. It is reasonable to ask, therefore, whether they provide more valid data?
The Divided Attention Steering Simulator (DASS) developed in the UK and the AutoEd driving simulator developed jointly by UK and Australian investigators are simple relatively inexpensive computer based simulations able to acquire steering and speed deviation, divided attention, braking reaction and crash data at 10 Hz and 30 Hz respectively. The INRET and the OKTAL simulator developed in France are more advanced with real car interior controls to manoeuvre the vehicle. They use large high definition display (3D for the OKTAL) and collect more comprehensive data from fuel consumption to steering, braking and crashes. On-road vehicles equipped with dual controls and video cameras able to detect lane position have now been used by French sleep researchers. The use of professional driving instructors to assess driving performance during on-road driving has also been used in Australia.

When simple simulators such as the DASS have been compared to real driving, simulator performance measures correlate with on-road performance (relative validity) but tend to overestimate and magnify performance impairments relative to real driving. Higher fidelity simulators are found to more precisely represent real driving approaching “absolute validity”. The use of driving simulators and on-road driving experiments in patients with OSA reveal that regardless of which driving assessment tool is used, OSA patients’ consistently show significantly worse performance compared to non-OSA subjects, often with large effect sizes.

Basic and more advanced driving simulators are useful to detect driving performance impairment in OSA patients particularly in simple experimental designs. With further development of high fidelity validated driving simulators, these tools should become more accessible and provide more reliable information on driving performance in OSA and other populations at risk of MVAs and allow for more complicated and realistic experimental designs.

I013

SIMULATED DRIVING PERFORMANCE, CIRCADIAN MISALIGNMENT AND RECOVERY

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Introduction: The current U.S. Federal Motor Carrier Safety Administration (FMCSA) hours of service regulations permit commercial vehicle drivers to be on duty up to 14 h per day; to accumulate 60 h/70 h is on duty in a work period of 7/8 consecutive days, and to begin another work period after a 34 h “restart” break. These regulations apply for both daytime and nighttime drivers; the rule does not take into account the well-described circadian rhythms in sleep propensity and waking performance. This study investigated the effectiveness of the 34 h restart break for sustaining performance in daytime and nighttime schedules.

Methods: 27 healthy subjects (ages 22–39 y; 14f) participated in a 14-day in-residence laboratory study, which included a 5-day work period, a 34 h restart break, and another 5-day work period. Subjects were either randomized to a daytime condition (N = 14), involving nocturnal sleep (time in bed 22:00–08:00) daily during the two 5-day work periods and during the restart, or a nighttime condition (N = 13), involving nocturnal wakefulness and diurnal sleep (time in bed 10:00–20:00) daily during the two 5-day work periods, while reverting to diurnal wakefulness and nocturnal sleep during the restart. Subjects drove for 30 min on a PatrolSim IV high-fidelity driving simulator (MPRI, Salt Lake City, UT, USA). Each drive was preceded and followed by a 10 min Psychomotor Vigilance Test (PVT).

Results: Mixed-effects ANOVA revealed a significant interaction of work period (before restart, after restart) by condition (daytime, nighttime) for lane deviation on the driving simulator (F[1,15] = 9.15, p = 0.003) and for lapses (RTs > 500 ms) on the PVT (F[1,123] = 20.06, p < 0.001). In the daytime condition, after the restart as compared to before the restart, PVT performance was the same, and driving performance was improved owing to a practice effect. In the nighttime condition, after the restart relative to before the restart, PVT performance was degraded, and driving performance showed less improvement from practice than in the daytime condition.

Conclusion: A 34 h restart break between two 5-day work periods was adequate to sustain simulated driving and vigilance performance in subjects scheduled to daytime work shifts, but not in subjects scheduled to nighttime work shifts. This study highlights the importance of considering circadian effects on sleep and performance for effective hours-of-service regulations.


I014

SLEEP, ALCOHOL, DRUGS AND DRIVING

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Aim: Excessive sleepiness, alcohol and some legal and illegal drugs impair driving performance and increase crash risk. Laboratory studies have demonstrated significant interactive effects, suggesting that short periods of sleep deprivation and low doses of alcohol, which in them selves may not be dangerous, result in severe impairment of driving performance. Sleepiness increases alpha and theta power on EEG and periods of slow eyelid closure whilst driving, however the effects of sedating drugs and alcohol on these physiological outcomes have not been well studied. This project evaluated the relative effects of sleep restriction, acute effects from benzodiazepines and alcohol on driving performance and indicators of drowsiness.

Method: Eighteen current drivers undertook a 60 minute driving simulation (AutoEd) and measurement of sleep latency (Osler) during the day under four conditions in a randomized cross over design, one week apart: baseline measurement, following sleep restriction to four hours; after benzodiazepine ingestion; and following alcohol (BAC of 0.05% and 0.08%). EEG and the percent of time with eyes closed (Optalert) were recorded during the tasks.

Results: There was a significant increase in variation in lateral lane position (F[1,23] = 4.120, p < .05) and speed (F[1,23] = 5.56, p < .05) following all conditions compared to baseline with the benzodiazepines (temazepam 20 mg) tending to result in greater deterioration in performance than all other conditions. There was a tendency towards increased percent of time with eyes closed following all conditions, with the greatest increases following benzodiazepines and sleep restriction.

Conclusion: Sleep restriction to four hours for one night and acute benzodiazepine ingestion impair simulated driving performance to a similar degree to levels of alcohol that are illegal for driving. Physiological measures of drowsiness are affected by alcohol and benzodiazepines as well as sleep restriction, with previous studies suggesting that the combination of these conditions has at least an additive effect on driving impairment.
1015
TESTING THE EFFECTIVENESS OF SLEEPINESS COUNTERMEASURES IN THE DRIVING SIMULATOR
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Aim: Sleepiness while driving is a major contributor to fatal and severe road crashes. Taking a nap a one potential countermeasure to sleepiness. Further, taking a ‘break’ after two hours of driving has also been promoted as a countermeasure. The benefit for the critical driving skill of hazard perception performance of either a nap opportunity; or a break, have not been demonstrated.

Method: Twenty young-adult drivers completed a three-hour simulated drive on a hazard perception task. They did this on two occasions, one week apart. The test sessions began either at 9 am or at 1 pm (fixed with all participants arising at 5 am on the test day). After 2 hours on the task, they had either a nap opportunity (25 minutes in total) or an ‘active break’ opportunity (that included a 10-minute standard walk test). The order of the two conditions was counterbalanced across the participants. Participants then completed the third hour on the task. Sleepiness was assessed with EEG by standard criteria and by self report on the Karolinska Sleepiness Scale. The primary dependent variable was mean hazard perception latency during each hour on the task.

Results: Sleepiness increased across the initial two-hour simulated drive. Both the nap opportunity and the ‘active break’ resulted in decreased sleepiness during the third hour of driving when compared to the second hour of driving. The reduction in sleepiness (by both EEG power spectrum criteria and on self-report) was significant greater to the second hour of driving. Both the nap opportunity and the ‘active break’ resulted in decreased sleepiness during the third hour of driving when compared to the second hour of driving. The reduction in sleepiness (by both EEG power spectrum criteria and on self-report) was significant greater to the second hour of driving. After 2 hours on the task, they had either a nap opportunity (25 minutes in total) or an ‘active break’ opportunity (that included a 10-minute standard walk test). The order of the two conditions was counterbalanced across the participants. Participants then completed the third hour on the task. Sleepiness was assessed with EEG by standard criteria and by self report on the Karolinska Sleepiness Scale. The primary dependent variable was mean hazard perception latency during each hour on the task.

Conclusion: A nap break appears to have greater benefit for reducing sleepiness, and improving hazard perception latency, during a sustained drive than does a break without a nap. It remains possible that an active break could reduce other aspects of ‘fatigue’ that occur during longer drives. The capacity for individual drivers to take a nap when sleepy, and potential strategies to improve this capacity, needs to be further investigated.

1016
OVERVIEW OF GENETIC TECHNOLOGIES IN CURRENT USE
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Recent advances in DNA sequencing technologies allow an individual’s entire genome to be sequenced. In 2005, it cost about US$ 10 million to sequence one individual’s human genome, though this was a 50-fold decrease from the previous decade. The cost of this continues to reduce and should approach $1,000 in the near future; this is one of the major goals of the US National Human Genome Research Institute. Despite the impressive technological developments in gene sequencing there is still much that is unknown about the clinical value of having your genome sequenced. Genome sequencing involves the determination of the arrangement of the genetic code for an individual. Being able to read this code and understand how the cells translate the code into useful information is fundamental to our understanding of how our genetic background influences our health. Since 2003 with the completion of the Human Genome project we have had a better understanding of the information contained within our DNA, and the role of our genes. However understanding the function of all these genes do will take considerably more time. Similarly our understanding of how genes interact with the environment is lacking – a key consideration for common complex diseases such as diabetes, dementia, sleep apnoea and heart disease. The health benefits of genome sequencing may include early diagnosis and prevention of an illness or disease that can be tailored to each person’s unique genetic profile.

1017
CIRCADIAN RHYTHM GENES AND THEIR IMPACT ON SLEEP
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Over the past few decades, substantial progress has been made in our understanding of the molecular mechanisms underlying circadian rhythms. At the subcellular level of organisation, circadian rhythms are generated by transcriptional and translational feedback loops involving multiple clock genes. In mammals the core positive elements of the feedback loop are CLOCK, NPAS2 and BMAL1, and the negative elements are PER and CRY. Studies have examined the associations between specific genotypes and characteristics such as sleep timing and duration. Considerable attention in recent years has been on variable number tandem repeat (VNTR) polymorphisms in the PER3 gene. The PER35/5 gene is reported to be associated with morningness tendency, and conversely the PER34/4 gene is associated with eveningness. Recent evidence suggests that the VNTR polymorphism in the PER3 gene may affect the homeostatic regulation of sleep-wakefulness. Homeostatic sleep pressure, assessed by both electrophysiological and behavioural markers, was shown to accumulate more during a period of extended wakefulness in PER35/5 individuals than in PER34/4 individuals. In our recently completed studies evaluating the phase-shifting and sleep-promoting effects of the novel MT1/MT2 melatonin receptor agonist tasimelteon (1), we have begun to explore whether genetic factors account for individual differences in the sleep-promoting effects of tasimelteon. Our preliminary analysis shows that individuals with the PER3 non-5/5 genotype show greater response to tasimelteon as compared to placebo, perhaps because the agonist has more opportunity to improve sleep in such individuals due to greater sleep disturbance following the 5-h phase advance of the sleep-wake cycle.

Reference:
Aging is associated with substantial changes in the amount, quality and composition of sleep. Most characteristic are decreases in high amplitude slow wave sleep (SWS), particularly in men, and increases in light sleep and nocturnal awakenings. The reduction in SWS has been thought to reflect a biological marker of the gradual deterioration of the CNS with age because in young people SWS is a core component of sleep and is associated with sleep's anabolic and restorative properties necessary for good mental and physical health.

Sleep disturbances are also a prominent and disabling feature of Alzheimer's disease (AD) and are one of the most frequent causes of institutionalization for long-term care. In AD, frequent awakenings, decreased rapid eye movement (REM) sleep, and low amounts of SWS are found even in the early stages of AD, becoming more prominent in parallel with the patient's cognitive decline. In addition, the EEG during wakefulness in AD patients shows the pathological signs of abundant, diffuse large amplitude delta activity. This pathological slowing of EEG makes the distinction between sleep and wakefulness extremely challenging. More specifically, the 'carriyover' of this abnormal delta activity during non-REM sleep makes it difficult to distinguish abnormal delta from normal physiological SWS delta activity. Unfortunately, in traditional sleep studies of normal aging SWS has been measured by observing spontaneous EEG over a full night's sleep. This observational approach is dependent on the sleep quality of the individual in the laboratory and precludes experimental manipulation of variables. In contrast to this traditional approach, we have devised an experimentally controlled procedure that measures the brain's ability to generate delta frequency EEG. The procedure involves recording single delta frequency events (K-complexes) in response to auditory stimuli, determining the probability of K-complex production and averaging the EEG responses to stimuli to produce sleep evoked potentials. This paper describes a series of studies that have used this novel approach in the study of sleep EEG in both normal aging and in AD.

1021

SLEEP AND FALLS IN OLDER PEOPLE

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Falls are a common problem for older people with an estimated 30% of those aged more than 65 years falling each year. This percentage increases with age with 40% of those aged more than 80 years falling each year. Falls are the leading cause of both fatal and non-fatal injury in those aged 65 years and over, accounting for 63% of all non-fatal injuries. Falls and associated injuries can result in numerous serious consequences for older people such as physical and functional decline, residential care admission, fear of falling and depression. In a time trade-off study 80% of older people said they would rather die outright in a fall than need nursing home admission due to the functional decline associated with a hip fracture. Whilst some interventions to prevent falls have been effective, results are mixed and falls remain a problem for many older people.

Sleep difficulties and disorders have been proposed as contributing to falls risk in older people. Sleep disturbances are common yet they are under-diagnosed and often wrongly thought to be an inevitable part of ageing. Daytime sleepiness and poor sleep efficiency have been associated with a higher rate of falls in older people. Sleeping more than 10 hours or less than five hours per night is associated with increased falls risk in the elderly and sleep deprivation has been suggested to contribute to a loss of balance. Sleep fragmentation and hypoxia have been shown to be associated with poorer physical function even after adjustment for factors such as age, body mass index, smoking and comorbid diseases. Chronic poor sleep is associated with depression deficits in attention, delayed response times and decreased performance levels. All of these factors have also been found to be risk factors for falls.

Although there are documented associations between subjective sleep difficulties, objective sleep disorders, falls and falls risk, it is less clear whether there are causative links between sleep and falling. Further research exploring mechanisms underlying sleep changes in the elderly and the effect of treatments on falls risk are required.

1022

DOES DIET AFFECT SLEEP? CURRENT EVIDENCE

A RICHDALE

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This paper will present a review of evidence regarding relationships between diet and sleep. Particular emphasis will be placed on the child and adolescent literature. The most obvious links between diet and sleep are those between obesity and sleep apnoea in adults. In children and adolescents evening chronotype, reduced nighttime sleep and/or daytime napping have been associated with poorer nutrition or eating habits and other health behaviours; children and adolescents with adequate sleep have a lower risk of obesity. Over the last 30 years or more there has also been interest in putative relationships between diet and behaviour in children, particularly children with ADHD or autism. Additives and preservatives, salicylates and amines, gluten and casein, and micronutrients such as iron and magnesium have been investigated.
for their impact on behaviours, including sleep. It is also well documented that daytime behavioural difficulties are significantly associated with nighttime sleep problems in children, particularly in atypical populations. While many early studies were poorly designed and controlled, there is nonetheless some consistent evidence of nutrient and food additive effects on daytime behaviours, and in many cases sleep in sub-populations of children, including that sleep problems may improve with changes to diet.

**1023**

**THE RELATIVE AND COMBINED EFFECTS OF A DIET AND A BEHAVIOURAL INTERVENTION FOR BEHAVIOUR AND SLEEP PROBLEMS IN CHILDREN WITH SIGNIFICANT CHALLENGING BEHAVIOURS**

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**Background:** Sleep and behaviour problems are common in children and are often related. Although behavioural interventions, including Behavioural Parent Training (BPT) programs, have been shown to be effective in reducing sleep problems, both relative to, and compared with, behavioural interventions. There is some evidence that various elimination diets can improve behaviour and sleep, however there has been no examination of the relative impact of BPT and dietary interventions on behaviour in general and no examination of the impact of diet on sleep problems specifically.

**Objectives:** To investigate the relative and combined effects of a BPT program and the Simplified Elimination Diet (SED) on daytime behaviour and sleep in children with a range of challenging behaviour, including sleep problems. The SED excludes food additives, salicylates, amines, and glutamates, while the BPT teaches parents standard behavioural principles to manage their child’s difficult behaviours.

**Method:** 33 children aged from 4.0 to 11.9 years with an IQ > 85 and challenging behaviour, defined by a score > 85th percentile on the Rowe Behaviour Rating Inventory (RBRI), were randomly allocated to the BPT (19 children) or the SED (14 children) group (Phase 2). X children had a diagnosis of ADHD and 5 children had a diagnosis of Asperger’s disorder; the remainder did not have any formal diagnosis. Of these 33, 11 children from the BPT group then completed the SED and 8 from the SED completed the BPT program (Phase 3); participants maintained the Phase 2 intervention.

**Results:** While both interventions were individually effective in reducing children’s behaviour problems, children’s sleep problems generally responded more dramatically to the SED. The SED added to the effectiveness of the BPT but the BPT did not provide any additional benefit over the SED. Overall the SED was the more effective intervention; behaviour problems moved from the clinical to the normal range and sleep problems generally remitted. These findings were supported by all measures.

**Conclusions:** The SED was more effective than a BPT in reducing both sleep and behaviour problems in children with clinically significant challenging behaviour; the BPT did not add to the effectiveness of the SED. Thus, this study provides evidence that, at least in some children with challenging behaviour, which in majority of cases also included sleep problems, sleep and behaviour difficulties may be related to diet. This requires further investigation, including determining which dietary constituents are responsible for this effect.

The authors would like to acknowledge funds contributed by the Feingold Association, USA to assist with carrying out this study.

**1024**

**THE EFFECTS OF SUGAR LOAD ON SLEEP IN 118 CHILDREN AND ADOLESCENTS: SUBJECTIVE AND OBJECTIVE MEASURES**

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Sleep disturbances are common and consequential in children and are impacted by several factors. One understudied area is diet. We investigated interrelationships between diet, sleep, behaviour and attention in two studies. The first study investigated the relationship between self-reported sleep (Sleep Disturbance Scale for Children) and food intake (Victorian Food Diary) in 88 Australian children aged 6–13 years old (M = 8.94, SD = 1.78). We found that parents who reported a higher intake of carbohydrate, especially sugar also reported poorer quality sleep. In study 2, we manipulated sugar intake in 10 pre adolescent children in a randomised cross over design sleep laboratory study to objectively evaluate the effect of sugar on sleep quality, quantity and attention. We expect to see poorer sleep in those who consume more sugar. This information is novel and important given the decreased sleep increase in obesity in paediatric populations and the relationship between diet and sleep in children with ADHD. Given that both sleep and dietary intake are potentially modifiable behaviours for treatment regimes of children with ADHD, further investigation is needed.

**1025**

**THE EFFECTS OF SLEEP RESTRICTION ON ADIPOSE-DERIVED HORMONES IN HEALTHY ADULTS**

**S Banks**

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The prevalence of obesity is rapidly increasing with the changes in lifestyle and structure of meals. The high prevalence of obesity has led to an increase in medical conditions that accompany obesity, especially type-2 diabetes and cardiovascular disease. Adipose tissue was once thought to be an inert store for energy, but since the discovery of leptin in 1994, more than a thousand articles have redefined it as a key organ linking metabolism, reproduction and many aspects of immunity and inflammation. The recent interest in adipose tissue has led to the identification of a large group of adipocyte specific proteins. Leptin is the most well known of these and is secreted primarily from white adipose tissue. The level of circulating leptin is directly proportional to the total amount of fat in the body and it is a key regulator of energy homeostasis. Leptin acts directly on the hypothalamic nuclei, as well as several other areas of the brain to suppress food intake and increase energy...
This has provided a scientific framework for the delineation of myriad interactions between sleep and almost all other body systems. This new endeavour, having occurred only in the last 50 years. Remarkable scientific advances have enabled us to unravel much of the neurophysiology of normal sleep and circadian biology and recognition of the myriad interactions between sleep and almost all other body systems. This has provided a sound scientific framework for the delineation of the characteristics of some 100 distinct disorders of sleep. With the input of multiple clinical disciplines, including neurology, respiratory medicine, cardiology, ear nose and throat, paediatrics, psychiatry, dentistry, psychology, and nursing, these scientific advances have been translated into clinical practice. This has created the need for and emergence of sleep biology and sleep medicine as new specialty areas.

Sleep disruption related to working time arrangements is a common problem in 24-hour operations. Increasingly, sleep loss is also a symptom in non-shiftworking environments. Longer work hours, a global society and pressure to maintain a work-life balance all mean that sleep time is often sacrificed for other activities. The consequences of inadequate sleep for health, safety and well-being are significant. Fatigue-related errors are higher on night shift, higher on extended shifts and higher in the early hours of the morning. Some health complaints are more frequent in shiftworkers, nightshifters and other populations who have restricted sleep. The management of sleep health and fatigue-related risk associated with the workplace should be a critical priority. A number of key questions need to be addressed. Should the management of the risks be left solely to individual employees or fall at the feet of our employers? What do we know about the way in which experienced employees manage fatigue-related risk in the workplace that we might be able to share? What is it about the healthy shiftworkers that might be protecting them from the circadian and sleep disruption associated with the work patterns?

Sleep and its disorders have been the focus of intense research, education, and advocacy in recent years. Many sleep issues are behavioural (eg, self-imposed sleep deprivation or obesity), and several have been the targets of regulation and/or legislation. Because of this, public education is increasingly recognized as a critical component of sleep health. But whose job is this? Physicians are woefully uneducated about sleep and lack the incentive and the time for patient education. Schools have many competing mandates, and have been slow to incorporate sleep education into the curricula. As a result, much sleep health education takes place in cyberspace, and not all that is available is accurate or scientifically sound.

A successful model of public health education in the US is the National Sleep Foundation (NSF), now more than 20 years old. Lessons from the NSF can inform the development of sleep health education organizations. Among the issues are funding, turf, and keeping volunteers engaged. Diversification of funding is essential, both for stability and for credibility. Successful options for funding include continuing education, memberships, endorsement, special events, and sales of unique items. Competition for turf is inevitable and not necessarily unhealthy. Indeed, a successful organization is one that triggers mimickers. Transparency and consistency can reduce conflict and confusion. Volunteers are priceless resources, and keeping them engaged is essential. Volunteers seek meaningful work, regular interaction, positive feedback, the opportunity to meet and work with others who share interests, prestige/status, and altruistic fulfillment.

Choosing activities which maximize funding opportunities, avoid turf conflicts, and engage volunteers is critical success. For the NSF, addressing high school start times has been one such activity.
Due to an increase in demand on hospital based sleep services, in association with increased waiting times and inequity of access to specialist services, an integrated model was developed for assessment of patients referred from primary care with suspected obstructive sleep apnoea.

All patients referred to the hospital sleep service now have an initial standardised sleep apnoea assessment undertaken, including a detailed sleep history, focussed clinical examination and home overnight oximetry. This is performed by either an Approved General Practitioner (“Approved Provider”), a community based Clinical Nurse Specialist (“Respiratory Facilitator”) or a hospital based Sleep Clinical Nurse Specialist. All referrals are then discussed at a weekly hospital based sleep triage meeting where the next step is determined: direct to CPAP; higher level study, outpatients Sleep Specialist assessment; or return to General Practitioner with advice.

We have thus far managed over 1500 patients referred through this process. The main outcomes thus far achieved include greatly reduced waiting times for CPAP and specialist assessment, and greater involvement of General Practitioners in managing patients with sleep disorders. Specific data will be discussed in more detail during the presentation.

Minimal objective data exists concerning the prevalence and severity of sleep apnoea in Aboriginal and Torres Strait Islanders and this is a major deficiency in our understanding of sleep apnoea in Australia. It is likely that sleep apnoea is a major problem in these communities because of concomitant high rates of obesity, diabetes, cardiovascular disease, hypertension, renal disease, respiratory disease and other known comorbidities for sleep apnoea. In addition for rural patients with sleep disorders access to diagnostic facilities to diagnose sleep apnoea and to appropriate advice and expertise regarding therapy for sleep apnoea remains a challenge in many parts of rural Australia. These factors play an important role in understanding the prognosis and variable response of individuals with sleep apnoea, especially those of Aboriginal and Torres Strait Islander origin.

Currently only limited data exists on the scope of the problem of sleep apnoea in Aboriginal and Torres Strait Islanders and data will be presented from the Western Australian Sleep Health study which has collected questionnaire data (including ethnicity/ancestry), polysonmography and blood from over 3000 individuals. Approximately 50 individuals who are part of this study have identified themselves as Aboriginal and Torres Strait Islanders and these data will be compared to other individuals who are part of the study. Initial analysis of this small number of Aboriginal and Torres Strait Islanders suggests that they are more obese and have more severe sleep apnoea. However this observation is confounded by the strong referral bias of a sleep clinic population and by the difficulty of rural patients to access sleep diagnostic facilities in Western Australia. However given the lack of any other objective data thus far in Australia it is likely that sleep apnoea is
a largely undiagnosed but significant problem in these communities that requires further objective assessment.

I032
AN INTEGRATED SLEEP APNEA SERVICE UTILISING SLEEP TRAINED GENERAL PRACTITIONERS
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In response to unmet demand and inequities of access for diagnostic and treatment services for obstructive sleep apnea, and capped funding for the hospital based specialist service, the local sleep service has developed an integrated approach utilizing trained sleep general practitioners (SGP) to provide the clinical assessments and undertake oximetry studies in the community.

All referrals for sleep assessments are initially triaged by the specialist sleep practitioner (SSP). The SGP’s then provide the clinical assessments of the patients in their own consulting rooms following a standardized approach. Depending on symptoms, clinical prediction score and presence of other factors they may undertake counseling and an oximetry study, or request from the specialist service advice or a home based Somno respiratory polygraph study. Preset criteria are used to help determine who are offered continuous positive airway pressure (CPAP) therapy. The home based titrations studies and home trials are done by the sleep service. Patients not commenced on long term CPAP are reassessed by the SGP prior to discharge. Each step in the evaluation process is overseen by the SSP and selected patients transferred to the specialist service.

An independent evaluation of the service in 2008 confirmed it was effective and that the patients and referrers were happy with the way it was configured and operated. There were increased patient volumes, with less inequity of access and reduced cost per patient. There were operational efficiencies from integrating the functions of the specialist and community services. A comprehensive clinical and administrative database has been established to support the functioning of the service.

I033
SIMPLIFIED MODELS OF CARE FOR OSA, BROADENING THE SKILLED HEALTH PROFESSIONAL BASE TO HELP US DEAL WITH A COMMON DISORDER
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OSA is a prevalent disease and long waiting lists for diagnosis and treatment are inevitable. Clinical sleep laboratories were first seen in the 1970s in the USA, evolving from neurology or psychiatric services or research programs. Sleep measurement was precise, with an encephalogram (EEG) focus. However it became apparent that OSA was the most common sleep disorder presenting for investigation and the discovery of a highly effective treatment, CPAP, markedly accelerated referrals. While the gold standard for OSA diagnosis remains attended laboratory PSG, it is notable that in the developing world there may be no sleep laboratory access at all. An important unanswered question is whether the level of complexity required of an attended laboratory PSG is needed for routine OSA diagnosis.

We need to evolve models of care that simplify the diagnostic process, make it more accessible and yet lead to acceptable patient outcomes. The importance and realities of OSA diagnosis and treatment in developing worlds should also be considered.

Results will be presented from 2 randomised controlled trials.

In the first a Nurse led model of care was applied to at three tertiary sleep medicine sites (Alfred Hospital, Royal Newcastle Hospital and Repatriation General Hospital). Referred patients were recruited with moderate-severe symptomatic OSA and randomised to either best practice laboratory and specialist management of OSA or to the simplified nurse led model of care. Outcomes were measured at 3 months. In the simplified model, oximetry was used to diagnose OSA and AutoPAP to titrate a fixed CPAP pressure. This model of care was shown to be save S1100 per patient treated and produce non inferior outcomes to best practice OSA treatment across a range of quality of life measures as well as subjective and objective sleepiness and patient satisfaction.

In the next randomised controlled trial, a simplified diagnostic algorithm a questionnaire (OSAS0 validated in and designed for use in a Primary care setting) and oximetry were used as a 2 step process to identify moderate-severe OSA in Primary care. Patients were then randomised to 2 arms of care a GP upskilled in diagnosis and management of OSA and Specialist Nurse and these outcomes were compared to Best Practice laboratory and physician outcomes for OSA.

As our field evolves we must move with it to design and validate simpler models of diagnosis and treatment for our patients with OSA.

I034
SLEEP-WAKE CHANGES ASSOCIATED WITH AGING
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Many believe the older adults sleep less than younger adults, yet most surveys have shown that older adults report sleeping about seven hours a night. Nevertheless, sleep architecture does change with age, with slow wave sleep beginning to decrease at middle-age, but stabilizing by about age 60. The number of awakenings per night may increase, and sleep efficiency does decrease with age. There are consequences to decreased sleep including increased risk of depression, increased risk of declining physical function, increased risk of cognitive dysfunction, increased risk of falls and increased mortality. The prevalence of insomnia also increases with age and is often related to pathological and treatable sleep disturbances. Primary sleep disturbances occurring in older adults include circadian rhythm disturbances, sleep disordered breathing, REM behavior sleep disorder, restless legs syndrome, and periodic limb movements in sleep. Particularly in older adults, sleep disturbances are likely to represent a multi-factorial syndrome in which medical illness, psychiatric illness, and medications may also play a role.

Chronic sleep disturbances in the elderly are primarily associated with indications of poor health (depressed mood, respiratory symptoms, fear to poor health, and physical disability). Improvements in sleep are generally associated with improvements in health. In short, aging itself does not result in poor sleep and healthy older adults rarely complain about their sleep.
CIRCADIAN AND SLEEP-WAKE DISRUPTION IN NEURODEGENERATIVE DISORDERS – THE LINK WITH COGNITIVE DECLINE

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Sleep-wake disturbances are common in older people and are often associated with neuropsychiatric and neurodegenerative disorders. Data now suggests that they are not only correlates of these disorders but may indeed be a risk factor or prodromal feature. Of significance, sleep-wake disturbances are linked with depressive symptoms, behavioural disturbances, decreased quality of life and increased cognitive decline, including dementia.

This symposia will provide an overview of the various sleep-wake disturbances associated with neurodegenerative diseases, including late-life depression, mild cognitive impairment, Alzheimer's disease, Parkinson's disease and Frontotemporal dementia. Preliminary data exploring the relationship between sleep-wake disturbance and cognition will be provided and discussed in light of possible opportunities for early intervention.

CIRCADIAN DISRUPTION ASSOCIATED WITH ADOLESCENCE – DIFFERENTIATING NORMAL DEVELOPMENT AND THE ONSET OF MOOD DISORDERS

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Changes in the circadian and sleep-wake systems occur throughout normal development, with characteristic patterns occurring during adolescence. During this time it is common for individuals to experience delayed circadian phase, and to sleep for up to 10 hours per night. It is thought that these circadian and sleep characteristics are associated with pubertal and neurobiological development, and impact both brain and body maturation and growth.

Disruption to circadian rhythms and sleep-wake behaviour are common in adolescent onset mood disorders, including bipolar disorder and depression. Changes in circadian timing and sleep-wake behaviour often predate the onset of mood symptoms, and may potentially be markers for symptom relapse. These disruptions have a significant impact on mood symptoms, neurocognitive function and quality of life.

These symposia will provide an overview of changes in circadian and sleep-wake behaviour associated with normal ageing during the adolescent period, as well as those associated with adolescent onset mood disorders. Data exploring the relationship between mood disorders and circadian and sleep-wake behaviours will be presented to illustrate current thinking regarding the relationships between mood changes, mood disorders and the circadian and sleep-wake systems.

IDENTIFYING SOUNDS IN THE NIGHT: PERCEPTIONS OF SNORING

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Interest in the detection and quantification of snoring has grown as it has become recognised that, in addition to its well-known socially disruptive impacts, snoring per se may have hypothalamic sleep regulatory and mood effects that have implications for both snorers and bed partners. Progress, however, continues to be hampered by the lack of agreed, workable definitions for snoring and the absence of established standards and guidelines for recording and quantifying snores. Snoring is commonly assessed using questionnaire data, a process relying on human perception and recall. Most instruments are completed by the subject themselves, raising the issue of the accuracy of an assessment performed by an individual who is asleep at the time of the event. Partners tend to report more snoring than do the subjects themselves, but partner opinions are coloured by many inputs, including sensitivity to noise, gender and relationship to the snorer. Many snoring questionnaires have not been validated against relevant objective acoustic indices but, where this has been done, correlations tend to be moderate at best. More recently, psycho-acoustic techniques, focusing on relationships between acoustic stimuli and hearing sensations, have been used to develop snoring annoyance ratings, while environmental noise pollution metrics and standards have been deployed in an attempt to address potential health impacts from snoring. Annoyance levels vary with the properties of the sound itself (eg loudness, temporal structure) and, equally importantly, with factors influencing the listener's psycho-physiological noise sensitivity (eg mood, time of day). Consequently, both inter- and intra-observer reproducibility for annoyance scores is again only moderate. There are now a number of sophisticated signal processing algorithms for identification and quantification of snore sounds. However, most are trained to recognise acoustic features based on reference sounds originally nominated as snores by a human observer. Perception of an individual sound as a snore varies with both sound and listener characteristics. Some sounds are classified as snore or non-snore with almost universal agreement, while others provoke wide disagreement. It seems that, like the proverbial duck, if it sounds like a snore, then it is a snore.

DOES SNORING CAUSE VASCULAR DISEASE?

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Habitual snoring has been associated with stroke in epidemiological studies where it is considered a surrogate marker for obstructive sleep apnoea (OSA) rather than directly implicated in the process of vascular disease progression. As a result, the focus for research into cardiovas- cular sequelae of OSA has centred on the pathophysiological conse- quences of acute obstructive events, including intermittent hypoxia and arousals. However, in a cross-sectional study, we recently identified that heavy snoring in the absence of hypoxia is an independent risk factor for the presence of carotid atherosclerosis. This supports the hypothesis that during bouts of heavy snoring, the carotid arteries (which are in close proximity to the vibrating pharyngeal walls) will be subject to vibration energy levels that may induce carotid artery wall damage.
Sleep, Science and Research

Indeed, in a recent study we demonstrated that snoring associated vibrations are transmitted to the carotid artery wall and lumen. More recently, we have proposed that snoring-like vibratory energy transmitted to carotid artery walls may contribute to carotid artery atherogenesis by induction of endothelial dysfunction, a known atherogenic precursor. In support of this, we have demonstrated carotid endothelial dysfunction in response to six hours of directly applied snoring-like vibrations, with reduced tissue cGMP levels in vibrated arteries after the addition of an endothelium-dependent vasorelaxing agent. In addition, tissue cGMP did not differ between vibrated and control arteries when an endothelial-independent exogenous nitric oxide donor was used, confirming that the vibration induced dysfunction was confined to the carotid endothelium. Furthermore, we demonstrated reduced vascular relaxation for vibrated arteries in functional vascular reactivity studies, consistent with the presence of vibration-induced endothelial dysfunction. Therefore, carotid arteries subjected to 6 hours of continuous snoring-like vibrations display endothelial dysfunction, suggesting a direct mechanism linking heavy snoring to the development of carotid atherosclerosis. However, many questions remain unanswered including the relevance of snoring vibration frequency in causing endothelial dysfunction, the role of vibration amplitude, the interaction with other vascular risk factors such as the metabolic syndrome and whether there are individual variations in susceptibility to vibration stimuli.

In conclusion, current data demonstrate that snoring energy transmitted to carotid artery walls leads to endothelial dysfunction, which may promote the development of carotid atherosclerosis in heavy snorers.

1041

ANALYSIS OF SNORE RELATED SOUNDS AND WHAT IT CAN TELL US

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Snoring arises from the vibration of tissues in the upper airway during sleep and commonly occurs in patients with obstructive sleep apnoea. However the presence of snoring is not specific for OSA. Snoring perception, including loudness, sharpness and annoyance, is highly subjective and has limited discrimination of the severity of OSA. There has been a recent increase in interest in Snore Related Sounds (SRS) using more sophisticated analysis. Recorded snore related sounds are a function of the energy of sound at the source modified by upper airway properties (acting as an acoustic filter) and interference from background noise. Therefore upper airway properties are “buried” within signals of snore related sounds and this presents an attractive option to provide information about upper airway mechanics. There are many techniques in the literature for analysis of SRS, mostly pertaining to its use to diagnose presence of OSA. Measures of frequency or pitch of snore related sounds provide information on the compliance of the upper airway and several studies have shown differences in snoring frequencies between simple snorers and patients with OSA. Acute changes in pitch have been shown to be predictive of obstructive breathing with a sensitivity of >85–90% and specificity of 50–80%.

Pitch analysis appears more sensitive than other second order analysis of sound, such as power spectral analyses. More recently, technology developed for speech analysis has been applied to analysis of snoring. Non-linear techniques based on Higher Order Statistical analysis of pitch and airways response have reported sensitivity and specificity for detecting OSA of >90%. Analysis of the Gaussianity of breathing sounds (all sounds not selected snore segments) has been reported as a simpler approach as obstructed breathing is non-Gaussian. Studies assessing snore sounds to localise anatomical site of the snoring source and upper airway obstruction have been less successful. Despite the promise from this recent work, there are certain caveats that need to be considered. Many techniques rely on manual selection of snoring data fragments and are therefore dependent on the definition of snoring itself. Analysis of SRS require the use of filters to improve the signal to noise ratio, giving rise to potential manipulation of data by the selection of filter settings. Furthermore, studies to date have compared snore sounds to AHI rather than clinical outcome measures. The recent developments in analysis of SRS are encouraging but techniques need to be refined to be fully automated and its role needs to be defined in larger clinical trials.

1042

PSG TECHNICAL SPECIFICATIONS

B DUCU

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Sixty-five years ago the first all-night continuous polysomnogram was recorded by Loomis and colleagues. Since this time there has been a proliferation of commercial devices and software which allow us to record, view, analyse, report and store polysomnographic data. This has been particularly evident following the introduction of digital polysomnography. Unfortunately there have been no uniform specifications to guide the development of these devices.

The AASM manual of 2007 is the first wide-ranging effort to define criteria for digital polysomnography. The manual stipulates minimum
and recommended specifications for sampling rates, low- and high-frequency filter settings, monitor resolution and video card resolution. The guidelines also provide direction with respect to hardware and software features to be included in each system. While these features will have little impact on the scoring of sleep or sleep related events, they are considered essential to determining recording quality.

While this manual has attempted to examine the technical requirements for polysomnography, it is hoped that a comprehensive system of specifications will occur in the not-too-distant future.

1043
AROUSAL, CARDIAC AND PLM SCORING
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Cortical arousals are associated with a number of acute physiological changes and occur as a typical feature of normal sleep, increasing in frequency along the life span. The significance of brief arousal as a consequence of primary sleep disorders lies in the inherent fragmentation of sleep and the associated daytime sleepiness. Whilst Rechtschaffen and Kales (1) did not describe EEG arousals, the universally adopted American Sleep Disorders Association (ASDA) criteria of 1992 (2) defined arousals as an abrupt shift in EEG frequency for a minimum of 3 seconds in duration. Although arousals of shorter duration and autonomic arousals may be of clinical significance, the 3 second rule was adopted to ensure scoring reliability. The 2007 American Association of Sleep Medicine (AASM) criteria for scoring of arousals (3) confirm and extend the ASDA criteria, and serve to improve detection of arousals. However, if frontal EEG leads are included for arousal scoring, normative and pathological values for the arousal index may need to be re-evaluated.

Cardiac events are commonly encountered during routine polysomnography, particularly in patients with obstructive sleep apnoea. Although the utility of a single lead ECG to detect myocardial ischemia in patients is limited, simple measures of cardiac rhythm are feasible. Given the previous absence of clear guidelines for the scoring of cardiac events during sleep, the AASM criteria for tachycardia, bradycardia, asystole and arrhythmias are designed to provide scoring consistency. Similarly, the AASM criteria for periodic limb movements build on previous recommendations and now provide clarification around the timing of events in relation to arousals and respiratory events.


1044
SLEEP AND RESPIRATORY EVENT SCORING
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In 2007 the AASM published the document 'The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications'. The document was three years in preparation and included comprehensive literature reviews published separately. The standards are mandatory for accreditation of sleep laboratories in the USA. A number of criticisms of the guidelines have been made, particularly relating to respiratory event scoring.

To address these issues the Professional Standards Committee of ASTA with input from the Clinical Committee of ASA undertook to review the guidelines and to examine the likely impact of adoption of the AASM rules.

It was self-evident that ASTA and ASA did not have the resources to perform a separate analysis from that undertaken by AASM. Such an analysis would have lacked the scientific rigour and comprehensive coverage of the AASM document. In addition, adoption of a substantially different set of guidelines would have put Australasian research groups at a disadvantage. It was therefore accepted that the outcome of a review would be the adoption of the AASM recommendations, with modifications where necessary to address any important deficiencies or to achieve clarifications.

This presentation discusses the results of this review for adult sleep and respiratory event scoring. Areas where modifications were thought necessary will be highlighted.

1045
AASM RESPIRATORY EVENT SCORING IN CHILDREN – THE WAY OF THE FUTURE
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In 2007, the American Academy of Sleep Medicine (AASM) published new guidelines for scoring polysomnography. These are the first AASM guidelines to specifically address pediatric scoring. In order to be able to compare data from one sleep laboratory to another, and to evaluate the medical literature, it is imperative that all sleep centers use the same scoring criteria.

Pediatric scoring rules apply to children <18 years of age, although the guidelines allow adult data to be used for adolescents aged 13–18 years. Newer data suggest that if adult scoring rules are used, the Hypopnea B definition (50% drop in airflow associated with 3% desaturation or arousal) should be used.

For pediatric studies, both oronasal thermistors (primarily to measure apneas) and nasal pressure monitors (primarily to measure hypopneas) should be used.

In children, obstructive apneas and hypopneas are scored if they are at least 2 breaths in duration, in contrast to adults where events ≥10 seconds duration are scored. The rationale for this is that children have a faster respiratory rate than adults, and a lower functional residual capacity, and are therefore likely to desaturate even with short apneas. There is only one hypopnea scoring rule for children. Hypopneas are scored if there is a ≥50% decrease in airflow associated with either ≥3% desaturation or an arousal.

Central apneas are common in children, and are scored only if ≥20 seconds duration, or if shorter but associated with ≥3% desaturation or arousal.

The monitoring of PCO2 is important in pediatric studies. Hypoventilation is considered to be present when the PCO2 is >50 mm Hg for >25% of total sleep time; either end-tidal or transcruentaneous PCO2 may be measured.

Polysomnography is generally reliable in children, with low night to night variability, although studies have shown a first night effect. Further studies are needed to demonstrate associations between polysomnographic results and clinical outcomes.
Sleep disturbances affect 30% to 75% of cancer patients. This is double the rate in the general population. Sleep complaints in cancer patients consist of difficulty falling asleep, difficulty staying asleep and frequent and prolonged nighttime awakenings. These sleep complaints occur not just during chemotherapy, but also before and after the end of treatment. Risk factors for insomnia in cancer patients include the cancer itself (e.g., tumors, pain, dyspnea), treatment (e.g., corticosteroids), medications (e.g., narcotics, chemotherapy), environment, psychosocial disturbances (e.g., depression, anxiety) and physical disorders (e.g., headaches). In the cancer patient, insomnia can lead to fatigue, mood disturbances, contribute to immunosuppression, affect quality of life and affect course of disease. Objective measures of sleep in cancer confirm fragmented sleep and low sleep efficiency; more restlessness at night during treatment, longer sleep latency, increased wake time during the night, and more prevalent sleep disorders such as sleep apnea and periodic limb movements. There may also be some cancer type-specific insomnia, as sleep may vary by tumor type. Insomnia has the highest prevalence in breast cancer, but is also high in colorectal, prostate, ovarian, lung, hematologic cancers and malignant melanoma. Because insomnia in this patient population may be due to a variety of causes and co-morbidities, treatment must be multimodal and may include both pharmacologic (e.g., hypnotics) and nonpharmacologic (e.g., cognitive behavioral therapy) therapies. A handful of studies have shown that cognitive behavioral therapy is effective in treating insomnia in cancer survivors. One study has suggested that bright light therapy administered during chemotherapy might prevent deterioration of fatigue, circadian rhythm disruption, quality of life and sleep. In summary, an increased emphasis is needed on sleep as a “sixth vital sign” to be assessed in all cancer patients throughout their disease encounter.

Sleep issues in the intensive care unit

Sleep disruptions and derangements have been described in critically ill patients including altered circadian rhythm. The clinical implications and consequences of sleep disruption in critically ill patients are currently being investigated and they appear to increase morbidity and possibly mortality. The study of sleep and quantifying sleep disruption in the intensive care unit is difficult for a variety of reasons. Newer methods are currently being evaluated for scoring and quantifying sleep disruption in the ICU, and thereby may make it easier to study this issue in more detail. Noise and patient care related activities are well known determinants but account for less than one-third of the causes for sleep disruption. There are various other factors that are responsible for sleep derangements in the intensive care unit such as commonly prescribed medications in the ICU. The use of mechanical ventilators in ICU may predispose to patient ventilator dysynchrony and may therefore disrupt sleep quality. Delirium is a significant contributor to increased morbidity and mortality in the intensive care unit. Sleep disruption can lead to the development of delirium, and delirium can worsen sleep disruption. Interventional methods to address delirium and sleep disruption will improve sleep quality and quantity and may improve various patient outcome measures including patient’s ICU length of stay and possibly mortality. Further investigations in this area is urgently needed.
NI01

INVESTIGATING THE RELATIONSHIP BETWEEN CARDIOVASCULAR AND ASSOCIATED MORBIDITY WITH OBSTRUCTIVE SLEEP APNOEA USING WESTERN AUSTRALIAN LINKED HEALTH DATA

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Introduction: Obstructive Sleep Apnoea (OSA) is closely associated with cardiovascular (CVD) and metabolic disorders, and has been implicated in increased CVD mortality. The Western Australian (WA) Sleep Health Study data has recently been linked to population-wide WA Department of Health datasets (via computerized probabilistic matching), including hospital morbidity and mortality records. These statutory datasets, collected over the last four decades on the entire WA population, allow large-scale linkage of health records to various study data. The primary aim of our study was to compare co-morbidities in OSA patients with the general population, adjusting for conventional confounders.

Methods: OSA cases included consecutive new patients who attended the major adult sleep clinic in WA since 1988. Age- and sex-matched controls were identified via the electoral roll. Past occurrences of cardiovascular and associated co-morbidities in the OSA patients were identified via the electoral roll. All relevant International Classification of Disease (ICD) codes collected over the period of interest were standardized to ICD-10 coding for analysis. Sex-specific logistic regression models were fitted to characterize the multivariate associations (adjusted for age, obesity, co-morbidities, alcohol and smoking) with OSA case-control status.

Results: A total of 16,300 sleep clinic patients (69% males aged 59.7 ± 14.1 years, 31% females aged 58.2 ± 14.4 years) were linked as part of this study. Comparison of cases versus controls indicated that occurrence of type II diabetes (17% vs. 8%), hypertension (30% vs. 17%), ischemic heart disease [IHD] (16% vs. 10%), angina (3% vs. 3%), myocardial infarction (3% vs. 2%), chronic IHD (14% vs. 9%), other heart disease (18% vs. 10%), heart failure (7% vs. 3%), arrhythmias (12% vs. 7%) and cerebrovascular disease (3% vs. 2%) were all significantly increased in cases (p < 0.001). Sex-specific multivariate case-control analyses adjusted for conventional confounders showed that myocardial infarction and other heart disease, as well as diabetes, hypertension, hyperlipidaemia, (p < 0.001) were independently associated with OSA case-control status.

Discussion: These results suggest that OSA susceptibility is associated with ischemic heart disease independently of related co-morbidities. This supports the hypothesis that the link between OSA and IHD cannot be fully explained by associated co-morbidities such as diabetes, hypertension, obesity or hyperlipidaemia.

NI02

DISCHARGE PATTERNS OF TENSOR PALATINI MOTOR UNITS DURING SLEEP ONSET

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Introduction: Both tonic (e.g. tensor palatine – TP) and phasic (e.g. genioglossus – GG) upper airway muscles reduce their activity at sleep onset. In GG this is due to Motor Units (MUs) that have an inspiratory modulated pattern ceasing firing. However, the tonic pattern of TP multi-unit recordings suggests it has few inspiratory modulated MUs, raising the question as to what type of units contribute to the fall in the muscles activity at sleep onset. To answer this question we have analyzed the discharge patterns of TP MUs and determined which MUs ceased their activity at sleep onset.

Methods: TP EMG activity was collected on 2 electrodes from 9 male subjects on a total of 11 nights (age = 21.2 years, SD = 2.6; BMI = 22.8 kg/m2, SD = 1.7). Sleep and respiratory data were also recorded. Data were analyzed over sleep onsets for 30 seconds before and after alpha to theta transitions. MU activity was analyzed using Spike 2 software. Discharge rates and discharge patterns of MUs during wakefulness (alpha) were determined, as was any change concurrent with sleep onset.

Results: 130 MUs were identified: 54% were inspiratory modulated, 37% with a tonic component (inspiratory tonic) and 17% without (inspiratory phasic), 28% were expiratory modulated, 8% with a tonic component (expiratory tonic) and 20% without (expiratory phasic), and 28% were tonic. Both inspiratory and expiratory modulated MUs tended to cease firing at sleep onset (43 & 90% respectively), while tonic MUs rarely ceased firing (4%). These differences were statistically significant (p < 0.05). The mean discharge rates of the MUs were 16.8 (SD = 2.8) Hz for inspiratory tonic, 18.3 (SD = 2.4) Hz for inspiratory phasic, 12.4 (4.4) Hz for expiratory tonic, 16.0 (1.6) Hz for expiratory phasic and 18.1 (6.4) Hz for tonic.

Discussion: The overall tonic pattern of TP appears to be due to two features of the discharge patterns of single MUs: first, a high proportion of MUs had a tonic component (63%); and second, there was a similar proportion of inspiratory and expiratory modulated MUs, masking phasic activity. The large number of expiratory phasic motor units identified was different to the distribution pattern observed in GG. Finally, the fall in muscle activity at sleep onset was due to the loss of both inspiratory and expiratory phasic units.
NI03
IMPROVEMENTS IN SLEEP, DAYTIME SLEEPINESS AND A REDUCTION IN BODY MASS INDEX FOLLOWING AN AGE-APPROPRIATE SLEEP HYGIENE PROGRAMME DEVELOPED WITH YOUTHS
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Introduction: Sleep disturbances, which may negatively impact on daytime functioning, are relatively common in youth and can often result from poor sleep hygiene or habits. Although intervention via sleep hygiene programmes can be effective, few are developed to target youth specifically and none, as far as we are aware, have been developed in consultation with youth. We aim to pilot and test the effectiveness of a novel 20 week F.E.R.R.E.T sleep programme, (developed in consultation with 21 youths) in improving sleep, sleep hygiene practices and daytime functioning in youths aged 10–18 years.

Methods: F.E.R.R.E.T is an acronym for Food, Emotions, Routine, Restrict, Environment and Timing. Each category consists of 3 sleep rules aimed at improving sleep hygiene. Youths with self-identified sleep problems such as initiating and/or maintaining sleep were recruited and the programme delivered by one researcher. Participants were also given an education pack as well as ongoing telephone and outpatient support. Participants completed the Paediatric Daytime Sleepiness Scale (PDSS), Adolescent Sleep Hygiene Scale (ASHS) and Pittsburgh Sleep Quality Index (PSQI) twice (5 and 1 week) before and thrice (6, 12 and 20 weeks) after intervention. Height and weight were measured and Z-scores for age and sex obtained.

Results: Thirty-three youths (mean age 12.9 years; M/F = 1:2) with sleep problems (e.g. prolonged sleep latency) enrolled. Retention was 100%. We found significant improvements in daytime sleepiness, sleep hygiene and sleep quality PDSS scores (mean = 16.69) improved (−4.87, CI −6.45 to −3.29; p < 0.001) as did ASHS scores (mean = 4.72) post-intervention (0.20, CI 0.07 to 0.32; p = 0.002). PSQI scores (mean = 7.75) also improved (−3.16, CI −5.90 to −2.42; p < 0.001) after the intervention. BMI Z-scores (mean = 0.8) also decreased significantly post-intervention (−0.13, CI −0.20 to −0.05; p = 0.001), despite no height change.

Conclusions: These results suggest the novel F.E.R.R.E.T sleep programme is effective in improving sleep and daytime sleepiness, and might prove a feasible tool for weight management as seen in the decrease in BMI. The positive outcomes and high retention rate might reflect the fact that the programme was developed in consultation with youths. The programme will now be targeted at obese youth, where the findings may enhance our understanding of the performance-related consequences of mis timed sleep or circadian rhythm sleep disorders.

NI04
WAKE MAINTENANCE ZONE IS ASSOCIATED WITH FASTER REACTION TIMES ON THE PSYCHOMOTOR VIGILANCE TASK
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Prior to the onset of melatonin secretion, which usually occurs shortly before habitual bedtime, there is a 2–3 h window of reduced sleep propensity and increased alertness referred to as the wake maintenance zone (WMZ). The WMZ has been attributed to an increased circadian drive for wakefulness. While prolonged sleep latency and reduced total sleep time are apparent during this time, in normal sleep, the manifestation of the WMZ under conditions of normal entrainment is not well documented. The aim of the current study was to examine whether performance on an auditory psychomotor vigilance task (aPVT) improved during the estimated WMZ (3 h window immediately preceding dim light melatonin onset, DLMO) after extended wakefulness in a 50-h constant routine (CR) protocol. Sixteen healthy subjects were studied for 9 days in the Intensive Physiological Monitoring (IPM) unit at the Brigham and Women’s Hospital, including a 50-h CR on days 4–5. Days 1 to 3 were baseline days (8 h sleep in darkness; 10 h wake in −190 lux); from mid-way through Day 3 and during the CR, light levels were maintained at <3 lux maximum. Plasma or salivary melatonin was sampled every 30–60 minutes and subjects completed a 10-minute aPVT every 60–120 minutes. There was no difference between DLMO on day 4 and day 5. Without preceding sleep deprivation (Day 4) mean reaction times (RT) on the aPVT were significantly faster during the estimated WMZ (−3 to 0 h before DLMO time), when compared to trials occurring during the biological day (all aPVT trials after DLMO set until −3 h before DLMO time) and to all trials across the 24-h period. Following a night of total sleep deprivation (Day 5), mean RT on the aPVT were again significantly faster during the estimated WMZ when compared to trials across the biological day and to all trials across the 24-h period, despite −36 h of continual wakefulness. These results demonstrate that the WMZ is apparent under normally entrained conditions, as shown by a temporary improvement in psychomotor performance just prior to melatonin onset. The increase in alertness occurs at this circadian phase regardless of the increase in homeostatic sleep pressure during the CR. These findings may enhance our understanding of the performance-related consequences of mis timed sleep or circadian rhythm sleep disorders.

NI05
CARDIOVASCULAR RESPONSES TO EXERCISE IN LEAN AND OBESE CHILDREN WITH SLEEP APNEA/SNORING AND OBSTRUCTIVE SLEEP APNOEA
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Introduction: Childhood obesity and OSA are both independently associated with left ventricular hypertrophy. Cardiac output (Q) at rest and at peak exercise is higher in obese subjects, but any impact of OSA on these measures has not been studied in children.

Aim: To assess Q in children with and without OSA, at rest and during exercise.

Methods: Lean (BMI < 85th centile) and obese (BMI > 85th centile) children aged 7–13 years were recruited. All children underwent polysomnography to classify as being normal (AHI < 1), having primary snoring (PS; AHI < 5) or OSA (AHI ≥ 5). Q, stroke volume (SV) and heart rest (HR) were measured at rest and at peak exercise capacity using the USCOM Doppler and normalised against body surface area (BSA). Peak exercise capacity was achieved using a cycle ergometer and calculated when the respiratory exchange ratio (RER; VCO2:VO2) ≥1.10. Descriptive analysis and one-way ANOVA were used to compare groups.

Results: Amongst 45 children (mean age 10.0 years), the cardiac index (QI; Q/BSA) at peak exercise was lower in obese children with PS (n = 13, QI 5.4, p < 0.001) and OSA (n = 12; QI 5.4, p < 0.001) compared

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to controls (n = 4; QI 9.4). Response of Q to increased workload was lower in obese children with PS (ΔQI 2.4, p < 0.001) and OSA (ΔQI 2.3, p < 0.001) than controls (ΔQI 5.7). Whether lean or obese, children with PS and OSA all had a significantly reduced HR response to exercise compared to controls (lean PS n = 11, ΔHR 82 bpm, p < 0.05; lean OSA n = 5, ΔHR 68 bpm, p = 0.05; obese PS ΔHR 66 bpm, p = 0.001; obese OSA ΔHR 64 bpm, p < 0.001, controls ΔHR 111 bpm). There was no significant difference in QI, SV or HR at rest between the cohorts.

Conclusion: This is the first study to examine the effects of OSA on cardiac responses to exercise in children. Whether lean or obese, children who snore or have OSA have decreased cardiac responses to exercise compared to healthy children. What’s more, the effects were more far-reaching in obese children who had a significantly reduced cardiac output response to exercise and a lower cardiac output at peak exercise compared to healthy controls.

Reference:

NI06

ORTHOSTATIC BLOOD PRESSURE RESPONSE TO SLEEP DEPRIVATION IN AGING
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Introduction: This study aimed to determine how age affects the impact of sleep deprivation on blood pressure (BP) and to assess the impacts of sleep deprivation on the cardiovascular response to orthostatic stress in young and elderly adults.

Methods: Sixteen healthy normotensive men and women (8 young adults (24 (SD = 3.1) years, 20 to 28 y.o.) and 8 elderly adults (64.1 (SD = 3.4) years, 60–69 y.o.) underwent a night of sleep and 24.5 h of sleep deprivation in a crossover counterbalanced design. Brachial cuff arterial BP and heart rate were measured in semi-recumbent and upright positions and were compared across homeostatic sleep pressure conditions and age groups.

Results: A significant age by sleep interaction was found for systolic (F = 22.4, p = 0.0003) and diastolic (F = 7.9, p = 0.01) BP. Sleep deprivation increased systolic and diastolic BP compared to the sleep condition in elderly (all contrast p < 0.005) but not young adults. Importantly, this increase brought BP close to the clinical threshold for hypertension (140/90 mm Hg) in subjects that were normotensive. Moreover, a significant sleep by position interaction for systolic BP was found (F = 15.5, p = 0.002). While systolic BP decreased from semi-recumbent to upright position in sleep condition (p = 0.047), there was no significant difference between the two positions after sleep deprivation.

Discussion: These results indicate that sleep deprivation substantially raises systolic and diastolic BP in healthy elderly subjects whose BP and heart rate were comparable to those of young adults at baseline. Furthermore, sleep deprivation extinguished the systolic BP orthostatic response in both age groups, which suggests alterations in circulatory and autonomic regulation that may contribute to maintain high BP. These results are clinically relevant since frequent rises in BP maintained over long periods of time have been proposed to induce permanent BP elevation. Hence, by inducing repeated BP elevation, chronic sleep loss in the elderly may be a significant factor for hypertension.
Oral presentations

OP01
OXYGEN DESATURATION EVENTS DURING OVERNIGHT SLEEP IN BEDSHARING AND COT-SLEEPING INFANTS
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Understanding of infant sleep physiology is largely based on infants sleeping alone in a cot. We studied infants in their own home during infant-parent bedsharing and while sleeping in a cot to identify changes in oxygen saturation overnight and possible causes that might be related to a mechanism of sudden infant death syndrome.

Methods: Forty healthy, term infants, aged newborn to 6 months, who regularly bedshared with at least 1 parent >5 hours/night (BS) and 40 age-matched, cot-sleeping infants (CS) were studied. Infra-red sensitive video recorded overnight infant behaviour. Physiological sensors measured oxygen saturation (SaO2), heart rate, inspired CO2, respiratory airflow, respiratory pattern, and rectal, shin and ambient temperatures. Desaturation events (SaO2 < 90%) and possible causes were identified.

Results: BS infants experienced a mean of 6.8 desaturation events/infant compared to 3.1±0.5 the CS group resulting in a relative risk of 2.17 (95% CI 1.75 to 2.69). Adjusting for rectal-shin temperature difference reduced the RR to 1.54 (1.17 to 2.02) suggesting temperature difference largely accounted for the difference. A 1°C increase in rectal-shin temperature difference reduced the RR by 0.61 (0.50 to 0.75). Over 70% of desaturations in both groups had the following characteristics: minimum SaO2 between 85-90%, duration <5 seconds, preceded by a central apnoea of 5–10 seconds, and not associated with significant bradycardia or inspired CO2 >0.4%. Logistic regression showed no difference with respect to these characteristics in BS and CS infants.

Conclusion: Bedshare infants experienced more transient episodes of oxygen desaturation preceded by central apnoea than infants sleeping in a cot. Events appeared to be related to warmer temperatures of bedshare infants as identified by the decreased rectal-shin temperature difference but were not related to episodes of increased inspired CO2 and dyslipidemia. There are still no robust data to support a causal relationship with dyslipidemia. We conducted a randomised, placebo-controlled crossover trial to assess whether post-prandial lipidemia (PPL), a strong marker of cardiovascular risk, would improve with CPAP.

OP02
TREATMENT OF OBSTRUCTIVE SLEEP APNEA (OSA) WITH NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) REDUCES POSTPRANDIAL LIPIDEMIA (PPL). A RANDOMISED PLACEBO-CONTROLLED CROSSOVER STUDY
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Introduction: The mechanisms linking OSA to cardiovascular disease are thought to include central obesity, hypertension, glucose intolerance and dyslipidemia. There are still no robust data to support a causal relationship with dyslipidemia. We conducted a randomised, placebo-controlled crossover trial to assess whether post-prandial lipidemia (PPL), a strong marker of cardiovascular risk, would improve with CPAP.

Methods: Adult patients with OSA were recruited from three sleep clinics. Lipid profiles including triglycerides (TAG) were measured at 7 time points over a 24-hour period (inclusive of sleep) during three laboratory studies – at baseline prior to treatment and then after 2 months of either therapeutic CPAP or sham (placebo) CPAP (with an intervening 1 month washout). Patients consumed western style meals during the studies (55% carbohydrate, 30% fat, 15% protein) at set times during the daytime (wake) period.

Results: 29 middle-aged (48 ± 13 yrs) patients (3F:26M) who were obese (BMI 32.1 ± 3 kg m⁻²) with moderate-severe OSA (AHI = 41.2 ± 23.9 per hr) completed the study. Mean ± SEM compliance was higher on CPAP than Placebo (4.4 ± 2.2 vs 3.4 ± 2.3 hrs/night; p < 0.05). PPL determined from the mean integrated area under the 24-hr TAG curve (TAG-AUC24) was lower on CPAP than Placebo (3688 ± 294 vs 4045 ± 329 mmol L⁻¹ day; p = 0.035). TAG levels peaked at 2 time-points (2 pm and 3 am) and these peaks were significantly lower on CPAP (2 pm: 2.97 ± 0.22; 3 am: 3.07 ± 0.22 mmol L⁻¹) than Placebo (2 pm: 3.45 ± 0.22; 3 am: 3.48 ± 0.22 mmol L⁻¹) (p for difference <0.005 at both times). Moreover, TAG and Total Cholesterol levels across the whole 24-hour period were improved by CPAP (Main CPAP-Placebo difference (CI): TAG: −0.22 (−0.31, −0.12); TChol: −0.19 (−0.27, −0.11); (p < 0.0001)).

Conclusion: Treatment of OSA with CPAP improves post-prandial lipidemia (Triglycerides) and Total Cholesterol which are both strong markers of cardiovascular risk. This implies that the association between OSA and cardiovascular disease may, in part, be caused by direct effects on dyslipidemia.

OP03
INTERRELATIONSHIPS BETWEEN BODY MASS, OXYGEN DESATURATION, AND APNOEA-HYPOPNOEIA INDICES IN A SLEEP CLINIC POPULATION
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Introduction: Overnight oxygen desaturation index (ODI) has been used as a screening test for obstructive sleep apnoea (OSA). Oxygen desaturation during sleep is more severe in obese subjects. In this study we assessed the impact of obesity on ODI and the accuracy of ODI for detecting OSA in a large sleep clinic population.

Methods: Demographic information, height, weight, and polysomnographic data were collected in patients undergoing diagnostic inpatient polysomnography. ODI at 2%, 3% and 4% thresholds were derived. Mean ODI and the accuracy of ODI for detecting AHII>15 or >20 events/hour (Chicago criteria) were examined by BMI group, using area under the curve (AUC) of receiver-operator characteristic (ROC) curves for...
the 3 ODI thresholds. The relationship between BMI and the ODI/AHI ratio was examined.

**Results:** There were 14,702 polysomnogram results available for analysis. Mean ODI-2%, 3% and 4% increased in linear fashion with BMI group. Based on AUC (see Table) ODI-3% performed best, maintaining an adequate AUC of >0.80 for detecting AHI ≥ 15 in all BMI groups, and achieving AUC > 0.80 for detecting AHI ≥ 15 in obese BMI groups. For ODI-2%, the AUC for AHI ≥ 15 remained stable with BMI, and AUC for AHI ≥ 30 fell with increasing BMI due to diminishing specificity. The ratio of mean ODI-3% to AHI and ODI-4% to AHI progressively increased during a long vigilance demanding task, and that performance did not normalise following treatment. However, it is unclear if these performance decrements following sleep loss and alcohol extend to short cognitive tests. Previously observed vulnerability to sleep loss and alcohol in OSA patients during a long monotonous task suggests task duration and monotony may be important factors influencing vulnerability to these stressors in OSA patients.

**Discussion:** ODI-3% had the highest accuracy in detecting both moderate and severe OSA in obese patients (BMI ≥ 30). In non-obese patients, ODI-3% was less accurate in detecting moderate OSA.

**OP04**

**THE EFFECTS OF SLEEP RESTRICTION AND ALCOHOL ON COGNITIVE FUNCTION AND P300 IN OBSTRUCTIVE SLEEP APNOEA PATIENTS BEFORE AND AFTER CPAP TREATMENT**

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**Introduction:** Obstructive sleep apnoea (OSA) is a common sleep disorder associated with neurocognitive deficits. In addition, we have previously demonstrated that OSA patients are more vulnerable to further impairments with sleep loss and alcohol than healthy controls during a long vigilance demanding task, and that performance did not normalise following treatment. However, it is unclear if these performance decrements following sleep loss and alcohol extend to short executive function tasks and cortical event related potentials (P300) before or after treatment. Therefore this study compared neurocognitive performance and P300 in OSA patients and age matched controls following normal sleep, restricted sleep and alcohol conditions at baseline and after CPAP treatment.

**Methods:** At baseline evaluation, 34 OSA patients (age = 52.5 ± 10.5 y; BMI = 33.7 ± 8.3 kg/m², RDI = 45.1 ± 21.5/hr.), and 18 controls (age = 50.4 ± 10.3, BMI = 24.6 ± 2.6, RDI = 8.2 ± 6.0/hr.) (BL group) completed neurocognitive assessment at 4 pm following normal sleep (NS), restricted sleep (RS) (4 hrs in bed) and low-dose alcohol (ALC) (−0.02 g/dL) conditions in random order. This assessment was repeated in a sub-set (BL4FU group) of 9 severe OSA patients (age = 59.1 ± 7.7 y, BMI = 33.2 ± 6.0 kg/m², RDI = 64.5 ± 19.3/hr) and 9 controls (age = 53.2 ± 9.6, BMI = 24.3 ± 2.6, RDI = 6.6 ± 3.8/hr) at -3 months follow-up after CPAP treatment in patients. Cognitive tests included the Stroop, Trail Making, and auditory reaction tasks and P300.

**Results:** In the larger BL group, OSA patients had lower scores compared to controls on the Stroop task, prolonged reaction times, more lapses, delayed P300 latencies and reduced P300 amplitude (all p < 0.05). Compared to NS, RS but not ALC slowed reaction times and increased lapse frequency in both groups (p < 0.01), with no significant interactions. In the smaller BL4FU group OSA patients had lower scores compared to controls on the Stroop task, delayed P300 latencies and reduced P300 amplitude at baseline evaluation (all p < 0.05) and these differences remained at 3 months follow-up. No significant condition or treatment effects were observed.

**Conclusions:** OSA patients have deficits in neurocognitive function that remain in some cognitive domains despite CPAP treatment. However, additional sleep loss or alcohol do not differentially impair cognitive performance between patients and controls during short cognitive tests. Previously observed vulnerability to sleep loss and alcohol in OSA patients during a long monotonous task suggests task duration and monotony may be important factors influencing vulnerability to these stressors in OSA patients.

**OP05**

**SNORE BASED DIAGNOSIS OF OSA USING ARTIFICIAL NEURAL NETWORKS**

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**Introduction:** Snoring has been shown to carry vital diagnostic information on OSA, but its quantitative analysis is not used in clinical diagnosis. In this paper, we propose a quantitative method to analyze snoring. The method uses a feature vector that uses pitch-jump information, formant frequency (representing constrictions of the upper airway) and recurrence parameters (capturing the degree of periodicity embedded within the snore).

**Method:** Snore sounds were recorded from patients undergoing routine PSG testing. We used data from 51 males (AHI from 2.4 to 75.4) in this work. Snore segments were automatically identified, and the first and second formants (F1) and the pitch-jumps (PJ*) were computed for each snore. Then we trained an artificial neural network to separate the data into the two classes: OSA/no-OSA classification. The performance of the method was evaluated using a K-fold cross-validation technique.

**Results:** at the decision boundary AHIth = 15, the method resulted in OSA diagnosis sensitivities of 91 ± 6% while holding specificities around 89 ± 5% for the test data (n=50) test which was independent from the training set. At AHIth = 30, the corresponding numbers were 86 ± 9% and 88 ± 5%.

<table>
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**Discussion:** the method proposed here is likely to contribute to the technology of diagnosing/screening OSA based on snoring sounds. We will be testing it on a larger database of patients in the future. Male/female influences on diagnostic features (as reported in a companion paper) will also be exploited to improve the performance of the technique.
OP06

CHANGES IN BRAIN MORPHOLOGY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA) D McROBBIE1, R QUEST2, H PARDOE1, G PELL1, D ARBOTT1, P ROCHFORD3, R PIERCE1, G JACKSON1, D CORFIELD1, M MORRELL1

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Obstructive sleep apnoea (OSA) is a common disease that leads to daytime sleepiness and cognitive impairment. Attempts to investigate changes in brain morphology that may underlie these impairments have led to conflicting conclusions. We aimed to resolve this confusion and determine whether OSA is associated with changes in brain morphology, by studying a large group of OSA patients, using improved voxel based morphometry (VBM) analysis; an automated, unbiased method of detecting local changes in brain structure.

Methods: 60 OSA patients (Mean, confidence intervals) apnoea hypopnoea index [AHI] 55 (49–62) events/hr, 3 female) and 60 non-apnoeic controls (AHI 4 (3–5) events/hr, 5 female). Subjects were imaged using T1-weighted 3D structural MRI (69 subjects at 1.5T, 51 subjects at 3T). OSA grey matter differences were investigated, controlling for age, sex, site and intracranial volume. Dedicated cerebellar analysis was performed on a subset of 108 scans using a Spatially Unbiased Infra-Tentorial Template.

Results: OSA patients had a reduction in grey matter volume in the right middle temporal gyrus, compared to non-apnoeic controls (p < 0.05, corrected for topological false discovery rate across the entire brain). A reduction in grey matter was also seen within the cerebellum, maximal in the left lobe (VIIb close to XI, extending across the midline into the right lobe).

Conclusion: These data show that severe OSA is associated with focal loss of grey matter that could contribute to cognitive decline. Specifically, lesions in the cerebellum may result in both motor dysfunction and working memory deficits, with downstream negative consequences on tasks such as driving.

OP07

THE ANATOMICAL RISK FACTORS FOR INCREASED RETROPALATAL MECHANICAL LOADS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Sleep disordered breathing (SDB) is associated with impaired academic performance in school-aged children, but little is known about learning in pre-schoolers with SDB. This study examined whether persistent snoring, a marker for SDB, negatively correlates with early literacy and numeracy skills in pre-school children.

Methods: This prospective case-control study compared 85 snoring and 85 non-snoring New Zealand 3-year olds, matched on age (mean 3.8; range 3.2–4.0), socio-economic status, and Body Mass Index (z-score ± 1.5). Snoring was determined through a parental questionnaire and objective home sleep monitoring, while literacy and numeracy were measured using subtests from the WPPSI-III and assessments designed to measure different aspects of literacy and numeracy development in pre-schoolers.

Results: In pre-schoolers, early literacy and numeracy skills are just developing, and score distributions are often positively skewed, with zero scores and possible floor effects. Our data showed these characteristics, so for preliminary analyses, data were normalised where necessary using log transformation. One-way ANOVAs were used to compare snoring and non-snoring groups. Mann-Whitney U tests were also performed on raw data to examine the validity of the data transformation. Average performance of the non-snoring group was higher than the snoring group for all early skills measured, with statistically significant differences found for the following tasks: letter naming, rhyming, receptive vocabulary, information, oral counting (all p < 0.05), as well as picture naming (WPPSI version), visual discrimination, and number naming (all p < 0.05).

Discussion: The results of this study show that persistent snoring is associated with less well developed early literacy and numeracy skills in otherwise healthy 3-year-olds. Our findings are consistent with previous studies of school-age children. Further research is needed to investigate the affect pre-school snoring has on later achievement and...
whether recovery from snoring during the pre-school years is associated with better academic outcomes later in life.

OP09
COMPARISON OF 2S AVERAGING TIME VERSUS 16S AND 40S IN THE CHARACTERISATION OF SPO2 IN HEALTHY NEONATES OVERNIGHT
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Introduction: Measurement of photoplethysmographic arterial haemoglobin oxygen saturation (SpO2) by pulse oximetry is a fundamental tool in evaluating sleep disordered breathing. Pulse oximeters are often configured with long SpO2 averaging times to reduce noise susceptibility, which can significantly reduce the ability to detect rapid desaturations. To better characterise SpO2 dips in healthy neonates we employed a 2 s averaging time.

Methods: As part of a larger study, thirty-one healthy neonates with mean age 13.6 days (range 5–18) were studied overnight with a Masimo SET Radical 7 pulse oximeter set to 2 s averaging. SpO2 values were sampled at 1 Hz and analysed offline using standard oximetry analysis software (Download, Stowood), excluding SpO2 dips <25% or duration >180 s for motion artefact rejection. Results were compared with 16 s and 40 s averaging time applied to the same data.

Results: The mean observed SpO2 was 97.4% (SD = 1.1, range 94.8–99.0). A summary of Download SpO2 dip frequency analysis for 2, 16 & 40 s time averaging is shown below.

Conclusions: Analysis of SpO2 with 2 s averaging time in a healthy neonatal cohort found frequent, rapid desaturations, which were masked by longer averaging times, a finding not previously reported.

OP10
AUTOMATIC STAGING OF INFANT SLEEP USING NOVEL MATHEMATICAL ANALYSIS OF BREATHING DATA
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Introduction: In previous work we have described the use of the non-linear analysis tool, recurrence quantification analysis (RQA) of infant inter-breath interval (IBI) patterns, to discriminate between the infant sleep states, REM (R) and not REM (N). This discrimination tool has then been used to automatically classify 30 s epochs of infant sleep as R or N. For practical application however, it is necessary to also be able to stage wake from sleep. In this work, we propose the use of linear discriminant analysis (LDA) with features derived from statistical quantifications and RQA to classify Wake (W), R and N.

Method: 24 healthy infants underwent full overnight polysomnograms at 3 and 6 months of age, which were sleep staged by an expert clinician. RIP data was extracted, and inter-breath interval (IBI) data derived. RQA was applied using a moving 360 s window offset by 30 seconds with an embedding dimension of 8 and a fixed recurrence of 2% to calculate radius, determinism and laminarity. The statistical variables average IBI, and IBI inter-quartile range were calculated also using moving windows. These variables were applied as features in LDA to train a classifier using a leave-one-out training and testing methodology. The epoch by epoch agreement rate between the automated classification and the human expert was calculated.

Results: When age specific classifiers were trained, the mean agreement rate at 3 months was 88% (Range: 80–96%) and the mean agreement rate at 6 months was 86% (Range: 64–94%). When data was pooled, and an age generalised classifier was trained, the mean agreement rate was 86% (Range: 72–96%).

Discussion: The performance of this automated sleep state classification tool corresponds well with inter-human-scorer agreement rates, and outperforms respiratory or cardio-respiratory only automated sleep staging systems documented in literature. The requirement for only respiratory data means that this tool has potential application in remote or minimal channel studies, to augment standard sleep lab practice, or in epidemiological sleep research. Further research will investigate performance in older age groups, and in disease states.

OP11
WHO REGULATES WHO? PARENT AND INFANT DETERMINANTS IN THE DEVELOPMENT OF SLEEP SELF-REGULATION ACROSS THE FIRST YEAR
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Introduction: The developmental trajectory of infant sleep self-regulation is influenced by the interaction of biological, environmental and behavioural processes at both proximal and distal levels. By 6 months of age around 70% of infants have learned to self-initiate sleep (self-regulate) following a night awakening and will be sleeping for...
Results: videosomnography reports of infant sleep behaviours were objectively validated by parents completing sleep diaries each month for twelve months. Parental methods describe the interactions of factors influencing the development of sleep self-initiation from 0–3 months, and the development of primary infant sleep disturbance from 3–6 months. Central to the models are the interaction between the infants’ physiological constitution and parental behaviours as major determinants of sleep outcome. One aim was to test the first two models’ assumptions of the role certain parent and infant behaviours and infant sleep outcome.

Methods: Participants were 52 typically developing infants whose parents completed sleep diaries each month for twelve months. Parental reports of infant sleep behaviours were objectively validated by videosomnography.

Results: At age 1 month reactive co-sleeping and parental presence at sleep onset, and frequent infant night awakenings predicted membership to either a non-self-regulated or a self-regulated sleep group at 6 months; at age 2 months the longest sleep period, number of night awakenings and subsequent parental interventions predicted membership to either a sleep disturbed group or not at 12 months.

Discussion: Parents and infants both contribute to the development of sleep self-regulation over the first year with a synergistic relationship to either a non-self-regulated or a self-regulated sleep group at sleep onset, and frequent infant night awakenings predicted membership and infant characteristics in the development of sleep self-initiation and sleep self-regulation at 6 months, and infant sleep disturbance at 12 months. The implications of these findings will be described in detail.

OP13

CIRCADIAN VARIATION IN THE RESPONSE OF INTRINSICALLY PHOTORECEPTIVE RETINAL GANGLION CELLS

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Background: Intrinsically photoreceptive retinal ganglion cells (ipRGCs) exhibit photon counting properties that signal the primary environmental light input to the suprachiasmatic nucleus (SCN) for circadian pho-toentrainment and contribute to the post-illumination constriction of the pupil light reflex (PLR). The aim of this study was to determine the circadian dynamics of the ipRGC (inner retina) and rod and cone photoreceptor (outer retina) control of the PLR in humans.

Method: 11 participants (18–30 yrs; 4M, 7F) recorded their habitual sleep pattern with actigraphy for 1-week prior to testing. A 24-h testing protocol controlled for activity, sleep, posture, caffeine and caloric intake. The consensus PLR was recorded hourly, using a Maxwellian view optical system and infrared camera and analysed with custom developed software. The 10-sec PLR stimulus (14.6 log photons cm\(^{-2}\)·s\(^{-1}\), 488 nm, 610 nm) and laboratory illumination (10 lux) remained constant. Saliva was collected hourly for independent melatonin assay.

Results: The normalised PLR components (baseline diameter, maximum constriction and post-illumination constriction) and melatonin data derived from the hourly measurements during the 24-hr period were modelled with a skewed baseline cosine function and analysed using a linear mixed model univariate ANOVA. The ipRGC response (post-illumination constriction) shows significant circadian variation (p < 0.05). A decrease in ipRGC activity precedes the onset of melatonin production (DLMO) by 3.49 h. The return to baseline ipRGC activity precedes melatonin offset by 1.47 h. Rod and cone (outer retina) contributions to the PLR (maximum constriction) showed no significant circadian variation (p > 0.05) during a 24-h maintained wake period under controlled illumination.

Conclusions: Inner retinal ipRGC contributions to the post-illumination pupil response show dynamic changes that suggest circadian modulation. This variation has implications for the circadian dose–response curve to light, and for our understanding of the role of the retina in circadian physiology. This PLR method may provide a novel measure of circadian phase position.

Support: ARC-DP1096354 (AJZ), IHRI-MCA (SSS).
Introduction: The standard form of the Psychomotor Vigilance Test (PVT) is a 10 minute task with inter stimulus intervals (ISI) ranging from 2 to 10 seconds. There is some evidence from other simple visual reaction time tasks that when ISI is varied randomly, short ISIs are associated with longer reaction times (RT). This study aims to investigate firstly whether there is an effect of ISI on RT and errors within the PVT and secondly if the proposed effect changes with time of day, hours of prior wake or time on task (TOT).

Method: Twelve male participants (22.42 ± 2.31 years) completed a total of 16 PVTs across a single 28 h period of imposed 28 h Desynchrony. Over this period participants remained in temporal and social isolation with sound, temperature (22 ± 1°C) and light (10–15 lux) tightly controlled. Levels of prior wake were produced by testing participants at 1.5 h intervals each 28 h day. Each prior wake condition was also grouped into one of six 60° divisions of the circadian cycle, estimated from core body temperature. Performance was assessed by 10-minute PVT with ISIs from 2 to 10 seconds. Each trial within the PVT was grouped into one second ISI bins and one minute TOT bins.

Results: A mixed models analysis with the random effect of between subject variability (subject ID) was used to analyse the effect of ISI on RT. RTs that followed short ISIs (2 to 4 seconds) were significantly slower than RTs that followed longer ISIs (F(7,46091) = 105.28, p < .001). This main effect of ISI on RT was independent to the effects of time of day (F(42,46228) = 393.55, p < .001). There was a significant association between errors and ISI (X^2(8) = 393.55, p < .001) suggesting that the probability of an error response increased as ISI increased.

Discussion: These results support the previous findings that short ISIs lead to slower RTs, while the probability of an error response is a function of the time needed to wait for the stimulus. The finding that shorter ISI are not more sensitive to the effects of time of the day and time awake lends support to the idea of a 'checking and preparation' or 'recovery' component of the response process which inhibits the ability to respond to successive stimuli. These findings suggest that PVT test of ISIs between 4 to 10 seconds should be used in place of the commonly used 2 to 10 second ISIs.
on scheduled days and free days was associated with BMI, daytime sleepiness and perceived general health.

Methods: A New Zealand version of the Munich Chronotype Questionnaire was mailed to a stratified random sample of 5,000 Maori and 4,100 non-Maori adults, aged 20–59 yrs, obtained from the electoral roll (response rate = 54%). Sleep duration was calculated for the main sleep period and across the 24-hr period (TST/24 hrs) separately. Insufficient sleep was defined as a change in sleep duration ≥2 hrs between scheduled days and free days. Sleep duration was also categorised as short (<7 hrs), normal (7–8.99 hrs) and long (≥9 hrs). Logistic regression models were used to investigate the relationship between insufficient, short and long sleep with the following health outcomes: BMI (overweight/obese vs. normal/underweight), excessive daytime sleepiness (ESS > 10 vs. ESS ≤10), and self-rated health (poor/fair vs. good/very good/excellent). Other variables in the model were ethnicity (Maori vs. non-Maori), sex, age (in decades), and socioeconomic deprivation (using NZDep06 deciles).

Results: Independent risk factors for reporting excessive daytime sleepiness were: insufficient sleep (main sleep OR = 1.32, TST/24 hrs OR = 1.38); short sleep on scheduled days (main sleep OR = 1.37, TST/24 hrs OR = 1.34); and long sleep on free days (TST/24 hrs OR = 1.73, TST/24 hrs OR = 1.34). Independent risk factors for poor/fair self-rated health were short sleep on scheduled (TST/24 hrs OR = 1.36) and free days (main sleep OR = 1.52, TST/24 hrs OR = 2.10) and long sleep on scheduled days (main sleep OR = 1.77, TST/24 hrs OR = 1.43). Insufficient or abnormal sleep duration was not a significant independent risk factor for self-rated health.

Conclusion: This study supports previous reports that sleep duration is an important determinant of self-rated health outcomes after controlling for demographic and socioeconomic risk factors. Approximately one quarter of New Zealand adults reported insufficient sleep in this study. This would suggest that restricting sleep on scheduled days is a common problem with potentially significant consequences for general health and wellbeing.

OP18
THE EFFECT OF SLEEP ADAPTATION ON PSYCHOMOTOR VIGILANCE
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Introduction: Previous studies have demonstrated that psychomotor vigilance fluctuates with core body temperature (CBT) and decreases with hours of prior wake (PW). After a shorter sleep performance is also decreased. On subsequent sleeps however, the length of the sleep may not reflect the performance deficit well because the architecture of the sleep will change. The aim of this study is to determine if sleep stages are associated with the decline in psychomotor vigilance and incorporate this into a model of the effects of PW and CBT on performance.

Methods: Twenty-seven male participants (22.5 ± 2.2 years) were randomly assigned to either a ‘Baseline’ (1:2) or ‘Reduced’ (1:5) sleep/wake condition. They were tested at 2.5 hour intervals after waking. A single beat period was monitored across 7 ± 24 hr hours of temporal and social isolation. Over this period sound, temperature (22 ± 1 degrees Celsius) and light (10–13 lux) were controlled. Each prior wake condition was grouped into one of six 10 degree divisions of the body’s circadian cycle, estimated from core body temperature. Performance was assessed by a 10-minute psychomotor vigilance task (PVT) with reciprocal reaction time (RRT) analysed. Sleep was scored in 30 second epochs using standard polysomnography techniques.

Results: An ANOVA revealed that between the baseline and reduced sleep conditions time in each sleep stage decreased: SWS: F(1,1517) = 7.51, p < 0.05; REM: F(1,1517) = 1236.89, p < .001; S1-S2: F(1,1517) = 5353.15, p < .001. Time in S1-S2 sleep and REM sleep decreased the most, dropping 35% and 43% respectively, while time in SWS only decreased by 4%. A mixed model regression showed significant fixed effects on RRT for PW [F(8,1461) = 8.53, p < .001] and CBT [F(5,1461) = 34.72, p < .001] with the significant covariates of S1-S2 sleep [F(1,1461) = 43.17, p < .001] and REM sleep [F(1,1461) = 35.98, p < .001]. The covariate of time in SWS did not account for significant variance in the model [F(1,1461) = 0.3, p = 853]. Performance was worst when hours of prior wake was long, the body’s circadian phase was at its nadir and the previous sleep contained less time in REM and S1-S2 sleep.

The average global PSQI score was 8.2 suggesting substantially disturbed sleep. Mean total SCAS score was 29.6, where 24% of participants reported subclinical/levels of anxiety. Total SCAS correlated significantly with Global PSQI (r = 0.28, p = 0.03). Regression analyses suggested that sleep disturbance and sleep related daytime dysfunction were the predictors with the most utility for predicting total SCAS score and the generalised anxiety subscale. Daytime dysfunction significantly and independently predicted social phobia. Sleep disturbance independently predicted panic and obsessive compulsive behaviours. Sleep variables did not significantly predict physical fear or separation anxiety.

Conclusion: Poor sleep is a common complaint among adolescents, and is associated with different domains of anxiety among adolescent girls. Daytime dysfunction and sleep disturbance were found to be the best predictors of anxious symptoms. There is a lack of current normative data for the use of the PSQI among adolescents, and it is therefore possible that the PSQI cut-off for ‘poor sleep’ is too conservative for adolescent samples.

OP17
DISTURBED SLEEP AND ANXIETY AMONG ADOLESCENT GIRLS
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Introduction: There is increased awareness of poor sleep among adolescents. Existing literature links poor sleep to symptoms of anxiety. This pilot study examines sleep quality and its relationship with specific domains of adolescent anxiety in a community sample.

Method: 62 girls, aged 13–15, in year 9 at a Victorian secondary college completed the self-report Spence Children’s Anxiety Scale (SCAS) and Pittsburgh Sleep Quality Index (PSQI) during class time. The SCAS produced scores for 6 anxiety domains: separation anxiety, obsessive-compulsive disorder, social phobia, panic/agoraphobia, physical injury fears, and general anxiety. The PSQI assessed sleep quality, efficiency, disturbance, onset latency, total sleep time and sleep related daytime dysfunction.

Results: Overall, 46.8% of the participants reported poor sleep quality and seven girls reported taking sleep medication during the past month; 9.7% reported their sleep quality as very good. Average total sleep time was 7.8 (SD = 1.2) hours and sleep onset latency 38 (SD = 31.2) minutes. Although group average sleep efficiency was normal (88.9%), 40 girls (65%) had a global PSQI score of ≥5 indicating ‘poor sleep’.
OP19
THE EFFECTS OF INTERMITTENT HYPERCAPNIC HYPOXIA DURING SLEEP IN HEALTHY MALES ON LONG-TERM FACILITATION, RESPIRATORY AND UPPER AIRWAY CONTROL
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Respiratory control instability is a characteristic feature of obstructive sleep apnoea (OSA) and is thought to contribute to the pathophysiology of OSA. It has been proposed that intermittent hypoxia that accompanies OSA may induce unstable breathing via neuroplastic mechanisms such as long-term facilitation (LTF) which increases ventilatory drive. On the other hand, LTF could also help mitigate OSA by increasing upper airway muscle activity. In humans, concomitant carbon dioxide levels and arousal influences may modify intermittent hypoxia effects on LTF. Therefore, whether LTF is elicited by hypercapnic hypoxia during sleep, more analogous to gas disturbances in OSA, and the role it may play in the pathophysiology of OSA are currently unknown. The purpose of this study is to investigate whether intermittent hypercapnic hypoxia during sleep, designed to mimic the blood gas disturbances experienced in OSA, induces LTF and/or changes in control of ventilation and the upper airway. To date 4 healthy (BMI ≤ 23, FVC and FEV1 ≥ 80%, non asthmatic), non-snoring, non-smoking males aged 18–45 have successfully completed the study. Each subject was exposed to 30 s episodes of experimental gas tailored to the subject to achieve a blood oxygen desaturation of 85–80% (3% CO2, 2–3% O2), separated by 2 minutes breathing room air. Subjects were studied in the lateral position to reduce flow limitation and variability in desaturation, and the protocol was paused until the return to sleep following arousal. In random order and separated by at least 2 weeks, subjects completed a similar control night (intermittent medical air). Ventilatory measurements including breath timing and volumes, upper airway resistance and genioglossus EMG were obtained for 30 s epochs during control, each episode of gas delivery and separating 2 minutes, and at 5, 10, 30 and 60 minutes recovery. While there are insufficient preliminary data to draw conclusions, recruitment is continuing targeting a sample of 12 subjects. This study will help to determine if a stimulus similar to that experienced in OSA is sufficient to induce LTF during sleep, and if responses to intermittent hypercapnic hypoxia may be protective or destabilise respiratory and upper airway control during sleep.

OP20
AROUSAL FREQUENCY DECREASES BEFORE A DECLINE IN RESPIRATORY EVENT FREQUENCY DURING THE TRANSITION INTO SLOW WAVE SLEEP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA
P CATCHESIDE1, 2, 3, L HARMER1, 3, B FOXWELL1, 3, D STADLER2, D MCEVOY2, 3
1Adelaide Institute for Sleep Health, South Australia, Australia, 2Flinders University, South Australia, Australia, 3University of Adelaide, South Australia, Australia

Patients with obstructive sleep apnoea (OSA) frequently show marked reductions in respiratory and arousal event frequencies during sleep (slow wave) sleep. However, the mechanisms responsible for relative upper airway stability in slow wave sleep (SWS) remain poorly understood. Respiratory events frequently terminate with arousal, which in turn may promote the next cycle of obstruction via low post-arousal ventilatory and upper airway muscle drive. Respiratory and arousal events are therefore inter-dependent, with respiratory events clearly a leading cause of arousal, and sleep stage effects on arousal responses potentially influencing the propensity for subsequent respiratory events. We reasoned that changes in respiratory versus arousal event frequencies over the course of deepening sleep should help indicate the role of arousal versus non-arousal mechanisms in explaining improved OSA in SWS. If spontaneously improved upper airway function permits the transition into SWS, independent of arousal, then the frequency of respiratory events should decline before or perhaps in parallel with reduced arousal frequency over the transition into SWS. Alternatively, if reduced arousability helps stabilise upper airway function by promoting airflow recovery without arousal, and/or perhaps via progressively augmenting ventilatory drive, then arousal frequency should decline before the reduction in respiratory event frequency in SWS. In this study we examined respiratory and arousal event frequencies from inter-event intervals each minute in the 15 min before the first epoch of SWS in consecutively diagnosed OSA patients (AHI > 15/hr between Jan-Mar 2009, N = 146). A small decline in respiratory event frequency from baseline (−15 to −10 min) was first apparent only in the final minute before SWS onset (22 ± 3 to 17 ± 3/hr, p = 0.038). Arousal frequency showed a more prominent decline commencing 3 min before SWS onset (16 ± 2 to 11 ± 2/hr, p = 0.008), reaching a minimum of 5 ± 2/hr in the first minute of SWS (p < 0.001). These data suggest that reduced arousal propensity and/or more damped ventilatory arousal responses occur earlier than respiratory event improvements, and may therefore play a key role in the subsequent resolution of obstructive events in SWS.
OP21
SINGLE MOTOR UNIT ACTIVITY IN GENIOGLOSSUS IN RESPONSE TO NEGATIVE PRESSURE

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Introduction: Genioglossus (GG) motor units (MUs) have a variety of discharge patterns including MUs that discharge at relatively constant rates throughout the respiratory cycle (tonic-TT) or others that fire throughout the respiratory cycle but have elevated firing rates during inspiration (tonic-TT) or expiration (tonic-ET); other MUs only fire during inspiration (inspiratory phasic-IP) or expiration (expiratory phasic-EP). Multi-unit GG EMG activity is elevated in response to negative pressure. This study firstly examined, whether this is a consequence of increased activity in all MUs or in MUs that have particular discharge patterns; and secondly, whether this is due to MU recruitment or an increased discharge rate.

Methods: 18 males (mean ± SD; BMI 24 ± 3 kg/m²) were studied during wakefulness with four fine-wire electrodes percutaneously inserted into GG in the supraglottic region. Each participant breathed through four resistive loads of different magnitudes (5, 10, 15, 20, and 20 cmH2O/L/s) for 60 seconds with 30 seconds baseline and recovery periods. These four conditions were presented twice in the following order: 5, 15, 20, 20, 15, 10, 5.

Results: A total of 361 MUs were identified (IP 35%, EP 4%, IT 22%, ET 20% & TT 20%). 263 (73%) were active at baseline and 98 (27%) were recruited during loads. Among those baseline active MUs, 33 (13%) became inactive in response to increased negative pressure. Distribution of MUs with different discharge patterns changed significantly as a function of negative pressure (p < 0.1). There was a substantial recruitment in the number of IP (160%) and EP (180%) compared to IT (11%), ET (6%), and TT (0%) MUs. A higher percentage of baseline active EP (80%) and ET (23%) MUs became inactive in response to negative pressure compared to IP (6%), IT (9%), and TT (6%) MUs. In response to increased negative pressure, mean discharge rates for IP and IT MUs increased significantly (p < 0.05), and for IP MUs, there was a significant interaction between time and negative pressure conditions (p < 0.05). No significant change in mean discharge rates was found for ET and TT MUs.

Conclusions: MUs with different discharge patterns responded differently to increased negative pressure. The recruitment of phasic MUs and an increase in discharge rate among inspiratory modulated MUs contributed to increased GG EMG activity in response to negative pressure.

OP22
MECHANISM FOR REDUCED BAROREFLEX SENSITIVITY DURING SIMULATED SNORING

A26

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modeled as rigid bodies. Other muscles (including genioglossus, geniohyoid, sternohyoid, thyrohyoid, stylohyoid, styloglossus) were modeled as elastic connections (springs). Initial model boundary and contact definitions were defined from anatomy. Model parameters were then refined using data from studies performed in anaesthetised, tracheostomised rabbits where bony and tissue displacements associated with mandibular advancement (MA) and tracheal displacement (TD) were measured using CT imaging. Model outputs include upper airway (UA) lumen geometry, peri-pharyngeal tissue stress and strain distributions and displacement of anatomical structures (e.g. hyoid, tongue).

Results: Model simulated TD and MA application resulted in UA elongation (TD), UA shortening (MA), UA volume increase (both MA, TD), anterior movement of soft palate and tongue (both MA, TD), caudal hyoid displacement (TD) and anterior hyoid displacement (MA), all of which were qualitatively similar to previously measured CT data obtained from anaesthetised rabbits in our laboratory.

Conclusion: We have constructed a FEM based on rabbit UA which predicts tissue movements and UA geometry changes associated with interventions known to improve UA patency. The model requires further refinement and validation against physiology based measurements but shows potential for providing enhanced understanding of interactions between peri-pharyngeal tissue mechanics and UA patency.

OP24

FACIAL PHOTOGRAPHIC DIMENSIONS ARE RELATED TO UPPER AIRWAY STRUCTURES ON MRI IN OBSTRUCTIVE SLEEP APNOEA

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Introduction: Craniofacial morphology is known to play an important role in the development of obstructive sleep apnoea (OSA). We hypothesized that the facial phenotype is closely linked to upper airway structures. Hence, the aim of this study was to investigate the relationship between facial photographic dimensions and upper airway structures in subjects with OSA.

Methods: Patients from the Icelandic Sleep Apnoea Cohort (ISAC) had upper airway MRI and calibrated facial photographs performed. Facial dimensions derived from photographic analysis were correlated with MR pharyngeal and soft tissue volumes.

Results: Preliminary analysis in 19 men with severe OSA (mean [± SD] age 51.5 ± 13.0 years, mean AHI 42.7 ± 17.4/hr) demonstrated significant correlations between a number of facial dimensions and upper airway structures. The strongest associations were between the neck circumference and base of tongue volume ($r = 0.81$, $p < 0.001$), and craniofacial height and total upper airway soft tissue volume ($r = 0.7$, $p = 0.001$). The mandibular plane angle ($r = 0.7$, $p = 0.001$) and facial index ($r = 0.55$, $p = 0.02$) were positively correlated with the total airway volume. Both face width ($r = −0.56$, $p = 0.01$) and lower-face width ($r = −0.05$, $p = 0.02$) were negatively correlated with retroglossal airway minimum cross-sectional area.

Conclusion: These preliminary data suggest that there is a relationship between surface facial dimensions and upper airway structures, including the airway and surrounding soft tissues, in subjects with OSA. Further work is required to verify these findings and to evaluate the influence of gender and ethnicity on this relationship.
Poster presentations

P001
SLEEP DISORDERED BREATHING IN PATIENTS WITH CHRONIC PAIN ON LONG TERM OPIATE THERAPY
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1Adelaide Institute for Sleep Health, Adelaide, South Australia, Australia, 2Flinders Medical Centre, Adelaide, South Australia, Australia

Rationale: The use of opiate medication for chronic pain has been increasing worldwide over the last two decades. The side effects of these medications are significant. We aimed to define the prevalence of sleep disordered breathing in a group of patients on oral morphine/opiate formulation for chronic pain. The impact of these medications on daytime arterial blood gases and psychomotor vigilance was also studied.

Methods: Twenty-four patients aged 18–75 yrs on long term opiate (>6 months duration, dose range 40–500 mg of MS Contin or equivalent) were prospectively recruited from the Pain Clinic of Flinders Medical Centre. They underwent detailed home polysomnograms (PSG) and daytime arterial blood gases and psychomotor vigilance testing.

Results: 11/24 (46%) had at least moderate to severe sleep disordered breathing (AHI > 30/hr). The mean AHI was 32.9 ± 27.4. The AHI was not significantly different to a comparator group (matched for age, sex and BMI) drawn at random from patients referred to our sleep service for evaluation of sleep disordered breathing. The pattern of SDB was different however with the opiate patient having a significantly higher Central Apnea index (3.9/hr vs. 0.3). Asymptomatic hypercapnia was observed in 9/20 (45%) of the pain clinic patients. The wake arterial PaCO2 correlated with the amount of time patients spent below 90%.

Conclusions: The prevalence of moderate to severe sleep disordered breathing in patients on long term opiate for chronic pain was 46%. Asymptomatic hypercapnia was noted in almost half of opiate-treated patients and psychomotor vigilance was markedly impaired. The morphine equivalent doses correlated with the AHI. The wake arterial PaCO2 correlated with the amount of time patient spent below 90%.

Supported by: Foundation Daw Park Investigator Grant.

P002
HIGH PREVALENCE OF BREATHING DISORDERED SLEEP (BDS) IN SUBJECTS WITH SYMPTOMS OF CHRONIC NOCTURNAL NASAL CONGESTION (CNNC)
S LEE1, A VIDAL1,2, W ELIAS1,2, M VERMA1,3, R PERRI1,3, M MADRONIO1,3, M BAARBE1,3, A WONG1,3, T AMIS1,3, J WHEATLEY1,2,3
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Introduction: Subjects with symptoms of CNNC often complain of disturbed sleep but objective data are lacking.

Methods: We performed standard in-home overnight polysomnography (Alice PDX, Respironics) on 91 volunteers reporting CNNC and poor sleep (65 males and 26 females; age: 49 ± 15 yrs [mean ± SD]; BMI 29.1 ± 5.6 kg/m2). Sleep studies were scored according to American Academy of Sleep Medicine criteria and prevalence rates for graded levels of standard indices of breathing and sleep quality were then calculated.

Results: See table below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0–5 events/hr</th>
<th>5.1–15 events/hr</th>
<th>15.1–30 events/hr</th>
<th>&gt;30 events/hr</th>
</tr>
</thead>
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<tr>
<td>RDI</td>
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<td>30.8</td>
<td>29.7</td>
<td>36.3</td>
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<tr>
<td>RERA</td>
<td>13.2</td>
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<tr>
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<td>19.8</td>
<td>13.2</td>
<td>16.5</td>
</tr>
<tr>
<td>ODI</td>
<td>54.9</td>
<td>22</td>
<td>7.7</td>
<td>15.4</td>
</tr>
<tr>
<td>AI</td>
<td>1.1</td>
<td>18.7</td>
<td>41.8</td>
<td>38.5</td>
</tr>
</tbody>
</table>

(RDI = Respiratory Disturbance Index; RERA = Respiratory Effort Related Arousal; AHI = Apnoea/Hypopnoea Index; ODI = Oxygen Desaturation Index (>4%/hr; AI = Arousal Index). The level of sleep disturbance was such that 21% of subjects experienced <15% of sleep time in slow wave sleep (N3).

Discussion: We conclude that there is a high prevalence of BDS in individuals who report CNNC and disturbed sleep. The level of breathing disorder in some subjects is sufficiently severe that it results in hypoxic episodes and prevents the achievement of normal quantities of slow wave sleep. Normalisation of BDS in CNNC subjects will likely require effective relief of their nocturnal nasal obstruction.

Supported by: Foundation Daw Park Investigator Grant.
P003
INCREASED SLEEP DISORDERED BREATHING IN SJÖGREN’S SYNDROME
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Introduction: In this study we analysed if OSA is more prevalent in patients with Sjögren’s syndrome, an autoimmune disease that affects the salivary & lacrimal glands and causes abnormal drying of mucosal surfaces including the upper airway (upper airway surface tension).

Method: 28 female patients with primary Sjögren’s syndrome (pSS) and 18 non-pSS control subjects matched for gender, age and body mass index (BMI) were recruited. All subjects underwent an overnight polysomnography. Epworth sleepiness scale (ESS), hospital anxiety & depression scale (HADS), functional assessment of chronic illness therapy-fatigue scale (FACIT-F) and maintenance of wakefulness test (MWT) were also measured.

Results: Sjögren’s patients and control subjects were not different in age or BMI (53.8 ± 11.3, 55.8 ± 3.4 years, 26.6 ± 1.2 and 27.6 ± 1.2 (kg/m²) respectively). Patients demonstrated more sleep disordered breathing and had more sleepiness, anxiety, depression and fatigue compared to control subjects.

Conclusion: pSS patients have increased levels of OSA which potentially relates to increased UA surface drying and tension. OSA may contribute to the increased levels of daytime sleepiness and fatigue observed in pSS.

P004
COGNITIVE DEFICITS IN OBSTRUCTIVE SLEEP APNOEA
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Introduction: Impairments in cognition are frequently observed in untreated patients with obstructive sleep apnoea (OSA), including deficits in memory, executive functioning, attention, and processing speed. The precise nature and causes of these deficits remains controversial. The present study aimed to characterise the magnitude of cognitive deficits in a sleep clinic sample of OSA patients. Specifically, we sought to define the dose response relationship between cognition and disease severity.

Methods: Ninety patients with moderate to severe OSA were recruited for cognitive testing following their diagnostic overnight sleep study and prior to starting any treatment. Cognitive testing included computerised and pencil & paper tasks assessing short and long term verbal and visual memory, visuoconstructional ability, verbal fluency, cognitive set shifting, verbal and visuospatial working memory, reaction time, vigilance, and nonverbal reasoning.

Results: Participants were aged 32–77 years (M 53.8 ± 11.3), 50% male with mean AHI 44.6 ± 23.7, range 15.5–108.7. After controlling for the effect of age, the severity of OSA (using AHI) was significantly related to the quality of working memory (r = −0.35) and the accuracy of attention (r = −0.54), but not to an individual’s ability to learn new information (quality of secondary memory) or to executive function (planning and visuoconstructional problem solving).

Discussion: The more severe an individual’s OSA, the worse their ability to hold information in short term memory whilst working with it (both visuospatial and verbal), and the more errors they make on attentional tasks. Working memory and attention abilities are likely to impact on the capacity of patients with OSA to work efficiently and safely.

P005
SNORING DURING PREGNANCY: QUESTIONNAIRE RESULTS VERSUS OBJECTIVE MEASUREMENT
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Snoring is common during pregnancy, particularly in the last trimester. Most investigations of snoring during pregnancy have utilised questionnaires to determine the presence and severity of snoring. This study administered questionnaires and recorded snoring during sleep in 63 women in order to validate the use of questionnaires against objective measurement of actual snoring.

Methods: Berlin questionnaires were administered to 63 pregnant women. One question asked “Do you snore?” Snoring was then recorded in the woman’s home using a SonoMat™ device, a thin mattress in which sensors measure and record sound and movement. The results from the questionnaire were compared to recorded snoring.

Results: 37 women answered “Yes” to the question “Do you snore?” 20 women answered “No” and 6 women answered “I don’t know”. The average gestation of the three groups was 28 ± 4–8 weeks. In the group who answered “Yes” recorded snoring duration was 10 ± 18% of the night, in the “No” group recorded snoring was 12 ± 9% and in the “I don’t know” group snoring was recorded as 16 ± 21%. There were no significant differences between the percentages of snoring recorded in the three groups.

Conclusion: Snoring is very common in pregnancy. Questionnaire results appear not to be a reliable method of determining the presence of snoring in pregnant women.
P006
CARDIOPULMONARY EXERCISE TEST (CPET) IN ‘OVERLAP SYNDROME’
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Purpose: CPET provides a global assessment of the integrative exercise response. Exercise limitation has been reported in both OSA and COPD. Exercise responses in overlap syndrome have not been reported.

Method: Fifteen patients of newly diagnosed overlap syndrome and ten healthy age and sex matched controls were retrospectively analyzed at Metro Centre for Respiratory Diseases, India between June 2008 and January 2010. All patients underwent incremental work load symptom limited CPET on bicycle ergometer. BMI, Apnea Hypopnea Index (AHI), Pre and Post-bronchodilator FEV1 %, VO2max, VO2max % predicted, anaerobic threshold (AT), AT% predicted VO2max, Breathing reserve (BR), Oxygen desaturation during exercise and oxygen pulse were measured and statistically analyzed.

Results: Healthy controls had mean BMI 25.27 ± 3.87, AHI 2.08 ± 0.73 and post-bronchodilator FEV1 % 94.20 ± 14.26%. Overlap syndrome patients had mean BMI 30.36 ± 6.97, AHI 22.72 ± 21.74 and FEV1 % 56.18 ± 20.31%. There was no significant difference in age (55.63 ± 10.58 Yrs vs. 51.40 ± 9.03 Yrs, p-value 0.24) and sex ratio (33/51 vs. 61/10 male/total) in two groups. Compared to controls, overlap syndrome patients had significantly lower VO2max (1.77 ± 0.43 l/min vs. 1.09 ± 0.42 l/min, p-value < 0.001), VO2max % predicted (84.92 ± 15.48% vs. 54.27 ± 15.95%, p-value < 0.001), AT (1.15 ± 0.34 l/min vs. 0.75 ± 0.35 l/min, p-value 0.002), AT% predicted (57.25 ± 21.54% vs. 37.31 ± 14.77%, p-value 0.001), VO2/HR (14.00 ± 4.69 ml/min vs. 8.63 ± 3.28 ml/min, p-value < 0.001), VO2/HR % predicted (84.21 ± 36.94% vs. 70.79 ± 29.40%, p-value < 0.001) and BR (50.2 ± 13.72 vs. 35.90 ± 21.17%, p-value 0.045). There was also significant fall in 26% in overlap syndrome compared to normal subjects (3.75 ± 4.19% vs. 0.50 ± 0.85, p-value 0.018). Exercise test was done for mean 6 min 57 sec duration and limited due to severe breathlessness in 16, leg fatigue in 14 and breathlessness with leg fatigue in 21 patients. Exercise limitation in overlap syndrome was multifactorial with ventilatory in 19/51 (37.25%), cardiac in 36/51 (70.58%) and deconditioning in 15/51 (29.41) patients.

Conclusion: exercise limitation in overlap syndrome is multifactorial and further evaluation is required to see effect of CPAP and adequate bronchodilators.

P007
IMPACT OF RHINOSTEGNOSIS ON THE FLOW IN UPPER AIRWAY OF PATIENT WITH MODERATE OBSTRUCTIVE SLEEP APNEA
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Introduction: We performed flow computations on an accurate upper airway model in a patient with obstructive sleep apnea and simulated the situation with one nasal obstruction. Under such circumstance, we then computed the velocity and static pressure in the model.

Methods: Cartesian coordinates for airway boundaries were determined from cross-sectional CT images, and a 3D computational model of upper airway was constructed by software Ansys 14.0. The model was imported into the software Fluent 6.3.26, and the flow simulations were performed. The results were analyzed from the perspective of area, velocity and static pressure of selected section. Then by numerical simulation, the situation of one nostril obstruction was obtained, and the same procedures were done. The data were compared to discuss the change between the situation with and without rhinostegnosis, and investigate the reason why the difference occurred.

Results: 1. A CFD model of the UA in a patient with moderate OSAHS was successfully established. 2. With rhinostegnosis, the average air velocity increased 0.25 m/s and the average pressure dropped 2.90 pa in 190 ml flow. However, the flow pattern in UA did not change under such circumstance.

Discussion: 1. In this study, based on the CT scan and the commercial software application, the human upper airway could be reconstructed in accordance with the real situation. 2. Rhinostegnosis is not the initiation factor but the promoter for the process of OSAHS. It was recommended that the nasal airway reconstruction should be integrated into the entire sequence of OSAHS treatment plan.
P009
MEMORY COMPLAINTS IN OBSTRUCTIVE SLEEP APNOEA
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Introduction: Impairments in cognition are frequently observed in untreated patients with obstructive sleep apnoea (OSA), including deficits in memory. However, the degree to which individuals with OSA complain of memory deficits has not previously been explored. Nor has the relationship between memory complaints, mood, or symptoms of sleepiness or fatigue.

Method: A prospective, longitudinal cohort study. Participants were recruited from a local sleep clinic, where they completed questionnaires at their diagnostic overnight sleep study. Questionnaires assessed participants’ contentment with their memory (Contentment) and self-reported memory failures (Ability), plus depression (DASS-21 & CES-D scales), anxiety and stress (DASS-21 scales), and self-reported fatigue (Fatigue Severity Scale) and sleepiness (Epworth Sleepiness Scale).

Results: To date, 517 participants have completed the questionnaires. They were aged 19 to 83 years (M = 52.1), with a mean AHI of 39.0 ± 31.6, range 19 to 83. One-third (36%) of participants reported below average contentment with their memory (M = 42.5, cf. normative M = 39.3). Forty-two percent reported below average memory ability (M = 48.7, cf. normative M = 45.0). Lower contentment and poorer memory ability were both significantly associated with greater self-reported depression (r = −.49 & .56, respectively), anxiety (−.23 & −.27), stress (−.50 & −.47), and fatigue (−.27 & −.39) but only ability was related to sleepiness (−.38), after controlling for the effect of age. However, none of these was related to OSA severity measured with AHI (all r < .16).

Discussion: These data show that memory complaints are common in OSA and strongly related to psychological well-being and subjective but not objective OSA symptoms. It will be important to explore the relationship between memory complaints and objective memory performance before and after CPAP use so as to determine whether CPAP treatment improves subjective complaints of memory difficulties.

P010
ILLNESS PERCEPTIONS IN OBSTRUCTIVE SLEEP APNOEA POPULATION: PATIENTS DO NOT BELIEVE THAT THEIR SYMPTOMS ARE DUE TO THEIR SLEEP PROBLEMS
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Introduction: Obstructive sleep apnoea (OSA) has been identified as one of the most common sleep disorders in Western society. Continuous positive airways pressure (CPAP) has been shown to reduce OSA symptoms and associated health risks, however research has revealed surprisingly low rates of treatment use, as well as treatment uptake. One reason may be that patients do not believe that their symptoms are due to their sleep problems. This preliminary study assessed the relationships between illness representations, based on the Common Sense Model of Illness Behaviour, to sleep difficulties and disease severity in a sample of patients attending a sleep clinic for a diagnostic sleep study.

Methods: A prospective, longitudinal cohort study. Participants were recruited from a local sleep clinic, where they completed questionnaires at their diagnostic overnight sleep study. Questionnaires assessed symptom complaints (e.g. sore throat, sore eyes, headache, fatigue, irritability) and whether patients attributed these to their sleep difficulties (Illness Identity) from the Illness Perceptions Questionnaire Revised.

Results: To date, the questionnaire has been completed by 517 participants. At their overnight PSG, patients complained of an average of 6 symptoms (SD 3.5, 0–14), but over 1/5th (22%) reported that these were not due to their sleep difficulties (M 3.5, SD 3.0, 0–13). Neither the number of symptoms reported (r = .02) nor the number of symptoms attributed to their sleep difficulties (r = .09) were related to the severity of their OSA (indicted by AHI).

Discussion: These data suggest that there is a mismatch between patients’ perceptions about their illness and the diagnosis they are being given. Moreover, their experience of symptoms is not related to the objective severity of their condition.
P012
NECK CIRCUMFERENCE AS A PREDICTOR OF SLEEP APNOEA SEVERITY
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Introduction: In Australia, many patients attending a sleep unit for the diagnosis of obstructive sleep apnoea are initially referred by their local General Practitioner (GP). While GPs are reasonably good at identifying patients who are symptomatic for sleep apnoea, they are less successful at identifying individuals with mild to moderate sleep apnoea. Neck circumference (NC) has been described as a reasonable predictor for sleep apnoea, though its success has been variable. We determined whether NC could predict mild to moderate sleep apnoea in patients attending an Australian clinical sleep laboratory.

Method: 91 patients (49 Male, 42 Female) underwent a full laboratory-based PSG study and had their NC taken. Patients’ laboratory-based PSG data were recorded using Compumedics Profusion PSG 3 with Respiratory Disturbance Index (RDI) & oxygen desaturation nadir measured. Data were analyzed using linear regression, subjected to Sensitivity & Specificity analyses, with ROC analyses also performed.

Results: 75 of the 91 patients had at least mild OSA (RDI ≥ 10/hr), while 33 had a NC ≥ 40 cm. Using these values as cut-offs, NC sensitivity = 65.7%, & specificity = 75.0. A Positive Predictive Value (PPV) of 31.6% & Negative Predictive Value (NPV) of 92.5%. ROC curve revealed the AUC = 0.70 (p < 0.001). Regression analyses revealed that NC was a significant predictor of RDI (R² = 0.27, p < 0.001), but was an even better predictor of the oxygen nadir (R² = 0.35, p < 0.001).

Conclusion: While the PPV for NC was relatively low, the NPV was very high. Thus, a NC of under 40 cm indicates there is a 93% chance that the person does not have at least mild OSA. Thus, NC could be used to rule out the presence of sleep apnoea, especially in the context of conflicting data. It would be interesting to determine if adding factors such as daytime tiredness or snoring together with NC would improve the Positive Predictive Value for the predictive capacity of NC for mild-moderate OSA.

P013
“SNORE TO SNOOZE”: COMMUNITY BASED SLEEP ASSESSMENT – CANTERBURY INITIATIVE
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It has been identified by the Canterbury District Health Board that to provide healthcare to the people of Canterbury in 2020 under the present system, a further 600 hospital beds, 2000 extra rest home beds and 25% more GPs will be required.

Patients have said they wanted better access to health services, better health outcomes, services closer to home and less delay and uncertainty in their healthcare. Health Clinicians asked for better networks across the entire health sector, referral guidelines and pathways and to develop recognised skills.

The Canterbury Initiative was formed in 2008 with the aim to re-orient new services in the community, achieve and sustain true integration between primary and secondary services and to implement referral, assessment and treatment pathways.

Community Based Sleep Assessments is one service developed by the Canterbury Initiative.

Using a collaborative approach between the Sleep Unit, Christchurch Hospital and the Community Respiratory Service of the Canterbury Initiative, more than 500 Sleep Assessments have now been performed in the community by “Approved Providers of Sleep Assessments” and Mobile Respiratory Nurse Facilitators.

This poster will describe how this service has been developed and implemented. It will include outcomes of the sleep assessments and a description of the quality framework used.

P014
COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF UPPER AIRWAY RECONSTRUCTED FROM COMPUTED TOMOGRAPHY IMAGING DATA
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Objective: To reconstruct the 3D finite element model of the upper airway (UA) of a moderate OSAHS patient, and to apply the CFD method to simulate the inner flow in UA.

Methods: Based on the data of CT scan of one moderate OSAHS patient confirmed by standard polysomnography (PSG), a 3D finite element model was reconstructed by the commercial software Amira 4.0 and Gambit 2.3.16. Import the model into the software Fluent 6.3.26, and simulate the characteristic of inner flow.

Results: 1. Establish one cases of CFD model of the UA in a patient with moderate OSAHS. 2. By simulation, the minimum size of cross-sectional area in UA is 1.340 × 10–4 m², located in the velopharynx, which is in accordance with the clinical examination and cephalometric analysis. 3. Maximum air velocity (14.39 m/s) in 190 ml flow and maximum pressure change (40.60%) in 190 ml flow were observed at the narrowest area.

Conclusion: 1. In this study, based on the CT scan and the software application, the human upper airway can be reconstructed in accordance with the real situation. 2. In moderate OSAHS patients, the velocity and the change of pressure in UA is closely related to the diameter of the luminal. However, the pressure continuously drops in the luminal.

P015
THE ROLE OF DAILY LIFE STRESSORS IN MEDIATING THE RELATIONSHIP BETWEEN SLEEP DISORDERED BREATHING AND MOOD DISORDERS
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Researchers have long explored and debated a possible link between psychological disorders and Obstructive Sleep Apnoea Syndrome (OSAS) with mood disturbance has been reported to be the most
common psychological disorders associated with OSAS. The current study looks specifically at the potential changes and continuities of moods and other psychological factors in OSAS patients and examines the role of daily life stressors in the relationship between OSAS and mood disorders. One hundred and ten patients who attended a sleep laboratory for a sleep diagnostic study were recruited for psychological testing prior to an overnight sleep diagnostic study. They completed a number of psychological instruments assessing their moods as well as sleep questionnaires. Measures of apnoea severity (RDI, oxygen desaturation) and physiopsychological data (such as EEG, EOG, and EMG) were also collected. Results indicated that daily life stressors do mediate the relationship between OSAS and depression. These findings shed a new light in the understanding of the relationship between OSAS and depression.

P016

CLINICAL EQUIPOISE AND POTENTIAL CLINICAL TRIAL TARGETS IN SLEEP SURGERY: CENSUS OF ASOHNs MEMBERS

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Introduction: The effectiveness and funding of upper airway surgery for snoring and sleep apnea has recently been questioned due to the paucity of multi-centred randomised clinical trials. However, clinical trials in surgery are technically difficult to undertake, expensive to execute and without direct input and participation by a broad cross-section of practicing surgeons are destined to fail. Trials must answer questions that are regarded as important, where significant surgical community equipoise exists as to the best treatment option and where sufficient surgeons are willing to become engaged as active investigators. We aim to ascertain from the ENT community which clinical scenarios are regarded as important, which are largely regarded as unresolved questions, and which studies surgeons would want to be involved with.

Method: Every member of ASOHNs was surveyed in a multistage mail, email, internet and phone-based questionnaire aimed at quantifying attitudes towards 5 clinical scenarios.

Results: We continue to collect surveys but the response rate is now greater than 50% of practicing ENT sleep surgeons. At this point, over 70% of respondents live in an Australian capital city, over 80% are VMO consultants, over 50% perform the majority of their surgery in private hospitals, more than 90% are male and the average age of respondents is around 50 years. Marked community equipoise (where the broad cross-section of surgeons does not favour one particular treatment approach or surgeons are generally in agreement that the question has not yet been resolved) was seen in 3 scenarios. Oddly, interest in joining these trials was lower than in those scenarios where clinical equipoise did not exist. In addition a snoring treatment scenario, where equipoise existed, was not regarded as important. This may indicate the lack of serious sequelae for the condition and implies that funding for such a trial may be difficult to secure from public sources. Willingness to be involved in studies could also be caused by unfamiliarity with the techniques suggested.

Conclusion: Of the 5 clinical scenarios, 3 offer potential clinical trial targets. They are regarded as important, community equipoise exists and greater than 30% of surgeons are willing to be involved in a randomised study. In all scenarios presented, surgeons were more in favour of randomised than non-randomised studies.

P017

SLEEP AND COGNITION IN CHILDREN – A META-ANALYSIS

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Introduction: Over the past years an increasing interest has arisen in the topic of sleep and cognition in children. However, as yet the results of past research have appeared inconclusive in regards to the existence of a relationship between nighttime sleep and daytime cognition in childhood. It therefore seems timely to aggregate all previous findings by meta-analysis to determine the status of, and gaps in, our current knowledge.

Methods: An extensive literature search was performed to find all research incorporating an objective measure of sleep, a measure of cognition and a healthy childhood participant group. All relevant articles were objectively scored by two reviewers, and methodological and statistical aspects were imported into Comprehensive Meta-Analysis software (Biostat, Englewood, USA). Independent effect sizes were calculated and an overall meta-analysis tested for the strength of a possible correlation between sleep duration and cognition. Next, cognition was split into psychological domains which were each meta-analysed separately. Random effects models were used throughout.

Results: The combined effect size, adjusted for publication bias, for the overall relationship between sleep duration and cognition revealed a small, yet significant, association ($r = 0.059$, $p < 0.001$) in a heterogeneous set of 50 studies ($n = 20,268$), $Q (49) = 110.5$, $p = 0.001$. The split into cognitive domains revealed significant effects only for General Cognitive Functioning ($r = 0.101$, $p < 0.001$), Declarative Memory ($r = 0.104$, $p < 0.05$), and School Performance ($r = 0.082$, $p < 0.001$), but not for Vigilant Attention, Executive Functioning or Procedural Memory.

Discussion: This meta-analysis on sleep and cognition in childhood conclusively reveals a significant association between sleep duration and cognition in childhood. Although the overall effect size is small, it confirms the existence of a previously disputed relationship.

P018

COGNITION VS. BEHAVIOUR IN A CLINICAL SAMPLE OF PRESCHOOL CHILDREN WITH SLEEP-DISORDERED BREATHING

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Introduction: All severities of sleep-disordered breathing (SDB) in school-aged children have been associated with cognitive and behavioural changes. Currently, developmental profiles of preschool children with SDB are not as well described. Given the high prevalence of SDB during the preschool years, a vulnerable developmental period, a clinical imperative exists to determine which children may benefit from treatment.
Methods: Eighty-one children (52M, 3–6 y) referred for SDB assessment and 18 non-snoring children (10M, 3–6 y) recruited from the community were studied. The clinical sample was grouped by diagnosis following overnight polysomnography based on the obstructive apnoea-hypopnoea index (OAHI); primary snoring (PS, OAHI ≤ 1, n = 38), mild obstructive sleep apnoea syndrome (mild OSAS; OAHI > 1–5, n = 22), and moderate/severe OSAS (MS-OSAS; OAHI > 5, n = 21). Intellectual function was estimated with the Stanford Binet 5 Abbreviated Battery IQ (ABIQ) and parents completed the Child Behaviour Checklist (CBCL), Behavior Rating Inventory of Executive Function Preschool Version (BRIEF-P), and Adaptive Behaviour Assessment System Second Edition (ABAS-2). One-way analyses of variance or Kruskal Wallis tests with pairwise post hoc tests were conducted.

Results: The MS-OSAS group had reduced ABIQ relative to the control group (p < 0.01). Conversely, the MS-OSAS group was not behaviourally different from controls on any summary measure and had fewer problems than both the PS and mild OSAS groups on the BRIEF-P (p < 0.05). Children with PS and mild OSAS had more behavioural dysfunction than controls on the summary scales of the BRIEF-P, CBCL, and (PS only) ABAS-2 (p < 0.05).

Discussion: Parents of children with mild SDB identified behavioural disturbances in the context of relatively intact cognitive development. On the other hand, children with MS-OSAS appeared to have reduced ABIQ with fewer problematic behaviours. These results may reflect inherent biases within clinical samples or differences between direct measures of development and parental report. Simple developmental screening relying on only one assessment approach may not adequately inform treatment decisions.

P020
IS ROUTINE POST-OPERATIVE ICU CARE REQUIRED FOR YOUNG CHILDREN WITH MODERATE-SEVERE OBSTRUCTIVE SLEEP APNOEA SYNDROME POST ADENO-TONSILLECTOMY? M THEILHABER1, SS ARACHCHI1, MJ DAVEY2, DS ARMSTRONG3, GM NIXON2
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Introduction: Post-operative respiratory adverse events (AE) are frequent in children having adenotonsillectomy (AT) for obstructive sleep apnoea (OSA). Key risk factors include age <3 y, co-morbidity and severe OSA. Many hospitals have a policy of routine admission to the Intensive Care Unit (ICU) after surgery for those children at highest risk. It was our aim to determine the frequency and severity of post-operative AE in children admitted to ICU, to assess the appropriateness of this care plan.

Method: Retrospective chart review of children admitted to ICU after AT at our institution from Jan 2007–Dec 2009. OSA severity was determined from overnight oximetry or standard overnight polysomnography performed pre-operatively. Mild AE included requirement for supplemental O2 or repositioning to improve airway; severe AE included mask ventilation or endotracheal intubation. Patients were dichotomised into severe and moderate AE. Data on OSA severity and other factors were recorded.

Results: 72 children were identified (F = 26, age 1–13.6 y). OSA severity was available for 65: mild 2, moderate 9, and severe 54. 29 children (40.3%) had a significant coexistent morbidity (CM). 24 patients (33.3%) suffered at least one post-operative AE, of these 13 (54%) were in children <3 y. These events were mild in 18 (23%) and severe in 6 (8.3%). 5/6 children suffering severe AE were <3 y; 3 had CM. For those with severe AE, OSA severity was moderate in 1, severe in 4 and unknown in 1. Median time from end of operation to severe AE was 130 min (range 13–1330). 4/6 severe AE occurred while the child was still in the post-operative recovery unit. One of the 2 patients with late severe AE suffered aspiration pneumonia and was transferred to ICU 22.5 h post operation, the second required BiPAP for recurrent oxygen desaturations 11.5 h after the operation.

Discussion: Our results confirm high rates of respiratory AE post AT, with age under 3 y, severe OSA and CM being frequent in those having severe events. Conversely, 91.7% of children admitted to ICU in this
series did not suffer a severe AE and 4 of the 6 severe AE occurred in the recovery unit and were dealt with there. These results suggest that routine post-operative ICU care may not be necessary in this patient group, but supports the practice that children <3 y or with moderate-severe OSA or CM should have AT performed in a centre where paediatric ICU is readily available if needed.

**P021**

**FACTORS CONTRIBUTING TO PARENTAL PERCEPTION OF PROBLEM SLEEP DURING INFANCY**

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Introduction: Sleep problems of varying nature and intensity are reported in over one-third of infants. Factors associated with problem sleep need to be understood to enable parents and clinicians to effectively identify and address sleep problems.

Methods: Questionnaire, diary and actigraphy data describing sleep and environmental factors were collected from healthy infants. Aims included piloting study methods and the assessment of factors associated with infant sleep.

Results: Subjects were 52 (33 male) one-year-olds (11–13.9 months), born between 35 and 42 weeks of gestation. Over one-third of the infants were still breastfeeding (38.5%). Most of the infants were sleeping in a room alone and soothing themselves to sleep at night (85%).

<table>
<thead>
<tr>
<th>Sleep variables</th>
<th>Median</th>
<th>Range</th>
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<tbody>
<tr>
<td>Reported bedtime at night</td>
<td>19:00</td>
<td>18:15–21:00</td>
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<tr>
<td>Hrs sleep at night (Actigraphy, 7 pm–7 am)</td>
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<td>8.5–12.2</td>
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<td>Reported time awake (mins)</td>
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<td>No. of times put to bed per 24-hrs (diary)</td>
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<td>1.5–5</td>
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<td>Hrs in bed per 24-hrs (actigraphy)</td>
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<td>12.3–16.9</td>
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<tr>
<td>Hrs sleep per 24-hrs (actigraphy)</td>
<td>12.2</td>
<td>9.8–14.4</td>
</tr>
</tbody>
</table>

Thirty-five percent of parents considered their infant’s sleep to be a small problem (none reported a serious problem). Parentally defined problem sleepers were 2.5 times more likely to be still breastfeeding (p < .05), and 3.4 times more likely to spend 20 minutes or more awake during the night (p < .001, as reported by parents). Time spent in bed did not differ between groups, however problem sleepers were having approximately 40 minutes less sleep at night, and 1 hour less sleep per 24 hours (as recorded actigraphically, p < .05). Problem sleepers were put to bed more often per 24 hours (p < .05) and were 2.6 times more likely to be defined as in a moderate-bad mood at bedtime rather than a good mood (p < .05).

Conclusion: The detection of problematic sleep at an early age is important as this is a leading predictor of continued problems into childhood. Infants considered to be problem sleepers by their parents were confirmed as spending less time asleep. Further research using larger samples is required to address these predictors as well as other mediating factors, to fully understand the mechanisms contributing to problematic sleep during infancy.

**P022**

**THE RELATIONSHIP OF SLEEP TO DEPRESSION, ACADEMIC PERFORMANCE AND DAYTIME FUNCTIONING IN ADOLESCENTS: THE SEMI-TANGLED WEB**

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Introduction: Previous research on adolescent sleep has revealed associations between poor sleep and an array of negative outcomes. However, much of this research has examined simple bivariate relationships. A broader explanatory framework is needed to better understand the complex interrelationships between sleep and adolescent outcomes. To address this, a theoretical model was developed to examine the relationships between sleep, daytime functioning, depressed mood and academic performance.

Method: 186 adolescents in Years 9, 10 and 11 were recruited from four high schools. Participants completed a modified Sleep Habits Survey and kept a sleep diary over 8 days. Path analysis was conducted using AMOS 17.0.

Results: The theoretical model was tested against the data and was found to be a satisfactory fit, $X^2/df = 2.0$, RMSEA = .07, CFI = .97. While the path from circadian typology to daytime dysfunction via sleep quantity was non-significant, removal of this path did not improve the model fit, $X^2/df = 2.2$, RMSEA = .08, CFI = .96.

Discussion: This model provides a good starting point to understand the complex ways that sleep affects mood, daytime dysfunction and academic performance. It reveals sleep quality as a much stronger predictor of poor outcomes than sleep quantity. This has implications both clinically and for future research, as sleep quantity has frequently been the locus in both arenas. The relationship of both daytime dysfunction and depressed mood to grades reveals the potential for statistical suppression, where the opposite effects of the variables “cancel out” each other when considered separately. This may help to explain why prior cross-sectional research has failed to consistently find a relationship between sleep and academic performance. The positive relationship between daytime dysfunction and grades was unexpected and warrants further exploration. Future development of such models is needed to elucidate the relationships between predictors of poor sleep and the mechanisms by which they work. Supported by ARC grant # DP0881261.

![Diagram](image-url)
P023

OBJECTIVELY AND SUBJECTIVELY MEASURED SLEEP OF 6–8-YEAR-OLD NEW ZEALAND CHILDREN

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Introduction: Research suggests a link between children’s sleep and mood, behaviour, school performance, and risk of obesity. Limited objective data on the longer sleep duration and stability of sleep patterns of New Zealand children. This pilot study aimed to collect normative data on children’s sleep across school and non-school nights.

Method: Actigraphy and sleep diaries were used over seven consecutive days and nights with 52 children, aged 6–8-years, living in the Wellington region. Parentally-completed questionnaires, incorporating the Children’s Sleep Habits Questionnaire (CSHQ), captured information on children’s typical sleep behaviour.

Results: Average actigraphically measured sleep duration was 9.9 hours (SD = 0.5) on school nights and 9.5 hours (SD = 0.7) on non-school nights. On school nights, children went to bed significantly earlier (school night: M = 20:19 vs. non-school night: M = 20:42, t(50) = –4.49, p < 0.001), and started sleeping significantly earlier (school night: M = 20:43 vs. non-school night: M = 21:10, t(50) = –5.74, p < 0.001). No significant difference was found in the time that children woke up on school and non-school mornings (school morning: M = 06:35 vs. non-school morning: M = 06:41, t(50) = –1.34, p = 0.185). Sleep efficiency did not differ significantly across the week (school night: 88.1% ± 5.3% vs. non-school night: 88.3% ± 5.7%, z = –1.14, p = 0.23). Compared with actigraphy, parental report of children’s usual sleep on week nights and weekends over-estimated children’s sleep (week nights: Mdn = 10.5, IQR(50) = –6.62, p < 0.001, weekends: Mdn = 10.5, z = –5.16, p < 0.001).

Discussion: Results of this within-subjects design study showed stable objectively measured sleep patterns. Parents generally over-estimated the amount of sleep children had, compared with actigraphy. Knowledge of this may assist families with strategies to support children to obtain adequate sleep.

P024

INFLUENCES ON RESPIRATORY VARIABILITY IN A PAEDIATRIC CLINICAL POPULATION

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Introduction: The aim of this study was to describe influences on respiratory variability during sleep in a paediatric clinical population.

Methods: Paediatric patients referred for polysomnography (PSG) were recruited. Nasal pressure, ECG and SpO2 data were downloaded from Stage 2, Stage 4 and REM sleep and entered into a purpose built programme in Labview. Respiratory onsets (f) were determined and I-I intervals measured. The following variables were calculated: Ventilatory frequency (f), standard deviation of f (SDf), median I-I interval (median I-I), kurtosis of the I-I interval histogram (Kurtosis I-I), and skewness of the I-I interval histogram (Skew I-I). From f and SDf the coefficient of variation of f (CVf) was calculated. Obstructive Sleep Apnoea (OSA) as a PSG diagnosis was defined as a respiratory disturbance index of 25 events per hour. BMMz scores were calculated for children 22 years of age. Influences on variability measures associated with sleep state were assessed by repeated measures analysis. Linear regression was used to look for risk factors for oxygen saturation, f and kurtosis of the I-I interval in REM and Stage 4 sleep with BMIz, the presence or absence of OSA, age, oxygen saturation and the diagnostic groups of Down syndrome (DS), Prader Willi Syndrome (PWS) and Central nervous system (CNS) controlled for.

Results: Of 113 subjects recruited, 88 had data suitable for analysis, 41 female, 47 male. Median age was 6 years (range 0.3 to 15 years). There were 15 CNS, 13 DS, 7 PWS and 49 Normal subjects. Sleep state influenced SDf (p < 0.0001), CVf (p < 0.0001), and skewness of the I-I histogram (p = 0.001 and p = 0.002). Increasing age was associated with lower f in both REM and stage 4 sleep (p = 0.002 and p = 0.003). There was an increase in f in Stage 4 sleep for those with OSA (p = 0.02). Children with PWS had a higher f in Stage 4 sleep but not REM. For DS children f was decreased compared with other diagnostic categories in Stage 4 sleep (p = 0.04) and there was a trend to an effect in REM (p = 0.08). Increased f was also associated with increasing BMIz in Stage 4 sleep (p = 0.02).

Conclusions: Respiratory variability is influenced by sleep state in children referred for PSG. The way that other factors such as diagnosis, age and obesity influence respiratory variability varies with sleep state.

P025

TODDLER SLEEP BEHAVIOUR VALIDATED QUESTIONNAIRE

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Introduction: In order to systematically evaluate normal sleep-related behaviours and patterns in 1–5 year old children, a validated Toddler Sleep Questionnaire was developed.

Methods: An initial screening questionnaire was developed by a paediatric sleep physician. Face and content validity were tested by distributing the questionnaire to qualified and practicing, Australian paediatric sleep physicians for feedback. Feedback was incorporated to improve the questionnaire. A group of parents/guardians of 1–5 year olds completed the questionnaire on 2 occasions. Internal consistency was assessed by Chronbach alpha. Test, re-test stability was assessed across the 2 time points. Construct validity was tested by testing for expected correlations between items. A clinical sample with a paediatric sleep physician diagnosed behavioural sleep disorder was recruited. Results were compared with the community sample using the unpaired t-test and discriminate validity was assessed.

Results: 14/17 Australian paediatric sleep physicians provided feedback about the initial screening questionnaire. Minor modifications of the questionnaire were made. 24 parents/guardians of non-referred children completed the questionnaire on 2 occasions. The questionnaire was modified such that Chronbach alphas ranging from 0.6–0.9 were achieved. Correlation across time points (p < 0.05) confirmed test, re-test stability. A number of anticipated correlations were confirmed, indicating acceptable construct validity. 20 parents/guardians of children with a diagnosed behavioural sleep disorder were recruited. The community and clinical samples were shown to differ in usual location of sleep onset (p = 0.007), time taken to fall asleep (p = 0.03), frequency of calling out (p = 0.03) getting out of bed before going to sleep (p = 0.02), and nighttime awakenings (p = 0.00).

Discussion: A toddler sleep behaviour questionnaire has been developed and validated. It screens for sleep environment, stimulant use, sleep and wake timing, bedtime and naptime routines, nighttime awakenings and parasomnia-like behaviours. The questionnaire is able to discriminate between community and clinical samples, and can be...
P026

CLINICAL APPLICATIONS OF ACTIGRAPHY IN PAEDIATRIC SLEEP MEDICINE
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Introduction: Actigraphy has been used to study sleep/wake patterns for over 20 years. Actigraphy can be useful in infants and children for evaluating sleep patterns and in paediatric cohorts where polysomnography can be difficult to perform. Actigraphy has been validated and found to be superior to sleep diaries for documenting sleep onset and is used in conjunction with diaries when evaluating sleep/wake disorders. Recently AASM guidelines have been drafted for the use of actigraphy in clinical practice.

Aim: To describe the role of actigraphy in a tertiary paediatric sleep clinic setting.

Methods: Clinical information on patients who underwent actigraphy as part of their sleep assessment over five years (2005–2009) was reviewed. The reason for referral, clinical diagnosis, actigraphy data, actigraphy diagnosis, impact on management and follow-up was gathered. The patients used the Actiwatch® and the proprietary software was used to derive the actogram. Sleep diary was used in conjunction to give the time in bed. A sleep physician reported the actogram.

Results: We performed 108 actigraphy recordings during the 5-year period. The indications were: Disturbed Sleep – 30, Daytime Somnolence – 28, Hypersomnolence – 20, Poor Sleep Initiation – 11, Snoring and Disturbed Sleep – 10, Parasomnias – 5 and Behavioural sleep issues – 4. The actigraphy diagnoses were: Poor sleep hygiene – 60, Syndrome related – 20, Normal – 18, Inconclusive – 10. In more than 80% of the patients actigraphy had a direct impact on the management of the presenting sleep problem. In a significant group of patients the need for polysomnography (PSG) was averted. The unresolved actigraphy patients went on to have PSG and 5 patients were diagnosed with OSA.

Discussion: Actigraphy is a useful adjunct in delineating sleep patterns and devising appropriate treatment strategies in conjunction with clinical history and a sleep diary. It has proved to be useful in confirmation of sleep patterns, evaluating hypersomnolence and documenting sleep change post intervention.

Reference:

P027

OBRUSTIVE SLEEP APNOEA IN CHILDREN WITH PRADER WILLI SYNDROME REFERRED PRIOR TO COMMENCEMENT OF GROWTH HORMONE THERAPY
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Introduction: Prader Willi Syndrome (PWS) is a genetic disorder characterised by developmental delay and obesity. In Australia, growth hormone (GH) is licensed for children with PWS to improve linear growth and body composition. There have been case reports of sudden death in children with PWS on GH, possibly due to worsening of obstructive sleep apnoea (OSA). Accordingly, guidelines for the use of GH treatment in PWS require that children are evaluated using polysomnography (PSG) and any sleep disordered breathing treated prior to commencing GH.

Aim: To evaluate the prevalence of OSA in children with PWS referred for PSG prior to commencement of GH.

Method: The sleep unit database was used to identify all children with PWS referred for PSG prior to commencing GH from 2003–10. Chart review was performed to determine age, symptoms of OSA, tonsillar size (small: <50% of pharyngeal diameter, large: >50%) and BMI Z-score (>2.7). Standard overnight PSG was performed in the sleep laboratory. OSA was defined by an obstructive apnoea hypopnoea index (OAHI) >1/h. Data were compared using the Student t-test or Fisher’s exact test.

Results: A total of 43 children with PWS having PSG were identified, 24 in whom the primary indication for PSG was assessment prior to GH treatment. OSA was diagnosed in 10/24 (42%), OAHI mean 3.7/h, range 1.5–14.2/h. GH was deferred in 8/10 cases: 7 were referred for adenotonsillectomy and 1/7 commenced CPAP. Those with OSA were significantly older than those without OSA (mean ± SD 10.6 y ± 4.6 vs 5.8 y ± 3.1, p = 0.03) and more likely to have enlarged tonsils (3/9 vs 0/11, p = 0.008). There was no significant difference in mean BMI Z-score (1.8 ± 0.34 vs 2.1 ± 0.77, p = 0.26). Symptoms of OSA were reported in only 6/24 (25%) cases, and those with OSA were not more likely to be symptomatic (3/10 vs 3/13, p = 1.0).

Conclusion: OSA was diagnosed in 42% of children with PWS referred for a pre GH PSG; OSA was more likely in older children and those with enlarged tonsils. In children with PWS and symptoms of OSA the prevalence of OSA was 50%. This study supports the current GH guidelines, and highlights the importance of a detailed sleep history, examination and referral for PSG of children with PWS independent of the assessment process for GH treatment.

P028

DEVELOPMENT, ON-LINE DELIVERY AND EVALUATION OF GRADUATE CERTIFICATE IN PAEDIATRIC SLEEP SCIENCE
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Introduction: Paediatric sleep science is a rapidly developing field. Practice within this area requires specific knowledge and expertise. The specialised nature of this field however makes this knowledge and expertise difficult to obtain, particularly as this discipline is not well established. Furthermore there are few formal qualifications specific to practice in this area.

An Australian University has developed a novel graduate certificate in paediatric sleep science. The course, currently in its sixth intake has been delivered by distance education using an on-line environment, to students in Australasia, Asia, Europe and North America.

Method: To evaluate graduated students perception of the Graduate Certificate in Paediatric Sleep Science, 24 of 43 students completing the course between 2005–2010 have completed a survey consisting of 59 positive statements about the courses. The questions were grouped into domains including manner of delivery, content, professional development, usefulness, interactions and feedback. Students responded to each statement as follows: 5 – strongly agree, 4 – agree, 3 – neither agree nor disagree, 2 – disagree, 1 – strongly disagree.

Results: Students rated the course very highly, for all statements the median response scores were 4 or higher No students strongly disagreed
and students infrequently disagreed with statements, indeed only 3 domains had greater than 4% disagree statements. The statements receiving the most positive responses were in the domains of workload 94%, vocational skills 97%, feedback 100%. While those with most negative responses were in the domains of student effort 9%, student motivation 6%, presentation 6%.

Discussion: Graduating students had a high perception of the course. The flexibility inherent in the on-line delivery allows students to integrate a course within their work and other commitments, whilst providing ample resources and opportunities for learning.

P029
SLEEP DISORDERED BREATHING AND NUTRITIONAL STATUS AMONGST MALAY SCHOOL CHILDREN
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Introduction: The underlying cause for Sleep Disordered Breathing (SDB) for children and adult seemed to differ. Adeno-tonsillar hypertrophy remained the commonest cause of Obstructive sleep apnea (OSA) in children while obesity in adult population. However, as obesity and weight increase is increasing globally, its importance even in developing country like Malaysia creates attention and awareness especially in young population. Valuated UMPSQ by Chervin et al was used as alternative to detect reported SDB in both malnutrition groups i.e. overweight-obese and thin or severely thin. Malay ethnicity was chosen as their facial structures are different compared to Chinese or Indian population which are another two major ethnic in Malaysia.

Methods: Both English UMPSQ and translated Malay language questionnaire were distributed to a rural school children aged 6–10 years old. Nutritional status and BMI was defined and calculated following 2007 WHO child growth standards. The final score of UM-PSQ of ≥0.3 was considered positive for SDB. Physical findings that were looked for were weight, height, BMI, tonsillar hypertrophy, swollen nasal inferior turbinates, micrognathia and retrognathia.

Results: 548 students completed questionnaires and physical examination. Total 545 Malay students were included. Male to female ratio was 1.06. 25% (136) were overweight-obese and 6.2% (34) were thin. Based on UM-PSQ, 14.8% (81) students have SDB and 39.5% (32) of them were overweight-obese and another 7.4% (6) was thin or severely thin (WHO classification). Amongst overweight-obese and thin with SDB, 68.7% (22) and 50% (3) had tonsillar hypertrophy respectively. However, swollen nasal inferior turbinates were seen in 53% (17) of overweight-obese SDB and none of the thin-SDB has swollen inferior turbinates. Micrognathia and retrognathia were not significant in this studied population.

Discussion: This is the first study looking at SDB in both malnutrition groups in Malaysia. Despite it was a rural school in a developing country, overweight-obese was gigger than thin group. However, SDB was still common in both groups especially overweight-obese group and worsened by the presence of tonsillar hypertrophy or swollen inferior turbinates.

P030
SETTING UP AND EVALUATING A HOME PAEDIATRIC SLEEP STUDY SERVICE
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Introduction: While laboratory polysomnography (PSG) remains the gold standard for the diagnosis of childhood sleep apnoea, the demand for diagnostic services far exceeds the capacity. In order to meet the increasing demand alternative diagnostic pathways need to be investigated. Following a pilot study a metropolitan wide home sleep study service was introduced in 2008 for children referred with suspected Obstructive Sleep Apnoea (OSA).

Method: To evaluate the success of a ‘Paediatric Home Sleep Study Service’ for children referred for investigation of OSA. Children ≥5 years without co-morbidities, referred for investigation of OSA were studied. Sleep studies were unattended using a SomiÉ Ambulatory system (Commedics, Melbourne, Australia). Set-up was in the home and equipment retrieved the following morning by in the home (HITH) paediatric nurses trained by sleep laboratory staff. PSGs analysis: staging, arousal scoring and respiratory scoring were performed according to current laboratory guidelines.

Results: To date, 69 children have been studied (38 or 55% male), median age 10.5 years (range 4–17). The median wait time to sleep study for these children is 2 months compared to the standard referral process wait time of 8 months, and equates to a saving of 60 overnight bed stays for the hospital. 9 (13%) of studies needed to be repeated in the laboratory due to technical difficulties or diagnostic uncertainty. OSA was diagnosed in 44% of children.

Discussion: The feasibility of unattended PSG in the home as an adjunct to standard sleep study laboratory services has been demonstrated. The majority of children do not need to proceed to laboratory PSG. Widespread implementation of such services could reduce the demand for laboratory-based PSG, diversify service delivery; improve wait times and free up hospital beds.

P031
FACTORS CONTRIBUTING TO PROBLEM SLEEP OF 15 MONTH OLDS
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Introduction: There are limited data concerning the sleep of infants across Australasia. Factors associated with problematic sleep need further investigation.

Method: This study describes survey data on the sleep of infants at 3 and 15 months of age (N = 372) from a prospective asthma cohort covering rural and urban New Zealand.

Aim: To identify factors associated with problem sleep across infancy.

Results: At 3 months, 17.5% of parents considered their baby’s sleep to be a problem (small-serious problem), while at 15 months 16.9% reported a problem. Factors with a significant univariate relationship to parental report of problem sleep at 15 months were: having a problem at 3 months (p < 0.05), still breastfeeding (p < 0.01), a lower gestational period (p < 0.05), sharing a bedroom with others (p < .01), a sleep latency of 20 minutes or more (p < 0.01), shorter sleep duration.
over 24 hrs (p < 0.001), more awakenings (p < 0.005) and spending 20 minutes or more awake at night (p < 0.001).

<table>
<thead>
<tr>
<th>Variables</th>
<th>15 mth No Prob</th>
<th>15 mth Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestation</td>
<td>40 28–43</td>
<td>39 32–42</td>
</tr>
<tr>
<td>TST24hrs</td>
<td>13.5 9.8–16</td>
<td>12.5 10–15</td>
</tr>
<tr>
<td>% TSTnight</td>
<td>84.2 67–90</td>
<td>83 75–95</td>
</tr>
</tbody>
</table>

Discussion: The results from this survey support previous studies – parental reports of problem sleep are related to continued breastfeeding and (parentally reported) sleep duration. Some relevant parental behaviours, including how often infants are put to bed each day, were not examined. Further research is required to clarify the relationships between duration of gestation and problem sleep including awakenings. These relationships were not present at 3 months. There is a need for further research using objective monitoring to better understand the mechanisms contributing to problematic sleep during infancy.

**P032**

**A FEASIBILITY STUDY TO INVESTIGATE COMPOSITE SCORING USING OXIMETRY AND THORACO-ABDOMINAL BANDS FOR SCREENING OF OSA IN CHILDREN**

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Introduction: It is becoming increasingly apparent that Obstructive Sleep Apnoea (OSA) in children contributes significantly to burden of disease given 10% prevalence of snoring and 2–3% prevalence of OSA. At present, assessment of OSA requires comprehensive sleep laboratory overnight polysomnography (PSG) which is expensive and limited to major centres. Consequently, many children experiencing symptoms of OSA are unable to access these diagnostic services, thereby impacting significantly on public health. In this feasibility study, we investigate whether a reduced channel diagnostic study could provide a basis for screening. In particular, the performance of an empirical rule-based classifier (SEA Model) using the frequency of three parameters: SpO2, desaturation clusters (S), respiratory events (E) and arousals/movements (A), which may be calculated using only Oximetry and respiratory inductive plethysmography (RIP) data, was investigated.

Methods: Fully scored retrospective PSG diagnostic studies were examined by clinical experts, and OSA assessed as normal, mild/moderate or severe. 30 PSG studies from each class were identified for a total of 90 studies (mean age 6, range 2–14 yrs). Custom software calculated S, while E and A were based on expert scoring recorded by a proprietary (Embla) PSG system. The agreement between the two methods was compared.

Results: The confusion matrix below shows 83% of studies were correctly classified.

<table>
<thead>
<tr>
<th>Predicted OSA (SEA model)</th>
<th>Normal</th>
<th>Mild-Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full PSG Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>23</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Mild-Moderate</td>
<td>2</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

Discussion: The overall performance of this classification system and the low false normal rate (2/60) are promising and suggest that a pre-PSG screening tool based on oximetry and RIP is feasible. A limitation of this study is that E and A were scored by experts using full PSG data in this study. E and A parameters scored using only oximetry and RIP data will be evaluated in further research.

**P033**

**INSOMNIA, DYSFUNCTIONAL BELIEFS ABOUT SLEEP AND DEPRESSION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA OR PERIODIC LIMB MOVEMENT DISORDER**

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Introduction: The interrelationship between sleep disturbances and depression is well-established. Both Obstructive Sleep Apnoea (OSA) and Periodic Limb Movement Disorder (PLMD) are associated with depression, and those with OSA have also been found to have dysfunctional beliefs about sleep (DBAS). Dysfunctional beliefs are implicated in both depression and insomnia, and it has recently been shown that DBAS play a central role in the relationship between insomnia and depression in a community sample (see Mitchell & Oliver). This study investigated the role of DBAS in the relationship between insomnia and depression in a sample of patients with OSA or PLMS.

Methods: Seventy-five adults, newly diagnosed with OSA (n = 54) or PLMD (n = 21) (aged 31–79 years, M = 51.97 years), completed a demographics page, the Insomnia Severity Index (ISI), the Dysfunctional Beliefs and Attitudes About Sleep 10-Item Scale (DBAS-10) and the Centre for Epidemiologic Studies Depression Scale (CESD).

Results: Almost 62% of respondents scored above the cut-off for clinical insomnia, and a further 25.8% scored as having sub-threshold insomnia. All participants scored above the clinical cut-off for depression. Insomnia severity, DBAS and depression were all positively correlated. Results of regression analyses supported the additive model, partially supported the mediation model, but the moderation model was not supported.

Discussion: The majority of participants scored as having either clinical or sub-threshold insomnia, highlighting the frequent co-morbidity of insomnia with the more physiologically-based sleep disorders. Alarmingly, all respondents scored as having possible depression, potentially illustrating the psychological impact of disturbed sleep on mood in this population. Insomnia severity and DBAS simultaneously predicted level of depression, and degree of sleep impairment was also related to depression indirectly, via DBAS. While successful medical treatment of OSA has been shown to improve mood, the results of this study highlight the importance of addressing maladaptive sleep-related cognitions.
in many patients with OSA or PLMD. Psychological interventions to correct these DBAS should assist in alleviating or preventing depression in people with these sleep disorders.

**P034**

**THE PREVALENCE AND SEVERITY OF SLEEP APNOEA IN OLDER ADULTS WITH SELF-REPORTED INSOMNIA**

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**Introduction:** Sleep apnoea and insomnia are prevalent conditions in the older population. While the co-morbidity of sleep apnoea and insomnia is known, the nature of the relationship is often reported in terms of sleep apnoea patients also exhibiting symptoms of insomnia. As insomnia is commonly diagnosed by self-report tools, little is known about the prevalence of sleep apnoea in patients presenting with insomnia as their primary complaint. This study examines the prevalence and the severity of sleep apnoea in older adults whose primary sleep complaint is insomnia.

**Methods:** 31 participants (14 male) aged 57–89 years (M = 69.7, SD = 8.6), with a primary complaint of insomnia were recruited from the community. Participants were screened via clinical interview by an experienced sleep physician and enrolled if they met the DSM-IV criteria for primary insomnia, and were considered unlikely to have sleep apnoea. Participants then completed subjective and objective measures of sleep, including a full in-laboratory polysomnography.

**Results:** Significant sleep apnoea with an Apnoea Hypopnoea Index (AHI) of 15 or greater was found in 51.6% of participants. These participants had a mean (SD) AHI of 30.7 (12.1) and a mean (SD) nadir oxygen saturation of 81.5 (8.2)%. A total of 16.1% of participants had an AHI of 40 or greater, and these participants had a mean (SD) AHI of 45.6 (4.0), and a mean (SD) nadir oxygen saturation of 78.8 (11.2)%.

**Discussion:** Identifying sleep apnoea in the insomnia population can be difficult in older adults, where both conditions are common and can exhibit similar overt symptoms. While insomnia is the most common sleep complaint in older adults, these preliminary data suggest that even after screening for sleep apnoea, unsuspected sleep disordered breathing is present in around half of presenting cases. In clinical practice, where the diagnosis of insomnia is commonly based on self-report, the presence of sleep apnoea may go undiagnosed unless objective diagnostic screening is performed. This may have a major impact on the response to insomnia treatment and the health and wellbeing of patients. Further data collection is underway to facilitate additional understanding and characterisation of insomnia in the elderly.

**P035**

**THE BURDEN OF INSOMNIA ON INDIVIDUAL FUNCTIONING AND HEALTHCARE CONSUMPTION**

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**Introduction:** There is limited information about insomnia in Australia and whether it poses an independent burden on individuals and the healthcare system.

**Methods:** Cross-sectional data from the 2007 National Mental Health and Wellbeing Survey was analysed. Participants were 8,841 respondents representative of the Australian population aged 16 to 85. Sleep maintenance insomnia was defined as sleeping only in short bursts and being awake most of the night over the past week. The main outcome measures were individual functioning, disability days, disability, and quality of life, and healthcare consumption: use of sleep medications, use of mental health medications, visits to general practitioners, hospital admission, visits to alternative healthcare providers, and unmet need for mental health services.

**Results:** Population-weighted prevalence of insomnia was 5.4%. Older age, female gender, pain, chronic physical conditions, and psychological distress were all independently associated with insomnia. Controlling for these and other potential confounders, insomnia was associated with higher risk of (Adjusted Odds Ratio; and 95% CI): disability days (1.66; 1.31–2.09), disability (1.45; 1.05–1.99) and poor quality of life (1.94; 1.25–3.01). Greater risk for hospital admission (1.45; 1.12–1.88) and the use of sleep medication (2.55; 1.88–3.45) was associated with insomnia. Insomnia was not significantly associated with visits to general practitioners (1.19; 0.92–1.52) or to alternative healthcare providers (0.90; 0.43–1.81). Neither was it independently associated with the use of medications for mental health (1.01; 0.76–1.33) or unmet need for health services (1.20; 0.89–1.62).

**Conclusions:** One in twenty adult Australians experience insomnia, which is associated with impairments in functioning independent of physical and psychiatric comorbidities. This burden is however not consistently reflected in greater healthcare consumption.

**P036**

**THE WORKING MEMORY PERFORMANCE OF OLDER ADULTS WITH INSOMNIA**

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**Introduction:** Older individuals suffering insomnia typically report subjective declines in their cognitive performance beyond what they consider to be normal changes due to the aging process. Recent neuro-imaging studies have suggested there may be objective evidence for these declines in cognitive performance. Research has demonstrated frontal lobe hypoactivation among insomniac populations when compared to healthy, good sleepers. However, it remains unclear whether this hypoactivation translates into objective declines when performing tasks hypothesized to draw upon this brain region. This study aimed to objectively identify if older insomnia sufferers demonstrate significantly impaired performance on a working memory task when compared to age-matched good sleepers.

**Method:** To date, forty-eight (22 males, 26 females) older adults (M = 63.23, SD = 6.82) suffering from sleep maintenance insomnia have been compared with 19 age and gender matched good sleepers. Cognitive performance was assessed using the Double Span Memory Task, a computer-based working memory task which asks participants to indicate the names and/or spatial locations of increasingly longer sequences of visually presented objects.

**Results:** Results indicate that after controlling for general intelligence, the individuals suffering from insomnia did not perform significantly different when compared to good sleepers on either the simpler or more cognitively demanding components of the task.

**Discussion:** The results from this study suggest older insomniacs do not display an observable impairment on working memory process relative to good sleepers. This may be an indication that mechanisms,
such as chronic hyperarousal, may assist insomniacs in maintaining performance at a level similar to good sleepers.

P037

YOGA FOR IMPROVING SLEEP AND LIFE QUALITY IN THE ELDERLY POPULATION

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Introduction: Insomnia is prevalent in the elderly, reducing quality of life, diminishing cognition and increasing the risk of accidents and mortality. Treatment with sedative-hypnotic drugs has limited effectiveness and further increases the risk of falls and hip fractures. Yoga has been shown to increase wellbeing in the elderly via a range of breathing, physical and meditative exercises.

Objectives: 1. Examine effectiveness of yoga for insomnia and reduction in use of hypnotics/relaxants in the elderly; 2. Determine whether yoga enhances quality of life in the elderly; and 3. Determine whether yoga is suitable for elderly in western culture(s).

Methods: A mixed design crossover controlled trial (n = 74, age range 60–87, M = 74.4, SD = 7.1) with 2 weekly classes incorporating physical and meditative yoga, and daily home practice of meditative yoga for 12 weeks. Measures included self-reported assessment of sleep quality (Sleep Logs, KSS, ESS, PSQI, MAPS), mood states (DASS, POMS), general health (SF-36) and mobile home sleep studies.

Results: In comparison to the control group the treatment group showed significant improvements in the following subjective factors; overall PSQI sleep quality (p = .001), overall mental health scores DASS (p = .010) and POMS (p = .009), overall SF36 health (p = .008), and social function (p = .030), and in some objective sleep quality factors. Home practice compliance was highly variable, but high compliance was significantly related to improved sleep in comparison to those who showed poor compliance and the control subjects. There was no significant decrease in the use hypnotics/sedatives. It was also found that a significant proportion of elderly presenting with insomnia complaints also showed previously undiagnosed co-morbid obstructive sleep apnoea (OSA).

Conclusions: Yoga may improve sleep and life quality in an elderly population presenting mainly with insomnia complaints. Yoga is safe, applicable, and acceptable in a western geriatric setting. Outcomes depend on compliance level, specifically in daily home practice. Objective sleep studies are necessary to exclude cases of co-morbid OSA in the elderly and may also prevent misdiagnosis and over prescription of sedative/hypnotic drugs.

P038

REFRESH: RESTRICTION FOR REORGANISATION OF SLEEP HABIT, PROTOCOL FOR A RANDOMISED CONTROLLED TRIAL OF BEDTIME RESTRICTION FOR THE TREATMENT OF PRIMARY INSOMNIA IN THE PRIMARY CARE SETTING

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Introduction: Bedtime restriction (sleep restriction) is one of the components of multicomponent CBT. The aim of this study is to test the effectiveness of bedtime restriction as a treatment of primary insomnia in the primary care setting over six months.

Methods: Design: Randomised controlled trial
Participants: Adults aged 16 to 75 years old with primary insomnia recruited from Auckland general practitioners.
Intervention: Intervention includes a personalised bedtime ‘prescription’ (setting regular bedtimes and wake up times according to sleep diary information) plus ‘Good Sleep Guide’ handout. The control group receive ‘Good Sleep Guide’ handout.
Measures: Primary outcomes: sleep quality measured by the Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and sleep efficiency (sleep diary and actigraphy). Secondary outcomes: fatigue (Flinders Fatigue Scale), sleepiness (Epworth Sleepiness Scale), depression (PHQ-9), and anxiety (GAD-7).

Results: This trial is ongoing and results have not yet been analysed. A ‘response’ correlates to a reduction in PSQI ≥ 3 points, an increase in sleep efficiency by ≥ 25%, or a reduction in sleep-onset latency and/or wake time after sleep onset of ≥ 250%. A ‘remission’ correlates with a participant no longer meeting the general criteria for insomnia or poor sleep quality (that is, PSQI score is reduced to ≤ 5 or ISI ≤ 7). The proportion of those with a sleep efficiency ≥ 85% pre and post intervention between groups will also be analysed.

Discussion: General practitioners (GPs) are the health professional most likely to see a patient with insomnia. However, there is a high level of uncertainty about how to treat the condition. Cognitive behavioural therapy (CBT) has been shown to be an effective treatment for insomnia. Although effective, CBT remains poorly utilised as a treatment. Importantly, traditional CBT is not designed as a treatment that can be administered by a general practitioner and thus is not typically used in primary care. The hypothesis of this study is that bedtime restriction is the most ‘active ingredient’ of CBT for insomnia and could be used as a monotherapy and simple tool for treating primary insomnia.

P039

HOW DO PHARMACISTS RESPOND TO COMPLAINTS OF ACUTE INSOMNIA? A SIMULATED PATIENT STUDY

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Introduction: The objective of this study is to investigate how community pharmacists respond to complaints of acute insomnia from people seeking self treatment and determine what factors affect this response.

Methods: A simulated patient study was conducted in 100 randomly selected pharmacies located in Newcastle and Sydney, Australia. A standardized scenario of acute sleep onset insomnia was used in each pharmacy with a pre-determined scoring system.

Results: Of the 100 pharmacies, upon simulated patient presentation, 96% supplied a product, the remaining 4% referred to a physician. Non-pharmacological advice was provided in 42%. Pharmacists scored highly on information gathering and advice provided prior to (Presupply score/4, 3.6 ± 1.9) and with supply of a medication (Supply scores/4, 3.0 ± 0.9). However performance was considerably lower on the Sleep Score outcome (Sleep Score/8, 2.1 ± 1.7). A higher sleep score was associated with greater (or younger) age of the pharmacist, chain pharmacy type, and a pharmacy displaying evidence of association with a quality assurance programme (p < 0.05). Higher supply scores were associated with younger age (p < 0.05), whilst both younger age and
Discussion: difficulties in terms of eliciting insomnia type and counselling about medicines use. However more education for pharmacists would help to further promote good sleep health, and address behaviours that increase reliance on medicines taking and progressively worsen insomnia. Early good sleep health promotion at the presentation of acute insomnia can help resolve the problem instead of subsequent progression to chronic insomnia. Therefore further education and training for pharmacists, particularly about non-pharmacological strategies for the management of insomnia is recommended.

P040
SLEEP DISORDERS SCREENING, SLEEP HEALTH AWARENESS, AND PATIENT FOLLOW-UP BY COMMUNITY PHARMACISTS IN AUSTRALIA

Introduction: Community pharmacy is a primary health care facility that is readily accessible to the public placing pharmacists in a prime position to deliver education and counselling to improve sleep health. This study aimed to develop, implement and evaluate a pharmacist led sleep health awareness, education and monitoring program for patients at risk for a sleep disorder.

Methods: Twenty-three conveniently selected pharmacists were trained in screening, counselling and follow up. Patients were screened for excessive daytime sleepiness, obstructive sleep apnea, insomnia, and restless legs syndrome, and counselled or referred as per protocol. A close out questionnaire documented the outcomes of the pharmacist counselling on patient sleep health behaviours, physician follow up if relevant, and self reported impact on sleep health practices at five months after the initial visit.

Results: Over a four-month period, 325 patients were opportunistically screened (refusal rate 51%). 142 (44%) patients were identified as being at risk of having at least one sleep disorder. Pharmacists recorded 849 interventions; 53% (n = 454) included verbal counselling, 16% (n = 137) written referrals, and 31% (n = 258) written information. At follow up (n = 224), 48 patients (of 85 who recalled being referred) had taken up their referral. Of those patients followed-up, 4% reported improved smoking habits, 10% decreased caffeine intake, 9% indicated reduced alcohol intake, and 19% reported making improvements in their sleep environment. On a scale of 1–5 (1 = large impact, 5 = no impact), 59% reported a large to some impact on their confidence in asking their pharmacist about sleep health.

Discussion: Pharmacists can raise general awareness through the education of patients on sleep health, and through counselling initiate patient behaviour change in those at risk of having or developing a sleep disorder.

P041
IMPROVING THE SLEEP OF CARERS OF PEOPLE WITH DEMENTIA THROUGH THE USE OF A SIMPLE INFORMATION PACKAGE

Introduction: Carers of people with dementia (PWD) often experience sleep loss as a result of the disturbed sleep patterns of the PWD, being vigilant in the night in case of problems, and excessive worry and trouble unwinding. Consequently, PWD are often institutionalised earlier than would otherwise be the case. There are many strategies that can be used to prevent sleep loss from progressing. This paper reports on the findings of a project where an information package containing strategies for preventing sleep loss in carers was designed and trialled.

Methods: Twenty-six community-dwelling carers of PWD (Mean age = 70 yrs) who had noticed changes in their normal sleep patterns since they commenced care-giving were recruited. Participants’ sleep quality, sleepiness, daytime functioning, beliefs about sleep, and worry, were assessed using a small battery of sleep-related instruments. The study utilised a single group repeated measures design, wherein a four-week control period was followed by a four-week treatment period. In the treatment period, they were given a specially developed ‘Guide To Better Sleep’ to use at home.

Results: A significant improvement in sleep was shown by: a significant increase in hours slept (a mean increase of 31 minutes per night), a significant decrease in sleep onset latency (a mean reduction of 9.64 minutes per night), and a significant improvement in sleep quality (reduced PSQI scores). A significant reduction in insomnia-related feelings that impact on functioning (measured with the DFS) indicated that some changes in daytime feelings occurred, although no significant changes in sleepiness were found (as measured using the ESS). An improvement in cognitions related to sleep was detected, as shown by a significant reduction in both dysfunctional beliefs about sleep (measured with the DBAS-16) and worry (measured with the PSWQ). Very large effect sizes were observed in all analyses.

Discussion: Use of the sleep package resulted in improved sleep quantity and quality of carers of PWD, as well as reduced worry and improved cognitions related to sleep. The significant improvement in beliefs indicates that normative information about the nature of sleep may be a valuable offering for carers in the future.

P042
SLEEP AND FALLING IN OLDER PEOPLE – A PILOT STUDY

Introduction: Falls are a common problem for older people. Sleep difficulties are also common but under diagnosed in older people, and often wrongly attributed to be an inevitable part of ageing. The aim of the study was to investigate what specific sleep difficulties, if any, are associated with falling in older people and the feasibility of undertaking a larger study investigating the association between sleep difficulties and falls.

Methods: Veterans or war widows over 70 years of age who had fallen at least once in the previous year underwent an in-home assessment of falls risk, mobility, physical activity levels, depression, and subjective sleep quality followed by an in-laboratory full polysomnography.

Results: Thirty-five participants were recruited, 59.4% female, with a mean age of 82.9 years at first assessment (range 74 to 90 years). Preliminary analyses of 29 subjects suggested that those at a higher risk of falling had significantly higher state sleepiness (Karolinska Sleepiness Scale, p = 0.04, high falls risk mean KSS = 3.0, SD = 1.8 versus low
risk 1.7 (1.0)), and a tendency towards higher trait sleepiness (Epworth Sleepiness Score, p = 0.081, high falls risk = 7.1 (3), low risk = 4.2 (2-4)). The somewhat demanding data collection strategy was found to be feasible and acceptable to older people, with all participants completing both assessments without any adverse consequences.

Conclusions: Consistent with previous studies of residential care dwelling older people, there seems to be a relationship between daytime sleepiness and falls risk in a community-dwelling Veteran population. Further research is needed to determine whether interventions to prevent sleepiness may reduce falls and falls risk.

Reference:

P043
USE OF CARE MONITOR IN NURSING HOMES MAY IMPROVE SLEEP
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Introduction: Routine night checks are considered a major factor contributing to disrupted sleep of nursing home patients. LifSys (Ltd) Care Monitor has been trialled in a Care UK nursing home in England. This monitor identifies times when residents get up out of bed and times of incontinence, sending a silent alarm to care assistants at times of need in an attempt to reduce the number of unnecessary routine night checks.

Aims: To compare sleep before (Time 1) and two months after the Care Monitor was installed into bedrooms of a nursing home (Time 2).

Method: Two weeks of night time actigraphy and diary data collected at Times 1 and 2, (with a two month interval whilst adjusting to the new Care Monitor). Participants were 21 residents of a UK nursing home, 8 were excluded from the study due to leaving the home, invalid actigraphy data or changes in sedating medication. Data were complete for 13 participants (9 male), average age 80 years (63–93), 10 had a diagnosis of dementia.

Results: Sleep data were extremely varied within and between participants. The number of times care assistants entered the bedrooms either to check or perform care duties significantly dropped from an average of 5.4 (3.9–5.6) times per night to 0.4 (0.1–1.7) times per night (z = –3.186, p < 0.001, r = –0.66). The number of residents wandering at night reduced from 7 to 3, and there was a trend of wandering incidences decreasing from an average of once per night (0–15) to 0 (0–9). None of the actigraphic sleep variables changed significantly between Times 1 and 2. However there was a trend towards higher sleep efficiency, from a median of 76% (62–97%) at Time 1, to 84% (52–97%) at Time 2, and a reduction in activity during the sleep period, from a median activity count of 31 (2–81) at Time 1, to 14 (3–77) at Time 2.

Discussion: The high participant exclusion rate due to the change of medications and living arrangements should be noted for future studies of this population. The introduction of the Care Monitor to nursing home bedrooms had a large effect on the number of bedroom entrances at night. Instances of wandering appeared to also reduce however future research is required recruiting a larger group of ‘wanderers’ to verify this trend. Despite the large reduction in room entrances there were no significant changes in objective sleep timing or quality between Times 1 and 2. However there were trends towards higher sleep efficiency and a reduction in activity within the sleep period. These trends warrant future, larger studies into the advantages of using the Care Monitor for improving sleep quality in this population.

P044
COGNITIVE-BEHAVIOURAL GROUP THERAPY FOR ANXIETY-RELATED INSOMNIA
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Introduction: Insomnia is a condition that goes largely untreated despite its negative impact on people’s quality of life. Currently there is no standardised psychological treatment available for insomnia in New Zealand. Despite the high co-occurrence of insomnia and anxiety problems, anxiety is not usually specifically targeted in the insomnia treatment.

This study evaluates the effectiveness of a cognitive-behavioural group therapy for anxiety-related insomnia, implemented at a Psychology Clinic in Wellington, New Zealand.

Methods: Participants were suffering from chronic insomnia and subclinical anxiety. The treatment targeted insomnia and anxiety separately. Three groups received anxiety treatment first, and 2 groups received insomnia treatment first. Scores on sleep, insomnia, and anxiety measures, alongside results on measures of quality of life and beliefs about sleep were examined. The pattern of treatment group results was also examined to determine the most effective treatment order.

Results: In addition to having their expected effects, insomnia treatment reduced scores on anxiety measures even before anxiety was specifically targeted. Similarly, anxiety treatment reduced scores on insomnia measures before insomnia was specifically targeted. Both treatment conditions were equally successful in treating insomnia by group conclusion.

Discussion: The current combination of anxiety and insomnia treatments demonstrated that anxiety treatment can be effective in reducing insomnia. These findings are in accordance with the most recent literature about the aetiology of insomnia, where anxiety seems to have a role in predisposing, precipitating and perpetuating insomnia. Treatment that targets both of these components should therefore be considered when people with chronic insomnia also present with subclinical anxiety.

P045
THE ROLE OF DYSFUNCTIONAL SLEEP-RELATED COGNITIONS IN THE RELATIONSHIP BETWEEN INSOMNIA AND DEPRESSION IN A COMMUNITY SAMPLE
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Introduction: Sleep and depression are interrelated and the relationship is bi-directional. Several theories propose biological pathways to explain this interaction, but there are limited psychological explanations available. Dysfunctional cognitions are central to the development of both insomnia and depression and play a perpetuating role in both conditions. This study tested the additive, moderation and mediation models to determine the role of maladaptive cognitions about sleep in the relationship between sleep impairment and depression in the general public.

Methods: A community sample of 188 adults (aged 18–81 years, M = 37.86 years) was recruited from two shopping centres. Voluntary participants completed a demographics page, an abridged version of the
Sleep Disorders Questionnaire (SDQ), the Insomnia Severity Index (ISI), the Dysfunctional Beliefs and Attitudes About Sleep 10-Item Scale (DBAS-10) and the Centre for Epidemiologic Studies Depression Scale (CESD).

Results: Almost half of participants scored as having insomnia and a third scored at or above the clinical cut-off for depression. Almost one-quarter of respondents scored as being at risk of Periodic Limb Movement Disorder (PLMD), while one in ten were at risk of Obstructive Sleep Apnoea (OSA). Levels of sleep impairment, dysfunctional sleep-related cognitions and depression were all positively correlated. Results of regression analyses supported the additive model, partially supported the mediation model, but did not support the moderation model.

Discussion: A large proportion of respondents scored as having concerning levels of insomnia and/or depression. While both dysfunctional beliefs about sleep and sleep impairment simultaneously predicted levels of depression, insomnia was also related to depression indirectly via maladaptive sleep-related cognitions. Specifically, increased insomnia severity was associated with more dysfunctional beliefs about sleep, which in turn related to worse depressive symptomatology. Interventions to correct maladaptive cognitions about sleep should help alleviate and prevent depression in those with insomnia. Given the high percentages of participants at risk of PLMD and OSA, it would be beneficial to replicate this study in a clinical sample of people with these sleep disorders.

P047

NIGHTMARE FREQUENCY IN A SAMPLE OF AUSTRALIAN UNIVERSITY STUDENTS

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Introduction: Nightmare experiences are ubiquitous in the general population, but frequent nightmares (weekly and monthly) are far less common. The prevalence of weekly, monthly and yearly nightmares in the Australian population remains unknown. This study aimed to examine the frequency and intensity of nightmares in a non-clinical sample. The study also aimed to determine the frequency of trauma-related and non-trauma related nightmares.

Participants: The participants were 440 students from Victoria University, 115 men and 325 women aged between 18–34 years (M=20.47, SD=2.63).

Materials: A survey consisting of retrospective measures, the Nightmare Frequency Questionnaire (NFQ), the Pittsburgh Sleep Quality Index (PSQI), the PSQI Addendum for PTSD (PSQI-A) was administered.

Procedure: The method of recruitment entailed strategically placing advertisements for participants around different campuses. Interested participants were given a survey and upon completion returned the survey.

Results: 89.3% (n=393) of the sample reported having nightmare experiences. This total was composed of yearly, monthly and weekly estimates, of which 42.5% (n=187) reported at least one nightmare experience in the previous year, 30.9% (n=136) reported having at least one nightmare experience in the previous month and 15.9% (n=70) reported having at least one nightmare experience in the previous week. From the 70 participants that reported weekly nightmares, 45.7% (n=32) reported nightmares related to a traumatic experience, and from the 136 participants that reported monthly nightmares, 37.5% (n=51) also reported nightmares related to a traumatic experience.

Discussion: Weekly nightmare reports (15.9%) were considerably higher than previously reported frequencies in the literature (4–10%) for similar samples. However, monthly nightmare reports (30.9%) were similar to frequencies reported in the literature (29%) for similar samples. Trauma-related nightmares were almost half of the reported frequencies for both weekly and monthly nightmares. These findings suggest that both trauma-related and non-trauma-related nightmares are more frequent than previously believed and that prevalence and treatment studies are warranted.

P046

INSOMNIA TREATMENTS: DO EXISTING PSYCHOLOGICAL TREATMENTS MATCH CURRENT MODELS OF INSOMNIA?

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Background: Insomnia is a condition that affects a large number of people and is associated with poorer quality of life and psychological well-being. Insomnia can be present with or without co-morbid medical or psychological conditions. The recent advances in the treatment of insomnia have seen a shift from the use of behavioural strategies to the addition of cognitive strategies in the treatment packages, and the recognition that both primary and secondary insomnia can be successfully treated.

Current aetiological models of insomnia highlight the role of hyper-arousal and anxiety personality traits, in addition to maladaptive sleep behaviours and cognitions in the development and maintenance of insomnia. Although there is strong evidence for the efficacy of current treatments, a number of people show no improvement post-treatment.

Aims: This paper reviews the existing psychological treatments for insomnia in light of the current aetiological theories in an attempt to identify whether they target the full range of causal and maintaining factors described in the literature.

Discussion: The majority of treatment packages target up to three out of the four areas described in the literature. Future treatment packages should aim to incorporate all aspects involved in insomnia aetiology in order to bridge the gap between insomnia theories and practice.
PHOTOGRAPHIC CRANIOFACIAL ANALYSIS AND MANDIBULAR ADVANCEMENT SPLINT TREATMENT OUTCOME

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Introduction: Mandibular advancement splints (MAS) can be an effective treatment for Obstructive Sleep Apnea (OSA). However predicting efficacy in individual patients is difficult and simple clinical methods are needed. MAS treatment outcome has previously been related to craniofacial structure. Quantitative photographic methods allow rapid computation of craniofacial surface measurements which can be used to predict the presence of OSA. We hypothesised that craniofacial phenotypes may differ between MAS treatment responders and non-responders.

Methods: Patients undergoing MAS treatment for OSA had calibrated frontal and profile facial digital photographs taken before commencement of treatment. Craniofacial photographs were analysed for linear and angular measurements as well as craniofacial areas and volumes. Overnight polysomnography was repeated after an acclimatisation period to determine MAS treatment outcome. Patients were classified as complete responders (post-treatment AHI < 5/hr), partial responders (≥50% reduction in AHI) or non-responders (<50% AHI reduction) for analysis.

Results: Preliminary analysis of 28 patients (mean ±SD age 46.9 ± 10.3 years, mean BMI 30.1 ± 8.0 kg/m², mean AHI 26.1 ± 11.6/hr), including 11 complete-, 10 partial- and 7 non-responders, has been completed. Several craniofacial variables significantly differed between treatment outcome groups.ゴンソリ-ク離距離は、完治群で非完治群に比べて有意に短かった（P < 0.05）。尖骨と顔面基部の角度（t-n-sn）は、完治群で非完治群に比べて有意に小さい（P < 0.05）。有り頭位の睡眠度（mid-face bed depth angle）は、完治群で非完治群に比べて有意に小さい（P < 0.05）。There was a trend for maxillary depth angle (t-n-sn) to be reduced in non-responders (p < 0.07).

Conclusions: These preliminary data suggest that there are relationships between surface facial dimensions and MAS treatment outcome. We anticipate that further analysis will reveal other relevant craniofacial variables associated with treatment response which may be useful in predicting MAS treatment outcome in the future.
**P051**

**THINKING INSIDE THE BOX: MANDIBULAR ADVANCEMENT AND THE LATERAL TISSUES OF THE NASOPHARYNX**

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Mandibular advancement splints are an alternative treatment for Obstructive Sleep Apnoea (OSA), but their mechanism of action is unclear. This study aimed to track the movement of tissues surrounding the airway during mandibular advancement using a dynamic MRI technique.

**Methods:** 12 subjects (AHI 5–82) were imaged using Spatial Modulation of Magnetization (SPAMM), an MRI technique for tagging tissues, in the midline sagittal and 2 axial planes (nasopharynx and oropharynx) of the head and neck. During imaging the mandible was advanced with a customized mouth guard. Images were taken 250 ms apart for 2 s with the subject at end expiration and 5 repeat images were taken in each plane. Points were tracked using the images showing adequate movement and average movement was determined for each subject at each site.

**Results:** In the sagittal plane (n = 12) the mandible advanced on average 5.6 ± 1.9 mm (±SD). The mean anterior movement of the tongue adjacent to the oropharynx was 1.9 ± 1.8 mm compared to 0.69 ± 1.5 mm adjacent to the nasopharynx (p = 0.003), with both showing a caudal movement component also. In the upper axial (nasopharyngeal) images 10 subjects had adequate images and in all subjects the lateral compartment moved independently of tissues anterior to the airway. This compartment was bounded by the pterygomandibular raphe, the mandibular ramus and the parapharyngeal fat pads and contained the pterygoid muscles and lateral airway walls. The lateral walls moved in the antero-lateral direction on average 2.2 ± 1.8 mm, which was the largest movement seen adjacent to the airway (p < 0.001 compared to antero-posterior movement in the oropharynx). Overall movement in the lateral compartment was greater than movement in the anterior compartment (p = 0.04) suggesting lateral connections between the ramus of mandible and the superior pharyngeal constrictor. In the lower axial plane there was mainly antero-posterior movement in the anterior and lateral tissues surrounding the airway.

**Conclusion:** Connections to the mandible in a lateral compartment in the nasopharyngeal region account for the greater part of airway opening seen at the time of mandibular advancement.

**Discussion:** HGNS therapy markedly reduced the AHI in two patients with OSA and HGNS at and above therapeutic levels substantially decreased airway collapsibility in the hypotonic upper airway. The reduction in Pcrit at stimulation levels above current ‘therapeutic’ levels suggests further decreases in AHI might be possible with greater levels of HGNS. Data collection is ongoing.
P053
LONGER-TERM EFFECTS OF TESTOSTERONE THERAPY ON SLEEP, BREATHING AND BODY COMPOSITION IN OBSESE MEN WITH OBSTRUCTIVE SLEEP APNEA (OSA) UNDERGOING WEIGHT LOSS: A RANDOMISED PLACEBO CONTROLLED 18 WEEK TRIAL
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Introduction: Testosterone (T) therapy reduces fat and increases muscle. Such body compositional changes in men with OSA should improve sleep disordered breathing. However we previously showed that high dose T therapy acutely worsens sleep breathing. The effects of longer-term, more physiological T therapy on weight, body composition, sleep and breathing are not known.

Methods: Sixty-seven obese men with OSA were randomised, in a 18-week double-blind placebo controlled parallel group study, to 3 IM injections (0, 6, 12 weeks) of either 1000 mg T undecanoate (n = 33, body mass index (BMI) = 36.6 ± 0.8 kg/m², apnea hypopnea index (AHI) = 33.2 ± 3.9 events/h) or placebo (n = 34, BMI = 34.9 ± 0.7 kg/m², AHI = 30.3 ± 2.7 events/h). Anthropometry, body composition (abdominal CT and whole body DEXA scans), arterial stiffness and the Epworth Sleepiness Scale (ESS) were measured before, during and after the treatment period. Overnight polysomnography was conducted at baseline, a week after the 2nd injection and week 18. Data were analysed by mixed models adjusted for baseline weight and are mean (or mean of change from baseline) ± SEM.

Results: Body composition improved in both groups by 18 weeks, but equivalently between groups: weight (T = −1.8 ± 0.3 kg, placebo = −2.1 ± 0.3 kg), visceral abdominal fat (T = −29.6 ± 18.9 cm², placebo = −47.1 ± 11.6 cm²) and, total body fat (T = −3114 ± 413 g, placebo = −2861 ± 566 g). Lean muscle mass significantly increased in the T (1194 ± 293 g) compared to the placebo (−408 ± 320 g, p = 0.001) group. T worsened oxygen desaturation index (3%) (p = 0.02) and snoring time (60%) (p = 0.03), total AHI (p = 0.03) and non-REM AHI (p = 0.045) acutely, but not after 18 weeks, compared with placebo. However, markers of cardiometabolic risk such as arterial stiffness (p = 0.035) and liver fat (p = 0.046) both consistently improved with T therapy, as did sexual desire (p = 0.01) compared with placebo therapy. T changed blood hormones as expected. Sleepiness and self-reported function improved with weight loss, but not more with T therapy.

Conclusion: T therapy increases lean mass, improves arterial stiffness and reduces liver fat. Sleep breathing was worsened acutely but not in the longer term. T may improve cardiometabolic risk in the longer term despite acutely worsening sleep breathing.

P054
AUDIT OF A WARD-BASED ACUTE NON-INVASIVE VENTILATION SERVICE IN A TERTIARY HOSPITAL
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Background: Non-invasive ventilation (NIV) can be delivered in the acute hospital setting using a variety of different service models. Our NIV service comprises a dedicated nurse, registrar and consultant primarily based on the respiratory ward, but with the capacity to deliver NIV in any ward of a 350 bed tertiary hospital.

Aim: To describe the number, types, location and outcomes of inpatients treated by a dedicated NIV service.

Methods: A retrospective audit of the number, types, location and outcomes of inpatients referred to the NIV service at The Alfred from the 1st January 2009 to the 30th June 2009.

Results: 199 referrals to the NIV service comprising 141 patients (age: 58 ± 17 years (mean ± SD), gender: 60% male) were received (repeat admissions 16 patients). The main indications for NIV were OSA (n = 47, 29% of total), acute exacerbations of COPD (n = 32, 20%), acute cardiogenic pulmonary oedema (ACPO) (n = 16, 10%), post lung transplantation (n = 10, 6%), mechanical ventilation weaning (n = 8, 5%), post operative recovery (n = 7, 4%). Treatment was delivered primarily in the respiratory ward (n = 36, 23%), cardiac ward (n = 15, 9%), general medical ward (n = 14, 9%), emergency department (n = 13, 8%) and ICU (n = 12, 8%). 55 patients received CPAP (pressure 10 ± 3 cmH2O) with OSA and ACPO making up 76% of those treated. 71 pts received bilevel positive pressure ventilation (IPAP 13 ± 3 cmH2O and EPAP 6 ± 1 cmH2O) with AECOPD and weaning post-ICU making up 43% of those treated. 33 did not receive NIV or type was not stated. Outcome data for bilevel NIV was available in a sub-group of 28 patients with AECOPD. Of these, 17 patients (61%) improved to the point where NIV could be ceased or they were discharged. 11 patients (39%) either deteriorated on NIV or could not tolerate therapy. Of these, 7 continued ward medical management and 4 were palliated.

Conclusion: Our NIV service model has managed a large number of referrals across a range of diseases in a variety of wards. This is likely to have reduced demand on ICU, HDU and respiratory ward beds. Our outcomes for AECOPD are comparable to the published literature. We believe that our service model provides a viable means of administering NIV to an ever expanding referral base.

P055
CEPHALOMETRIC VARIABLES FAIL TO IMPROVE ON SIMPLER ANTHROPOMETRIC-BASED STATISTICAL MODELS FOR THE OSA PHENOTYPE
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Introduction: Anthropometric and bony cephalometry-based phenotypic models for OSA typically explain <50-60% of AHI variance. We hypothesised that inclusion of craniofacial variables combining bony and soft tissue anatomy (external skin surface cephalometry) may better explain OSA variance.

Method: We studied 148 healthy volunteers (66 males, age: 33 ± 12 yrs [mean ± SD], BMI: 24.9 ± 5.3 kg/m², all Multivaraible Apteoae Prediction Index (AP) <1) and 142 diagnosed (apneoa-hypopnoea index >10 events/h) OSA patients (101 males, age: 55 ± 24 yrs, BMI: 32.5 ± 6.9 kg/m²). We recorded 12 anthropometric variables (including age, gender, height, weight, neck circumference [NC]), measured 12 individual cranial and 20 maxilla/mandible skin surface dimensions, and calculated mandible enclosure and retro-mandibular spatial volume (includes both bone and soft tissue components). Data were analysed

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using principal component (PC) analysis and multiple logistic regression (MLR).

**Results:** Across healthy and OSA subjects, three non-collinear PCs which explained 57% of the variability in anthropometric and surface cephalometry measurements were identified: PC#1 was primarily associated with overall size and gender (37% of total variability); PC#2 essentially contrasted craniofacial height, abdominal size and age (11% variability); and PC#3 was primarily associated with mandibular ramus height and forehead size (9% variability). PC1–3 were significant independent predictors for OSA (MLR model; Cox and Snell $R^2 = 0.49$; $P < 0.001$). However, an MLR model using only age and NC achieved Cox and Snell $R^2 = 0.52$ ($P < 0.001$).

**Conclusion:** In this study, skin surface craniofacial anatomy metrics did not contribute over and above age and NC alone in predicting OSA. We speculate that craniofacial bony and soft tissue structures (excluding neck anatomy) do not contribute greatly to the OSA phenotype (as defined by AHI level).

**P057**

**MANDIBLE LENGTH PREDICTS SLEEP DISORDERED BREATHING IN INFANTS WITH CLEFT LIP AND/or PALATE**

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**Introduction:** Infants with cleft lip and/or palate (CL/P) have smaller airways which predisposes them to sleep disordered breathing (SDB). While infants with CL/P in the context of a syndrome are known to have more severe SDB, other risk factors for SDB severity in this group have not been identified. We undertook a study of growth and facial measurements to determine if direct facial measurements could be used to assess for SDB amongst infants with CL/P.

**Methods:** Infants with CL/P were prospectively recruited. Measurements of growth parameters and direct facial measurements were taken at the time of polysomnography (PSG). PSG was completed to determine the presence of SDB defined by an apnoea-hypopnoea index (AHI) ≥15 events/h. Growth parameters and seven facial measurements plus composite measures were analyzed for their association with SDB and SDB severity.

**Results:** Results from 44 infants <12 months of age (2.7 ± 2.2 mo) were available for analysis, 25 infants had SDB. Head circumference (−0.74 ± 1.3 z-score vs 0.24 ± 1.4, $P < 0.05$) and total mandible length (right OBI-GN + left OBI-GN distance; 16.80 ± 1.89 vs 18.94 ± 2.17, $P < 0.01$) were significantly smaller in infants with SDB compared to infants without SDB. Total mandible length also correlated with severity independent of syndrome status; for each 10 mm decrease in mandible distance, AHI increased by 3 events/h. Linear regression, corrected for age, weight and head circumference, demonstrated a negative relationship between total mandible length and SDB severity. There were no significant relationships between measures of weight, length or facial height and SDB or SDB severity.

**Conclusions:** Measurement of total mandible length may assist in recognizing infants with CL/P at increased risk of SDB but further work is needed to standardize this measure for clinical application. Recognition of the facial characteristics associated with SDB can aid in prioritizing the investigation and management of high risk infants with CL/P.
according to existing guidelines. The PSG was conducted in a sleep lab using standard procedure and PSG variables were collated.

**Results:** We studied 17 patients (7 Boys and 10 Girls) who had PSG studies who had pre and 6 weeks post commencement of rhGH. Age ranges of patients were between 1.6 to 17.9 years (median 6.6 years). Nine patients had normal PSG study indicating no deterioration in SDB since commencing on rhGH. In four patients in Apnoea Hypopnoea Index (AHI) was noted, but rhGH was continued as the PSG changes were considered mild and was deemed clinically safe to discontinue. In these patients rhGH was ceased as SDB was considered clinically significant and the patient needed either adenotonsillectomy or close clinical monitoring for respiratory failure was instigated.

**Discussion:** Half of our PWS patients on rhGH had no evidence of worsening of SDB during the study 6 weeks post rhGH treatment. However in the other half a spectrum of worsening SDB was noted. It appears a subset of PWS patients are at risk during this window of vulnerability shortly after initiation of rhGH. As it is difficult to predict the impact of rhGH on SDB, patients with PWS should have PSG before and after starting GH. Ideal time interval for follow up PSG is yet to be determined.

**P059**

**INFLUENCE OF ORAL DIMENSIONS ON MANDIBULAR ADVANCEMENT SPLINT TREATMENT OUTCOME IN OBSTRUCTIVE SLEEP APNOEA**

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**Introduction:** Predicting treatment efficacy of mandibular advancement splints (MAS) for individual obstructive sleep apnoea (OSA) patients is problematic. Treatment outcome may relate to anatomical factors such as craniofacial size and upper airway soft tissue volume and/or anatomical balance between them. We aimed to assess whether craniofacial and oral cavity measurements are associated with MAS treatment outcome.

**Methods:** Dental impressions and lateral cephalometric radiographs were obtained from OSA patients prior to treatment with a customised two-piece MAS. Inter-tooth distances and maxillary and mandibular palatal depths were measured on plaster casts of the upper and lower dental arches to assess oral cavity dimensions. Standard cephalometric analysis was performed, with the addition of cross-sectional area (CSA) for tongue and the bony oral enclosure.

**Results:** Of 53 patients, 25 were complete responders (post treatment AHI < 5/hr), 17 partial responders (25-50% AHI reduction) and 11 non-responders (<50% AHI reduction). Cephalometric analyses revealed a shorter maxillary length in complete responders (83.8 ± 1.1 vs. 87.6 ± 1.2 mm, p < 0.05). Oral cavity measurements from dental casts did not differ between treatment outcome groups. Cephalometric measures of tongue and oral enclosure CSA was obtained in a subset of 30 patients. Oral CSA did not differ between treatment outcome groups however there was a trend towards a larger tongue CSA in complete vs. partial/ non-responders (39.5 ± 1.3 vs. 35.5 ± 0.5 cm², p = 0.09). A ratio of tongue to oral CSA was greater in complete vs. non-responders (p = 0.012) such that complete responders had a larger tongue for a given oral cavity size.

**Conclusion:** This study suggests that oral cavity dimensions do not differ between MAS treatment responders and non-responders. However responders appear to have a larger tongue volume for a given oral cavity size, suggesting that MAS help correct anatomical imbalance. Assessment of the ratio between tongue and bony enclosure size may be useful in predicting response to oral appliance therapy.
P061
THE ENVIRONMENT (HOME VERSUS LABORATORY) DOES NOT INFLUENCE SLEEP QUALITY IN SUBJECTS WITH DISTURBED SLEEP
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Introduction: It has been postulated that home versus laboratory polysomnographies (PSG) may be more representative of a subject’s regular nightly sleep on the basis that sleep quality may be better if measurements are made in the home. However, previous comparison studies have focused on sleep disordered breathing outcomes in patients presenting with obstructive sleep apnoea (OSA) symptoms, rather than symptoms of disturbed sleep.

Aim: The aim of this study was to compare sleep quality from home-based PSGs with laboratory based PSGs in volunteer subjects who presented with perceived disturbed sleep related to chronic nasal congestion.

Methods: Home (Alice PDX, Respironics) and laboratory (Compumedics) PSGs were conducted on 46 subjects presenting with symptoms of disturbed sleep. The studies occurred sequentially at least 5 days apart. The home PSG (H) measured the same parameters as the laboratory PSG (L) except for leg EMG and two rather than four EEG channels. Subjects with an H apnoea-hypopnoea index (AHI) of more than 30 were excluded from further analysis. Studies were analysed by one blinded observer using AASM criteria with the RERA option. Data were excluded from further analysis.

Results: For the group, no significant differences were detected between H and L for sleep stage (N1 = 7.1 ± 3.7%, 7.6 ± 3.5%, N2 = 47.7 ± 9.7%, 47.8 ± 7.5%, N3 = 23.8 ± 8.8%, 23.9 ± 6.9%, REM = 21.4 ± 6.2%, 19.7 ± 4.5%), arousal index (23.5 ± 11.7, 23.4 ± 11.6 events/hr) or sleep efficiency (82.9 ± 8.7%, 81.6 ± 10.6%). However, small differences were recorded for AHI (5.9 ± 8.3, 3.2 ± 4.8 events/hr, p < 0.01), with the higher values recorded on home PSG.

Conclusion: In a group of subjects with perceived disturbed sleep, PSG parameters that measure sleep quality were not significantly different between studies conducted at home or in a sleep laboratory. We conclude that the environment (home versus laboratory) does not influence sleep architecture and quality in subjects with a moderate level of sleep disturbance.

P062
SINGLE CHANNEL EEG BASED SLEEPINESS DETECTION SYSTEM
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Introduction: excessive daytime sleepiness (EDS) is a widespread symptom associated with sleep disorders such as apnea. The MWT/MSLT tests are routinely used in sleep laboratories to establish sleep onset characteristics. These tests are complicated, they demand multi-modality measurements (EEG, EOG, EMG, ECG) and substantial human intervention, and thus are not available for field use. In this paper we propose a fully automated, simplified method to estimate the sleepiness’ and sleep latencies, using only a single channel of EEG data.

Method: EEG data were obtained from 10 patients undergoing routine diagnostic MSLT testing (montage: C4-A1, C3-A2). We then computed the 1-D diagonal slice of the EEG Bispectrum. Features corresponding to (micro) sleep events were identified and used to define a novel Sleepiness Index, SI, (0 ≤ SI ≤ 1 continuous variable; SI = 0 (awake), SI = 1 (asleep)). The Sleep Latency (SL) was computed from the SI. The performance of the technique was evaluated by comparing the SL (SI-SL) with the technician scored (manual) SL (TS-SL).

Results: A strong correlation (r = 0.83, σ < 0.01) was found between TS-SL and SI-SL. Altman-Bland plots showed a small negative bias (bias = -1.23 min, σ = 0.28) in the estimation of SI.

Discussion: the proposed method is fully automated, objective and is based on a single channel of EEG. Its potential uses will be in the real-time estimation of sleepiness outside laboratory settings (e.g.: in wearable devices for drivers). It may also aid in the scoring of MWT/MSLT data.

P063
PIEZO LEG MOVEMENT SENSORS ARE NOT EQUIVALENT TO THE LEG EMG RECORDINGS WITH RESPECT TO DETECTING LEG MOVEMENTS DURING DIAGNOSTIC POLYSOMNOGRAPHY
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Introduction: The measurement of leg movements is an integral part of the standard polysomnographic investigation. Typically sensors are placed over the right and left anterior tibialis to detect muscle movement. In Australasia, piezo sensor is a commonly used sensor to detect the anterior tibialis muscle movements during polysomnography. The AASM guidelines, published in 2007, recommend the use of anterior tibialis EMG instead of the piezo sensors. There is currently no data comparing the equivalence of these two methods of assessing anterior tibialis muscle movement in the literature.

Methods: Twenty-five consecutive patients underwent diagnostic polysomnography due to the suspicion of sleep disordered breathing. As part of the diagnostic investigation anterior tibialis muscle movement was measured simultaneously with leg EMG and piezo sensors. Each measurement method was analysed separately using the ASDA leg...
not equivalent to the AASM recommended leg EMG sensors during a

Discussion: These results suggest that piezo leg movement sensors are not equivalent to the AASM recommended leg EMG sensors during a standard diagnostic polysomnogram.

P064

MANUAL VERSUS AUTOMATED DETECTION OF OXYGEN DESATURATION INDEX

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Introduction: Automatically generated oxygen desaturation indices (ODI) are increasingly utilised in clinical settings and research. However, desaturation events are not clearly defined in the 2007 AASM manual, there are a variety of definitions and validation methods described in the literature and there is a paucity of proper validation against well defined manually scored desaturation events.

Aims: (1) To develop a clearly defined, precise and robust oxygen desaturation definition for manual validation of automated indices and (2) assess the accuracy of an automatically generated ODI against this definition (using Compumedics Profusion 3.2 software (P3)).

Methods: Initially, 3 scientists experienced in PSG analysis scored desaturation events on a study (Compumedics E-Series, Nellcor N595 oximeter set to shortest averaging (2–4 seconds)) and then results discussed in a larger group of experienced scientists, on an event-by-event basis until a revised rule set devised. This process was repeated until no further alignment was achieved. Next, this rule set was tested on 3 new studies (2 scorers to date) and results compared between manual scorers and the automated analysis.

Results: Summary of rule set. Baseline: maximum value in 15 second moving window; Event start: start of decline to ≥5% reduction in SpO2; Event end: start of resaturation of ≥2% within 5 seconds. The ODIs (events/hr) and pairwise proportion of specific agreement (PSA) for manual scorers (S1, S2) and automatic analysis (P3) were:

<table>
<thead>
<tr>
<th>Study</th>
<th>S1</th>
<th>S2</th>
<th>P3</th>
<th>PSA (S1–S2)</th>
<th>PSA (S1–P3)</th>
<th>PSA (S2–P3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 2</td>
<td>129.9</td>
<td>131.7</td>
<td>118.7</td>
<td>0.99</td>
<td>0.99</td>
<td>0.93</td>
</tr>
<tr>
<td>Study 3</td>
<td>80.3</td>
<td>85.8</td>
<td>80.0</td>
<td>0.96</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>Study 4</td>
<td>1.9</td>
<td>0.6</td>
<td>1.0</td>
<td>0.47</td>
<td>0.70</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Discussion: This rule set is simple and clear and shows promise as a highly repeatable manual desaturation measure. The accuracy of the automated ODI measure compares favourably, although with some tendency to underscore, in comparison, in this data set. Further investigation in more studies and for different desaturation magnitudes is required. Subsequently, automated algorithms could be validated against a set of reference studies.

P065

CARDIOPULMONARY COUPLING: USE IN CLINICAL PRACTICE

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Current sleep study analysis techniques are biased towards measurements of respiration and do not take into account recent developments in the understanding of the neurophysiology of sleep. As such, in managing patients we are often faced with a paradox of symptoms that are out of keeping with our sleep study analysis. Newer techniques incorporating understanding of the important inter-relationship between oscillations in respiration and heart rate can give insights into contributing factors to sleep symptoms and help to guide management in our patients.

One such technique, cardiopulmonary coupling (CPC) has been described [1] and is available as a commercial software package (Embla) that can be used to assist in the management of complex patients. We describe an illustrative case. A 40 year old man with chronic pain and depression for which he was treated with buprenorphine and venlafaxine. His overnight sleep study showed predominantly obstructive and central sleep apnoea. Analysis using CPC showed a low proportion of high frequency coupling (23.5%), and analysis of low frequency coupling showed both broad band coupling (representing OSA) and narrow band coupling at a frequency of 0.02 Hz (representing CSA). As a consequence the patient was commenced on a combination of CPAP and zopiclone (to increase high frequency coupling and reduce central sleep apnoea) and had an excellent symptomatic response.

In clinical sleep medicine practice, we are commonly faced with patients who have persistent symptoms of non-restorative sleep and daytime fatigue, despite our best attempts at treating their apnoea. Novel techniques such as Cardiopulmonary Coupling will enable us to better assess sleep micro-architecture, predict those patients who will fail to respond adequately to standard CPAP alone and better tailor therapies to maximise sleep quality and therefore optimise daytime symptom improvement.

Reference:

P066

GENDER INFLUENCE ON SNORE SOUND BASED OBSTRUCTIVE SLEEP APNEA DIAGNOSTIC FEATURE

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Introduction: Snore sounds have been recently proposed for OSA diagnosis purposes. However, the impact of gender has not been considered in those techniques. We investigate some similarities/differences of male/female snore sounds and implications for diagnosis. The vocal tract shape is characterized by set of resonant frequencies named as formants. First formant (F1) frequency which represents the degree of
constriction in vocal tract. We estimated F1 of snore sounds of male and female subjects separately and investigated the distribution.

Method: Snore sounds were recorded from patients undergoing routine PSG testing. We used data from four males (AHI from 2.4 to 75.4) and four females (AHI from 4.1 to 83.1) in this work. One hour of snore data from each subject was randomly chosen and manually scored to identify the snore episodes (SE). This resulted in 1567 SEs from males and 1199 SEs from females. Formants were estimated for these episodes.

Results: 25–50% of SEs of males were found to be having F1 values less than 200 Hz. Corresponding statistics for females were from 0.01–25%.

Discussion: Results highlight F1 differences of male/female SEs, indicating different acoustical characteristics of the upper airway in OSA. Sound-based diagnosis techniques may benefit if these differences are taken into account. Further analysis of a larger set of data will be needed for a firm conclusion.

P067

EFFECT OF BODY MASS INDEX ON THE DIAGNOSTIC ACCURACY OF PULSE OXIMETRY FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Pulse oximetry is a potentially cheaper, more accessible tool compared to polysomnography (PSG) for the diagnosis of obstructive sleep apnoea (OSA) but changes in oxygen saturation (SpO2) can be influenced by factors other than sleep-related airway obstruction. Previous studies of older oximetry devices indicate a high discrepancy between PSG-derived Apnoea-Hypopnoea Index (AHI) in patients with lower Body Mass Index (BMI). Newer oximetry technology using higher sampling rates and lower averaging times show greater variation in oxygen saturation even when awake. This study aims to assess the effect of BMI on SpO2 and diagnostic accuracy of pulse oximetry compared to PSG derived indices.

Method: 40 PSG studies were manually scored for desaturation (23%) and an hourly average (Desaturation Index (DI)) was compared by correlation within BMI groups (20–29, 30–39, 40+ kg/m²) to PSG derived AHI.

Results: A significant correlation between DI-3% and AHI was seen in all BMI groups (p < 0.001). Discrepancy between AHI and DI (DI-3%–AHI) was greatest in subjects with a higher BMI. Baseline awake SpO2 had a negative relationship with discrepancy level (DI3%-AHI, p < 0.001).

Discussion: When compared to PSG derived AHI, oximetry (DI-3%) overestimates AHI in patients with BMI > 30 kg/m². Baseline SpO2 also influences the DI-3%–AHI difference.

P068

VALIDATION OF AN OXIMETER WITH A 4 BEAT AVERAGING TIME AGAINST AN OXIMETER WITH A RAPID 2 SECOND AVERAGING TIME IN THE SCORING OF RESPIRATORY EVENTS

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Introduction: AASM 2007 guidelines recommend that sleep laboratories use oximeters with a <3 second averaging time (aT) to ensure rapid changes in SpO2 associated with respiratory events are detected. Nonin-Xpod oximeters in the Compumedics E-Series have a 4 beat aT which is variable and dependent on heart rate. We compared the Nonin-Xpod to a device with a rapid aT of 2 sec (Masimo Rad-7) in the calculation of RDI.

Methods: Simultaneous recordings of SpO2, using the Nonin and Masimo were collected during overnight PSG. A single scorer analysed PSGs; respiratory events were scored twice using one SpO2 signal at a time. Paired t-tests and Bland-Altman plots were used to compare RDIs from the two oximeters.

Results: In 32 simultaneous recordings, the RDI was lower with the Nonin (RDI Nonin 16.8 ± 14.8 v RDI Masimo 18.5 ± 15.1, p < 0.001). The mean difference was 1.6 (95% CI 1.17 to 2.10). Limits of agreement show that 95% of the differences were between −1.0 and 4.2.

Discussion: Nonin derived RDI is systematically less than Masimo derived RDI. However, as mean difference is small and limits of agreement narrow, it is unlikely that using the two different oximeters will result in clinically significant outcomes. An oximeter with a 4 beat aT performs almost as reliably as an oximeter with a rapid 2 sec aT.

Acknowledgements: Masimo Australia Pty Ltd for the loan of Masimo Rad-7 device.

P069

CHARACTERISTIC PATTERNS OF OXYGEN DESATURATION IN SLEEP DISORDERED BREATHING

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Introduction: We hypothesised that different types of sleep disordered breathing may be associated with changes in the shape of the oxygen
MISPERCEPTION OF SLEEP LATENCY AND SLEEP DURATION IN PREGNANCY
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Introduction: Although it is accepted that sleep disturbance is common during pregnancy, there is a lack of objective sleep data due to the difficulty in persuading these women to spend a night in a sleep laboratory. It is likely that in this group, as found in the general population, self-report sleep quality is unreliable. This study compares self-reported sleep quality with objective measures on polysomnography (PSG) during pregnancy.

Methods: Twenty-one women in the third trimester (T3) and 17 women in the first trimester (T1) of pregnancy and 10 non-pregnant controls underwent overnight PSG and reported their perceived sleep onset latency (SOL), total sleep time (TST) and sleep quality.

Results:

Table 1. Objective vs Subjective SOL and TST in the T3, T1 and Control Groups

<table>
<thead>
<tr>
<th>Sleep Parameter</th>
<th>T3</th>
<th>T1</th>
<th>Control</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOL (mins)</td>
<td>30.0±42.9</td>
<td>19.8±17.7</td>
<td>29.8±36.3</td>
<td>46</td>
</tr>
<tr>
<td>TST (mins)</td>
<td>343.6±83.6</td>
<td>409.0±37.7</td>
<td>427.0±57.3</td>
<td>0.02**</td>
</tr>
<tr>
<td>SOL − SOLc</td>
<td>10.8±29.4</td>
<td>12.4±13.1</td>
<td>9.0±22.6</td>
<td>93</td>
</tr>
<tr>
<td>Abs. SOL − SOLc</td>
<td>22.7±21.0</td>
<td>14.8±10.1</td>
<td>17.1±16.6</td>
<td>34</td>
</tr>
<tr>
<td>TST − TSTc</td>
<td>11.9±57.8</td>
<td>−49.0±61.4</td>
<td>−30.5±36.7</td>
<td>0.05**</td>
</tr>
<tr>
<td>Abs. TST − TSTc</td>
<td>46.4±43.5</td>
<td>30.0±59.9</td>
<td>39.3±23.8</td>
<td>81</td>
</tr>
</tbody>
</table>

Note: † = subjective; ‡ = objective; Abs. = Absolute value; **p < .01

On average, all groups overestimated their SOL. The T3 group tended to overestimate TST, which differed significantly from the T1 and control groups who underestimated TST on average. Absolute values however show that all groups incorrectly reported TST by 40–50 minutes with substantial variability. The accuracy of sleep perception did not differ between those who reported their sleep quality as the same as usual or worse than usual.

Discussion: Sleep perception during pregnancy tends to be unreliable, but not significantly more so than in healthy controls. Negative perceptions of sleep quality regardless of objective measures have been shown to result in impaired daytime functioning. Misperception of sleep also has important implications for the vast number of studies based on self-report in the pregnant population.

P071

EFFECTS OF SCHOOL START TIMES AND TECHNOLOGY USE ON TEENAGERS’ SLEEP: 1999–2008
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Introduction: Teenagers typically sleep less than younger children, have later bedtimes and later sleep onset, often experience difficulty waking and functioning first thing in the morning, report increased daytime sleepiness (often accompanied by bad moods) and, when allowed, can sleep in much later than the rest of the household. School start times and technology use (computers, cell phones, etc) have been identified as factors that contribute to sleep restriction in teenagers.

Methods: Two surveys of the sleep of students at a New Zealand high school, Participants in 1999, were 71 Year 9 and 140 Year 12 students. In 2008, there were 137 Year 9, students, 132 Year 11, and 212 Year 12. Between the surveys, the school changed the start time for Year 12 students from 9:00 am to 10:30 am.

Results: Year 12 students in 2008 were less likely to report sleep loss on school nights (OR = 0.06, 95% CI = 0.01–0.11) and were less sleepy (OR = 0.58, 95% CI = 0.34–0.98) than those in 1999 or Year 11 in 2008 (sleep loss, OR = 0.31, 95% CI = 0.19–0.53; sleepiness, OR = 0.46, 95% CI = 0.28–0.75) (controlled for gender). There was no change in sleepiness or sleep loss for Year 9 students across the two surveys. In 1999, 80.7% of students had entertainment and communication technologies in the bedroom, while in 2008 it was 96.4% (p(χ2) < 0.001). In 2008, having more technologies was associated with getting less sleep on school nights (Spearman’s rho = 0.005). For Year 9 in 2008, being in the highest tertile group for number of technologies increased the risk of scoring as excessively sleepy (OR = 4.06, 95% CI = 1.44–11.41) and being evening type (OR = 3.38, 95% CI = 1.27–9.01) compared to the lowest tertile (controlled for gender).

Discussion: The results from this survey support previous studies showing the commonness of teenage sleep loss and sleepiness, and studies which show that presence of entertainment and communication technologies in the bedroom has negative relationship with total sleep time. The findings also support anecdotal reports from the school concerning the positive impact of delaying senior school start time from 9:15 to 10:30 am. Students with the later start time were less likely to report sleep loss on school nights and experienced less daytime sleepiness than the 1999 cohort, despite reports of greater presence of technologies used in the bedroom. The data suggest that high levels of technology use may be particular problem for the younger Year 9 students who do not have the benefit of the delayed school start time.

Delayed school start times are not a magic bullet for sleep loss and sleepiness among teenagers, which have multiple interacting causes. Good quality sleep education can be beneficial for parents, teachers and students, and further research evaluating the effectiveness of interventions is essential.
P072
NIGHTMARE TREATMENT PILOT WITH A STORY-LINE ALTERATION TECHNIQUE
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Introduction: There are few contemporary clinical reports focusing on the direct treatment of nightmares. Treatments for nightmare disorder can be categorised as follows: (1) Psychoanalytic and cathartic techniques; (2) Story-line alteration procedures; (3) Face and conquer approaches; and (4) Related behavioural techniques. The aim of this study was to implement a Story-line Alteration Technique (SLAT) in a sample of university students who reported experiencing at least one nightmare per week. It was hypothesised that the participants receiving SLAT would show a significant decrease in nightmare frequency in comparison to a control group who received a Systematic desensitisation (SysD) treatment. Participants: The participants were 20 students from Victoria University, 5 men and 15 women aged between 18-31 years (M = 21.6 and SD = 3.4). Materials: Nightmare Frequency Questionnaire (NFQ), the Pittsburgh Sleep Quality Index (PSQI), the PSQI Addendum for PTSD (PSQI-A), Nightmare Effects survey (NES), Posttraumatic Diagnostic Scale (PDS), Profile of Mood States (POMS-37 item/POMS-SF) were administered. Procedure: The 10 participants that formed the experimental group received the SLAT treatment and the 10 participants that formed the control group received the SysD treatment. Subsequently all participants completed pre-treatment measures before receiving the treatment CDs. Upon completion of the treatment participants filled-in post-treatment measures.

Results: Wilcoxon-signed ranks tests showed that the difference between pre-post treatment measures (NFQ & PSQI) in experimental group were significant (z = -2.82, p < .05) and (z = -2.72, p < .05) respectively. The median difference post-treatment between the experimental SLAT group and control SysD group was 2 nightmares per week, with the experimental group reporting less nightmares. A Mann-Whitney U-test found the difference to be significant (U = 13.0, N1 = 11, N2 = 9, p = .004, one-tailed).

Discussion: The SLAT treatment delivered via a treatment CD was shown to significantly reduce nightmare frequency in comparison to SysD treatment CD. This suggests that direct treatment of nightmares should be incorporated into various forms of psychotherapy because it can immediately improve sleep quality and this may improve therapeutic outcomes.

P073
AMBULATORY SLEEP-WAKE PATTERNS AND MOOD DISTURBANCES IN PATIENTS WITH PSYCHOTIC DISORDERS: A CONTROLLED STUDY
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Introduction: To date, sleep disturbances in people suffering from psychotic disorders have mostly been assessed through subjective report or a single night of laboratory recording. The current study aimed to assess multi-day ambulatory sleep-wake patterns of young adults with psychiatric disorders, and to investigate the potential relationships between sleep and mood disturbances in this population.

Methods: Eight outpatients with psychotic disorders and 8 age-matched healthy controls underwent 7 consecutive nights of actigraphy recording. Self-reported symptoms of depression, anxiety and stress were collected using the Depression Anxiety Stress Scales (DASS). Sleep and mood data were analysed using t-tests and Pearson correlations.

Results: Compared to healthy controls, the patients with psychosis had significantly later sleep offset (p = 0.01), more WASO (p = 0.03), higher intra-individual variance in WASO (p = 0.005), and in the number of wake bouts (p = 0.04); and tended to have lower sleep efficiency (p < 0.06). In addition, the patients with psychosis endorsed significantly higher levels of depression (p = 0.01) and anxiety (p = 0.02). Importantly, in the psychosis group, these depression and anxiety symptoms were clinically significant and negatively correlated with objective sleep efficiency (both r = 0.84, p = 0.04).

Discussion: Objective sleep-wake patterns measured across several days in the sleepers’ natural environment were significantly more disrupted in our sample of people with psychotic disorder than in healthy controls. The ability to consolidate sleep was found to be poorer and more variable from day to day in the psychosis group. Importantly, sleep disturbances in the patients with psychosis were associated with severe depression and anxiety symptoms, suggesting common pathogenesis mechanisms.

P074
PATIENTS’ BELIEFS ABOUT THEIR SLEEP PROBLEMS
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Introduction: Continuous positive airways pressure (CPAP) reduces OSA symptoms and associated health risks, however rates of treatment use can be low. One reason may be the beliefs that patients hold about what causes their sleep problems. This study assessed patients’ beliefs about their illness and their relationship to sleep difficulties and disease severity in patients attending a sleep clinic for a diagnostic sleep study.

Methods: A prospective, longitudinal cohort study. Participants were recruited from a local sleep clinic, where they completed questionnaires at their diagnostic overnight sleep study Questionnaires included the Depression Anxiety and Stress Scale and the Illness Perceptions Questionnaire – Revised (subscales assessed perceived causes, illness severity, coherence and consequences).

Results: To date, 517 participants have completed questionnaires at the overnight study. Analysis of these data indicates three perceived causal models for the participants’ sleep problems: psychological causes (stress, overworking); poor health habits (smoking, drinking); and, external causes (bad luck, pollution). The most common causal attribution was that psychological issues were causing their sleep apnoea: the primary attribution of 54% of participants. Those making psychological causal attributions were more depressed (r = .59) more anxious (r = .38) more stressed (r = .58) and more fatigued (r = .39). Participants also indentified symptoms they associated with their sleep problems, which are not commonly linked to OSA, such as stiff joints (31%), loss of strength (36%), and weight gain (33%). Participants felt their ‘sleep problems were serious’ (60% agreeing) and that they had ‘a major impact on their life’ (70% agreeing). In addition, 1 in 4 felt their ‘sleep
problems were a mystery' to them (23%) and that their 'sleep problems did not make sense' to them (22%).

Discussion: Despite being a physical condition, many patients appear to believe that stress and worry (psychological factors) caused their sleep problems and were unclear about their condition. The extent to which such beliefs impact on CPAP use needs exploring.

P075
THE SLEEP OF A COMMUNITY SAMPLE OF CARERS OF ALZHEIMER'S PATIENTS
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Introduction: Alzheimer's disease (AD) disrupts the sleep of care providers as well as patients. Poor sleep is cited as a key factor contributing to moving family members into institutionalised care.

Aims: To investigate relationships between caring (and caring for those with AD in particular) and older caregivers’ perceptions of their own sleep.

Method: Questionnaire data from the New Zealand Health Work and Retirement cohort. Participants: N = 2495 (45.9% Male), average age 63.3 years (SD = 4.5 years), including a community sample of non-paid caregivers (85 AD Carers and 484 'Other Carers').

Results: Compared to non carers, carers were more likely to report feeling worn out and tired as well as being dissatisfied with their sleep and more likely to have a diagnosed sleep disorder (Table 1).

Table 1. Comparisons of Sleep Between Care Groups (Chi Square Analysis)

<table>
<thead>
<tr>
<th>Sleep Variable</th>
<th>AD Carer</th>
<th>Other Carer</th>
<th>Non-Carer</th>
<th>X^2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tired (some-all of the time)</td>
<td>67.1%</td>
<td>57.5%</td>
<td>52.2%</td>
<td>9.80</td>
<td>0.007</td>
</tr>
<tr>
<td>Worn out (some-all of the time)</td>
<td>43.8%</td>
<td>42.3%</td>
<td>36.2%</td>
<td>6.75</td>
<td>0.034</td>
</tr>
<tr>
<td>Diagnosed Sleep Disorder</td>
<td>18.8%</td>
<td>9.3%</td>
<td>6.6%</td>
<td>18.84</td>
<td>0.000</td>
</tr>
<tr>
<td>Dissatisfied with sleep</td>
<td>23.3%</td>
<td>24.2%</td>
<td>19.2%</td>
<td>6.70</td>
<td>0.035</td>
</tr>
</tbody>
</table>

AD caregivers who were responsible for care all day, or all night, or 24 hrs were significantly more likely to report tiredness some/all of the time, compared to those with less time spent caring, after controlling for age and gender (OR = 9.76, 95% CI = 1.12–85.28).

Discussion: Unpaid care giving has a significant effect on sleep and daytime sleepiness of older New Zealanders. Caring for someone with AD increases the likelihood of reporting disordered sleep and feeling tired. Further research is required to clarify these relationships with a larger group of AD home carers and using objective sleep monitoring. Interventions are needed to improve the sleep of patients and caregiver to possibly extend the time AD patients can remain at home.

P076
ETHNICITY AND SOCIOECONOMIC DEPRIVATION ARE INDEPENDENT RISK FACTORS FOR INSUFFICIENT AND SHORT USUAL SLEEP DURATION
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Aim: Recent research has identified significant disparities between Māori and non-Māori New Zealanders in the prevalence of obstructive sleep apnoea and insomnia symptoms. This study aimed to document the prevalence of insufficient sleep and short usual sleep in Māori and non Māori adults, and to investigate whether ethnicity, sex, age and socioeconomic deprivation are independent risk factors for reporting these outcomes.

Method: A New Zealand version of the Munich Chronotype Questionnaire was mailed to a stratified random sample of 5,000 Māori and 4,100 non-Māori adults, aged 20–59 yrs, obtained from the electoral rolls (response rate = 54%). Sleep duration was calculated for the main sleep period and across the 24-hr period (TST/24 hrs) separately. Insufficient sleep was defined as a change in sleep duration ≥2 hrs between scheduled days and free days. Sleep duration was also categorised as short (<7 hrs) or normal (≥7–<9 hrs). Population prevalences were calculated by weighting the data by the actual population proportions of age, gender and ethnicity. Logistic regression models were used to identify independent risk factors for short sleep and insufficient sleep separately. Variables included in the models were ethnicity (Māori vs. non-Māori), sex, age (in decades), and socioeconomic (SE) deprivation (using NZDep06 deciles).

Results: 30% of Māori and 22.50% of non-Māori reported insufficient sleep (p < 0.0001). Independent risk factors for insufficient sleep (for both TST/24 hrs and main sleep) were age (p < 0.0001) and SE deprivation (p < 0.0001), but not ethnicity or sex. As expected, more participants reported short sleep duration on scheduled days vs. free days (main sleep: 20.52% vs. 10.81%; TST/24 hrs: 22.86% vs. 10.72%). Ethnicity and SE deprivation independently increased the risk of reporting short sleep in all models (for ethnicity, ORs ranged from 1.30–2.10; for NZDep06 ORs ranged from 1.04–1.08).

Conclusions: This study provides the first estimates of the prevalence of sleep restriction in New Zealand adults, as calculated by comparing sleep duration on scheduled days and free days. The findings suggest that sleep restriction is common in the adult population, and as for sleep disorders Māori are disproportionately affected.

P077
CHANGING RESPONSE RATES IN SLEEP HEALTH POSTAL SURVEYS
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Aim: To understand how contextual changes and specific aspects of questionnaires and research design may have contributed to declining response rates in New Zealand sleep health surveys.

Method: From 1999–2008, four population postal surveys were undertaken to investigate separate aspects of sleep health. Each study used similar methodology, seeking to recruit equal numbers of Māori and...
non-Māori participants, consistent with the Kaupapa Māori principle of equal explanatory power. The electoral roll was used as a sampling frame and extensive follow-up of non-responders was performed.

Methods: In successive surveys, there were fewer respondents in all age groups. Response rates from Māori were lower in all surveys and the percentage decline was greater than for non-Māori. Between 1999 and 2008, the response rate from the initial mail-out decreased by 50% and the proportion of the sample that were un-contactable increased by 50%. Identified societal trends included decreased currency of electoral roll address information, declining use of listed land-line telephones, numbers, and a possible increase in respondent burden. Features of the study design which may have contributed include changes in Māori leadership within the research team, increasing complexity of questions and the saliency of the different sleep research topics to potential participants.

Conclusions: The declining response rate in sleep population surveys is likely to be due to a number of factors. Additionally, the pros and cons of using the electoral roll as a sampling frame to obtain equal explanatory power between ethnic groups should be carefully considered.

P078

SLEEP QUALITY, BELIEFS AND ATTITUDES ABOUT SLEEP: A COMPARISON OF CAUCASIAN AUSTRALIAN, ZIMBABWEAN AND GHANAIAN IMMIGRANTS RESIDENT IN AUSTRALIA

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Introduction: The aim of this research was to explore ethnic differences in sleep quality as well as beliefs and attitudes about sleep in a community sample of Caucasian Australians (CAA), black immigrants from Zimbabwe (BZW) and those from Ghana (BGH), all currently resident in Australia.

Methods: Our sample consisted of 176 participants including CAA (n = 58), BZW (n = 59), and BGH (n = 59), aged between 18 to 70 years (M = 34.04 yrs, SD = 10.21). Groups were matched on age and gender, with a strong predominance of professional occupations in all groups. To be included in the study, BZW and BGH participants had to be resident in Australia for less than 15 years. BZW were resident in Australia for a shorter period (M = 3.88, SD = 2.6) compared to BGH (M = 7.25, SD = 3.9) and CAA (M = 32.83, SD = 10.1). All participants completed the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Dysfunctional Beliefs and Attitudes about Sleep (DBAS), and the SF-36 Health Survey.

Results: No statistically significant group differences were found on sleep quality, daytime sleepiness, and physical health. However, significant group differences on beliefs and attitudes about sleep (as measured by the DBAS) were found, F (10, 332) = 2.65, p = 0.04, partial eta squared = 0.7 (medium effect), with the main differences arising from BZW and BGH endorsing stronger agreement that insomnia was due to aging and chemical imbalances compared to CAA. A significant group by gender interaction effect on the DBAS was also found, F (10, 332) = 3.83, p = 0.09, partial eta squared = 0.9. BGH males held stronger dysfunctional beliefs on the ‘misattributions of the consequences of insomnia’ theme compared to BZW and CAA participants. CAA males on the other hand had more dysfunctional beliefs on the ‘perceptions of control and predictability of sleep’ theme than BZW and BGH across gender. Group differences were also found on SF-36 mental health, F (2, 170) = 2.99, p = 0.05, partial eta squared = 0.3 (small effect), with CAA reporting poorer mental health compared to the BZW and BGH participants, possibly arising from a small percentage of CAA participants who reported not working.

Discussion: BZW and BGH participants were more inclined to attribute sleep difficulties to physical rather than psychological phenomena than CAA participants. This ethnic difference on beliefs about sleep may have implications for the health education of black African immigrants, with more emphasis needed on the link between sleep and psychological problems. While previous studies (in America and New Zealand) have reported differences in sleep quality among ethnic groups, particularly those of low socioeconomic status (SES), the current study found no ethnic differences in sleep quality. This inconsistency may arise from differences in the SES levels of the participants across the studies, with no (or less) ethnic differences in sleep quality being evident in higher SES groups.

P079

DEVELOPMENT OF THE VIEWS ON SLEEP SCALE (VOSS)

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To date very little research has investigated community beliefs and attitudes about sleep. We sought to develop a new validated scale on sleep beliefs that can be used with the general community. The VOSS is a 25-item scale which was created, tapping various beliefs, attitudes, expectations, and attributions about sleep and insomnia. The items in the questionnaire were derived from many sources however, this scale drew heavily from Morin et al. (1993) DBAS Scale. All items were worded to assess people’s beliefs and attitudes about sleep in general, not their own personal sleep. A further aim was to assess the psychometric properties of the Sleep Beliefs Questionnaire (SBS), the current study found no validation of the scale had good internal consistency (α = 0.741). Based on these results the SBS is a scale measuring one single construct.

An exploratory factor analysis was conducted on the VOSS to identify underlying common factors that may organise its 25 items. The factor analysis revealed that many items loaded highly (>0.3) on more than one factor and it was concluded that the questionnaire was measuring more than one construct. Item analysis resulted in five items being omitted. The VOSS then became a 20-item scale measuring dysfunctional beliefs and attitudes about sleep. The internal consistency of the 20-item questionnaire was high (Cronbach’s α = 0.804). An exploratory factor analysis was conducted on the SBS to compare the three factors that the authors found. Results revealed that many of the items loaded highly (>0.3) on more than one factor. Reliability analysis revealed that overall the scale had good internal consistency (α = 0.741). Based on these results the SBS is a scale measuring one single construct.

The VOSS is a new 20-item scale that measures the general community’s beliefs and attitudes about sleep. The SBS is also a 20-item scale that measures the general community’s perception of positive or negative sleep behaviours. The second phase of the study will examine developmental perspectives on community beliefs and attitudes about sleep using the VOSS, SBS and other measures.


P080
DISTURBANCES IN SLEEP AND MENTAL HEALTH FOLLOWING ECSTASY USE: IS VULNERABILITY GENDER-BASED?
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The illicit drug ecstasy is classed as an entactogen for its capacity to induce feelings of closeness and intimacy towards others. Despite its growing popularity in many countries including Australia and New Zealand, ecstasy users report a number of adverse effects following use including mood and sleep disturbance. Several questionnaire studies have noted that ecstasy users report sleep disturbance and this is supported by laboratory studies showing altered sleep architecture in users. However, to date there has been no evaluation of whether male and female users are equally affected, nor has the relationship between sleep complaints and mental health functioning been explored. The present study investigated sleep parameters using the Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS), as well as mental health using the mental health component of the SF-12 in a sample of ecstasy users (n=268). 145 participants were male and 123 were female, and the majority of participants were polydrug users (87.3%). The aim of the study was to evaluate whether the patterns of ecstasy use and reported levels of sleep and mood disturbance differed between males and females. In addition, this study also examined the relationship between mental health functioning and sleep problems in ecstasy users. Male ecstasy users reported taking larger amounts of ecstasy compared with female users, but frequency of use did not differ between males and females. Despite this, female users were more likely to report increased harm following ecstasy use. Both male and female polydrug and ecstasy only users had mean PSQI scores >5, suggesting that they were on average experiencing clinically significant sleep disturbance. In addition, female users reported significantly decreased mental health compared to males, and there was a moderate correlation between mood and sleep quality, with those reporting poorer mental health having increased sleep disturbance (r = 0.329). These findings suggest that: sleep disturbance is commonly experienced by ecstasy users; there are differences between males and females; and, there is a link between sleep and mood disturbance in ecstasy users. Increased public awareness about the potential adverse effects of ecstasy use is warranted and combined treatment of mood and sleep problems may be required in ecstasy users.

P081
THE IMPACT OF COMORBID INSOMNIA IN PEOPLE WITH MENTAL DISORDER
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Objective: To determine whether insomnia independently impacts on functioning and use of health services in individuals with a mental disorder.

Method: Cross-sectional data from the Australian National Survey of Mental Health and Wellbeing 2007 was analysed. Insomnia, functioning and health service use were entered into logistic regression models.

Results: Of 883 respondents aged 16 to 65 with a past-month mental disorder, 17.6% reported insomnia compared to less than 4% in the rest of the population. Insomnia was most common in affective disorders, followed by anxiety disorders, and was least frequent in substance use disorders. Insomnia was associated with increased disability, more days out of role, poor quality of life, the use of medications for mental health, and the use of health services. These associations were diminished by the addition of the covariates, in particular, level of psychological distress. The only independent additional impact of insomnia was found in those with anxiety disorder, where it increased the risk of disability days.

Conclusion: Insomnia is common in mental disorders and strongly related to the level of psychological distress. Insomnia appears to have a differential impact across disorders, leading to more disability in those with anxiety disorders but not those with affective disorders. Comorbid insomnia does not lead more health service in those with anxiety disorders despite this additional impact.

P082
NIGHT SHIFT WORK AND DROWSY DRIVING IN AUSTRALIAN NURSES
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Excessive sleepiness during wake time is common in night shift workers due to acute and chronic sleep loss, and disruption of the circadian system. Extended duration work shifts and night shift work are associated with increased risk of motor vehicle crashes (MVCs) and injuries. A significant impediment to assessing the incidence of drowsy driving and the efficacy of sleepiness countermeasures has been the lack of practical, real-time technologies that can monitor drowsiness during on-road driving. The aim of this study was to assess the extent of sleepiness and drowsy driving experienced during the commute to and from work. Fifteen hospital-based nurses (1 M, 14 F; mean age 38 years) were assessed for two consecutive weeks, one week with only day shifts or days off, and one week that included at least three night shifts. Sleep habits were monitored using daily sleep diaries and wrist actigraphy. Driving behaviour, on-road driving events and subjective sleepiness levels were assessed before and after each commute. Drowsiness levels were monitored during each driving commute to and from work using the Optalert™ Drowsiness Measurement System (ODMS). ODMS uses infrared reflectance oculography to measure eye and eyelid movements, and provides an objective measure of drowsiness levels through the Johns Drowsiness Scale (JDS; range 0–10). Participants reported lower sleep quality and higher levels of sleepiness during episodes of night shift work compared to day shifts and days off. Self-rated sleepiness and JDS scores were higher during post-shift commutes compared to pre-shift commutes. Compared to commutes after day shifts, participants showed a higher incidence of JDS scores above cautionary (JDS ≥4) and critical (JDS ≥5) levels while driving home after night shifts. These findings demonstrate that night shift workers experience high levels of drowsiness while driving home after night-shifts, thus placing themselves and others at increased risk of MVCs.
P083
TIMING OF SLEEP AND ITS RELATIONSHIP WITH THE ENDOGENOUS MELATONIN RHYTHM
IN NEW ZEALAND ADULTS: CORRELATE WITH NEUROCOGNITIVE DEFICITS
AND SUBJECTIVE SLEEPINESS DURING 40 HOURS OF EXTENDED WAKEFULNESS

A QUESTIONNAIRE STUDY

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A New Zealand version of the Munich Chronotype Questionnaire was mailed to a stratified random sample of 5,000 Māori and 4,100 non-Māori adults, aged 20–59 years, obtained from the electoral rolls (response rate = 54%). Definitions for ASPD and DSPD were based on a combination of self-reported sleep onset and wake times, chronotype, and a desire to change their current sleep schedule. Population prevalence estimates were calculated by weighting the data by the actual population proportions of age, gender and ethnicity. Logistic regression models were used to identify independent risk factors for ASPD and DSPD separately. Variables included in the models were ethnicity (Māori vs. non-Māori), sex, age (in decades), and socioeconomic (SE) deprivation (using NZDep06 deciles).

Results: The prevalence of DSPD varied from 1.5% (Definition A: sleep onset after 2 am, wake up after 11 am) to 8.9% (Definition E: late type who would like to sleep earlier), with no differences by ethnicity or sex. DSPD prevalence was greatest in the 20–29 yr age group (DSPD (A): 4.3%; DSPD (E): 15.23%). The prevalence of ASPD ranged between 0.25% (Definition A: sleep onset before 9 pm, wake up before 5 am) and 7.13% (Definition E: early type who would like to sleep later). Prevalence was higher among men (ASPD (E): 8.80% vs. 5.56%, p < 0.004). The prevalence of ASPD was highest in the 50–59 yr age group (ASPD (A): 1.61%; ASPD (E): 1.08). Independent risk factors for DSPD were younger age and increasing SE deprivation. After controlling for ethnicity and SE deprivation, being male and older independently increased the risk of having ASPD.

Conclusions: This study suggests that if ASPD and DSPD are defined based on sleep timing alone then the prevalence in the New Zealand population may be as small as 1.5% and 0.25% respectively. Criteria that take into account self-rated chronotype and the desire to change their sleep schedule may provide a more accurate reflection of the patients who might seek clinical services if they were available.

P086
WAKE EEG MARKERS DETERMINED BY DETRENDED FLUCTUATION ANALYSIS
CORRELATE WITH NEUROCOGNITIVE DEFICITS AND SUBJECTIVE SLEEPINESS
DURING 40 HOURS OF EXTENDED WAKEFULNESS

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Introduction: Chronic sleep restriction and sleep disturbance is a common societal problem that exposes individuals to an increased risk of injuries and accidents due to impaired neurocognitive functioning. Changes in waking electroencephalographic (EEG) activity following sleep deprivation have been correlated to sleepiness and worsening performance. In this study, we evaluate the use of detrended fluctuation analysis (DFA) of the resting EEG as a novel marker of impaired neurocognitive performance.

Methods: Healthy subjects attended the sleep laboratory and completed a 3-day/night protocol that included two nights of PSG sleep assessment (night 1: 8 h time in bed baseline; night 2: 8 h recovery) and 40 h of extended wakefulness in between. Performance testing with the psychomotor vigilance task (PVT) and a simulated driving task (AusEd) occurred every 2 hours during wake. In addition, subjective sleepiness was assessed using the Karolinska sleepiness scale (KSS).

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Resting awake EEG was recorded during a Karolinska drowsiness test (KDT) prior to each 2-hourly assessment. The EEG (Cz/A1 derivation) of both ‘eyes-open’ and ‘eyes-closed’ conditions of the KDT was analysed by DFA. DFA quantifies fluctuations in the EEG and yields scaling exponents (ScE) as a measure of the alertness level of the subject at the time of the test.

Results: We assessed 9 healthy subjects (8 male, 1 female) without sleep disorders or significant co-morbidities (age 28 ± 4 yrs, BMI 23 ± 3 kg/m²). We found significant correlations within each subject between DFA ScE and the reciprocal slowest 10% of reaction times on the PVT (r = -0.476, p = 0.0001/r = -0.365, p = 0.0001), steering deviation during the AusEd simulated drive (r = 0.614, p < 0.0001/r = 0.476, p = 0.0001); and subjective sleepiness (r = 0.398, p < 0.0001/r = 0.377, p < 0.0001) during ‘eyes-closed’ portion of the KDT/entire KDT (‘eyes-open’ and ‘eyes-closed’ conditions) respectively.

Discussion: Increased DFA ScE was correlated with worse performance and greater sleepiness in these subjects during 40 hrs of extended wakefulness. DFA may provide a useful EEG marker of neurocognitive performance, and explain the inter-individual variability in response to sleep loss. Further, DFA may be a potential tool to identify those individuals at greater risk of vigilance failure such as impaired driving.

**P087**

**SLEEP INERTIA AFTER NAPS IS NOT MORE SEVERE WHEN WAKING FROM SLOW WAVE SLEEP**

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Sleep inertia is thought to be affected by many factors including the homoeostatic pressure for sleep, the time in the circadian phase when waking occurs, and the sleep stage woken from. Although findings are not consistent, some research suggests that waking from slow wave sleep (SWS) may result in the most severe and prolonged sleep inertia. We aimed to determine whether sleep inertia was affected by the sleep stage at waking after short naps.

The present study design involved manipulating the length of a nap to vary the likelihood of participants waking from SWS, and involved two within-subject protocols. Protocol 1 (P1) consisted of naps of 20, 40 and 60 min ending at 0200 hr after ∼20 hrs of wakefulness (n = 12, all male, mean age 25.1 yrs). Protocol 2 (P2) incorporated identical length naps ending at 1200 hr after ∼30 hrs of wakefulness (n = 12, all male, mean age 23.6 yrs). Both protocols included a control condition of no nap. At either 0200 or 1200 hr, immediately after waking, participants completed a test battery including a subjective sleepiness scale (KSS) and a 4-min 2-Back Working Memory Task (WMT) every 15 min for the next hour.

Results from mixed model analyses of variance indicate participants felt significantly less sleepy after a nap compared to when no nap was taken (P2 only, F2,50 = 5.28, p = 0.0094). Immediately after waking, mean reaction time on the WMT was slower if woken from Stage 1 and 2 sleep combined (S1/S2) or SWS (P1 F3,114 = 2.34, p = 0.0227, P2 F3,132 = 5.65, p < 0.0001) compared to if already awake. The number of correct responses was smaller if woken from S1/S2 or SWS (P1 F3,117 = 3.96, p = 0.0003, P2 F3,130 = 6.23, p < 0.0001) than if already awake. Similarly, the number of omissions was greater if woken from SWS than if already awake (P2 only F3,132 = 7.50, p < 0.0001). In P2, at 1230 hr the number of correct responses was greater if woken from SWS than if already awake. At 1245 hr the number of correct responses was greater if woken from S1/S2 or SWS, and the number of omissions was smaller if woken from SWS than if already awake.

Performance was not more impaired when participants woken from SWS compared to when woken from S1/S2. Under higher homeostatic pressure, a benefit of a nap was apparent 30 min after waking.

**P088**

**DISTINCTIONS IN SLEEP-WAKE BEHAVIOUR IN YOUNG PATIENTS WITH BIPOLAR DISORDER AND ADHD**

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Introduction: The early stages of bipolar disorder (BPD) and attention deficit hyperactivity disorder (ADHD) share a number of common traits, often resulting in misdiagnosis. Accurate diagnosis at the earlier stages of symptom presentation will allow for engagement in early interventions targeted to the specific disorder, thereby improving management and reducing severity of symptoms. In order to identify potential distinct biomarkers between these two disorders, we have first examined sleep-wake patterns using actigraphy.

Methods: N = 7 patients with ADHD (7 m, mean age 18.43 ± 5.59) and n = 10 patients with BPD (6 m, mean age 23.13 ± 4.08) were recruited from 2 community based mental health clinics. All participants completed at least 2 weeks of actigraphy and sleep diaries. T-tests were used to examine differences in sleep-wake variables between the two groups.

Results: There was no significant difference in the average sleep duration between the two patient groups (BPD: 568.3 ± 59.3 mins vs ADHD: 530.7 ± 55.2 mins). A greater amount of WASO (t = −2.31, P = 0.058) was seen in patients with ADHD in comparison to those with BPD. The patients with BPD experienced a mixture of short and long sleep durations throughout the assessment period. Furthermore, there was a trend for patients with ADHD to have greater activity levels during wake periods: 506.0 ± 129.6 mins versus 399.7 ± 94.9 mins (t = 1.96, P = 0.069).

Discussion: Even in this small sample, there was evidence of differences in sleep-wake behaviour between patients with BPD and ADHD. A decline in the stability of sleep duration in patients with BPD may be suggestive of underlying neurobiological mechanisms, together with reports of circadian disturbance that are generally observed in BPD. An elevation in activity levels during wake and sleep periods in patients with ADHD would appear to be characteristic of symptoms of this disorder.

**P089**

**QUANTIFYING CIRCADIAN DISRUPTION IN AN ELDERLY NEUROPSYCHIATRIC PATIENT POPULATION**

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Introduction: Circadian changes are common among the elderly population, especially in those with neurodegenerative and psychiatric disorders. Early detection and intervention may prevent or delay progression of symptoms. Current techniques in quantifying circadian rhythms, however, are not intuitive to interpret and are often performed under strictly controlled conditions. Social zeitgebers are often one of the determinants of habitual sleep timing, but are often controlled for in these techniques. The current study aimed to use actigraphy data to develop a clinical tool for quantification of circadian disturbance.

Method: Nine elderly participants (mean age ± SD = 80.0 ± 7.0, 4 M, 5 F) considered to be at risk of dementia by virtue of having cognitive dysfunction...
impairment or depression were recruited from an out-patient psychiatry clinic. Participants completed 2 weeks of actigraphy with sleep diary, Pittsburgh Sleep Quality Index (PSQI), Horne-Östberg questionnaire (HO) and dim light melatonin onset assay (DLMO). Circadian rhythm disturbance index (CRDI) and circadian phase index (CPI) were generated based on sleep onset, offset time and total sleep time (TST) against a predefined normative sleep patterns in this age group. Stability index (SI) was based on night-to-night variability against individual mean.

Results: CRDI for sleep onset correlated with PSQI sleep efficiency (r = 71, p < 0.05), sleep offset correlated with PSQI sleep disturbances (r = 86, p < 0.05), and TST correlated with both PSQI sleep efficiency (r = 68, p < 0.05) and sleep disturbances (r = 75, p < 0.05). CPI for sleep offset correlated with HO diurnal preference (r = 87, p < 0.05), and DLMO time (r = 73, p < 0.05); however these associations were not observed with sleep onset (p > 0.05). SI for sleep onset and offset were not correlated with PSQI (p > 0.05), however SI for TST correlated with PSQI sleep efficiency (r = 68, p < 0.05) and global PSQI score (r = 63, p < 0.05).

Discussion: CRDI identified disturbed circadian rhythm with reference to the age-matched population norms. CPI and SI provide a more in depth description to the sleep-wake behaviour when the circadian rhythms significantly deviated from the population norms. CPI classified sleep-wake behaviour into advanced, delayed or neither patterns. It was correlated with diurnal preference and DLMO timing. SI captured irregularity in sleep-wake behaviour and classified sleep-wake pattern into regular or chaotic types.

P090
THE INTERACTION EFFECT OF PRIOR WAKE AND CIRCADIAN PHASE ON NEUROBEHAVIOURAL FUNCTIONING IS SLEEP DEPENDENT
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Introduction: The 24/7 society demands consistent task performance around the clock, despite the fact that staying awake through the night impairs neurobehavioural functioning and consequently hinders task performance. It is known, from the interaction of prior wake and circadian phase, that the nocturnal impairment of neurobehavioural functioning could be countered by short prior wake, when a habitual dose of prior sleep is combined with minimal chronic sleep restriction. It is unknown if the effectiveness of this countermeasure (i.e., short prior wake) is sleep dependent or alters when a low prior sleep dose is combined with high chronic sleep restriction. This question is critical as nightshift personnel often obtain a low sleep dose prior to a shift and perform under high chronic sleep restriction. Using a novel methodology, this study is the first to examine if the interaction effect of prior wake and circadian phase on neurobehavioural functioning is sleep dependent.

Methods: 27 young healthy males were scheduled to 7 x 28 h sleep/wake cycle in a time isolation laboratory. 13 participants were in a control condition where a 9.3 h sleep opportunity was given per 28 h cycle (i.e., habitual prior sleep and minimal chronic sleep restriction); 14 participants were in a sleep restricted condition where a 4.7 h sleep opportunity was given per cycle (i.e., short prior sleep and high chronic sleep restriction). All participants completed a 10 min Psychomotor Vigilance Task (PVT) every 2.5 h during each wake period. Neurobehavioural functioning was indexed by mean PVT Reciprocal Response Time (RRT). Circadian phase was estimated from core body temperature.

Results: A mixed-effects regression using 3 universities, Prior Wake, Circadian Phase and Condition to predict RRT yielded a significant interaction between the 3 terms (F(1,147) = 1.61, p = 0.027).

Conclusion: The interaction effect of prior wake and circadian phase on neurobehavioural functioning was sleep dependent. When a habitual prior sleep dose was combined with minimal chronic sleep restriction, nocturnal neurobehavioural impairment was more present. When a less than habitual dose of prior sleep was combined with high chronic sleep restriction, nocturnal impairment was evident as early as 2 h awake. Thus, two pre-requisites for short prior wake to be an effective countermeasure are habitual dose of prior sleep and minimal chronic sleep restriction.

P091
COGNITIVE COMPONENTS OF SIMULATED DRIVING AND THE IMPACT OF SLEEP LOSS ON PERFORMANCE
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Aim: Driving involves a number of dissociable cognitive processes that can be assessed by neurocognitive tests, such as processing speed, vigilance and executive functioning. This exploratory study examined simulated driving and neurocognitive performance after one night of sleep deprivation, and investigated the association between neurocognitive outcomes and driving performance measures.

Methods: Nineteen professional drivers (age = 45 ± 3.1) underwent two randomized experimental sessions, one in a non-sleep deprived state, and one after 24 hours of sleep deprivation. A simulated driving task (AustEd©), the Psychomotor Vigilance Task (PVT), and neurocognitive tasks selected from the Cognitive Drug Research (CDR) computerized assessment battery (simple and choice RT, Stroop, Digit Symbol Substitution Task, Digi Vigilance) were administered in both sessions. Mixed-effects ANOVA was performed to examine the effect of sleep deprivation versus non-sleep deprived on performance measures. The neurocognitive performance measures that were significantly affected by sleep deprivation were then added as a covariate to determine their predictive value to driving performance measures (lateral lane position, speed variation, braking RT).

Results: Simulated driving performance and neurocognitive measures of vigilance and reaction time were significantly impaired after sleep deprivation (F ≥ 5.1, P ≤ 0.05), whereas information processing speed and executive functioning were not significantly affected (F ≤ 3.4, P ≥ 0.08). The PVT was the only task responding significantly to sleep deprivation that provided predictors of driving performance. PVT lapses (RTs > 500 ms) predicted variability in driving speed (F = 5.1, P = 0.04). PVT fastest 10% of RT predicted variability in driving speed (F = 6.4, P = 0.02).

Conclusion: Measures of driving-related performance, vigilance and reaction time performance were negatively affected by sleep loss. PVT performance significantly predicted aspects of driving performance. Vigilance and reaction time are key components of driving, which may...
be associated with sleepiness-related driving impairment. The generalizability of these findings to on-road driving performance remains to be investigated.

P092

COMPARING WEEKDAY AND WEEKEND SLEEPING PATTERNS IN A YOUNGER POPULATION WITH MOOD DISORDERS

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Introduction: Healthy adolescents who work or attend school particularly demonstrate differences in sleep-wake patterns on weekdays compared to weekends. Many adolescent patients with mood disorders are unable to or do not maintain a strict school or work schedule during the week. Therefore, it is likely to have a lack of scheduled routine and so sleep behavior would potentially not be different between weekend and weekday nights. Thus, the aim of this study was to compare weekday and weekend sleep patterns in a young group of patients with mood disorders.

Methods: N = 35 participants with mood disorders (13 M, 22 F; aged 14–30 y) completed 2 weeks of actigraphy (Actiwatch 64, Mini-Mitter, OR) and sleep diary. Paired t-test was employed to investigate changes in sleep onset/offset times and total sleep time during the weekdays and weekends. Weekday nights were the average sleep onset/offset times from Monday—Thursday and weekend nights were the average of Friday and Saturday. Sunday was excluded from the analysis due to a carry over effect from the weekend.

Results: A significant difference was found for the average weekday and weekend sleep duration with the participants sleeping longer on the weekends (p = 0.04). The average weekday sleep duration was 8.9 hours ± 0.94 minutes and the weekend average was 9.4 hours ± 93.3 minutes. There was no significant difference in the timing of sleep onset time between the weekdays versus the weekends (p > 0.05) and a trend for later sleep offset time during weekends (p = 0.056).

Discussion: In the present study, we found longer sleep durations on the weekend than the weekdays. This finding is consistent to what has been reported in healthy adolescent populations. We speculate that in this age group, independent of health status, any opportunity to extend sleep is taken.

P093

SLEEP DISORDERED BREATHING DOES NOT AFFECT THE AUTONOMIC CONTROL OF HEART RATE DURING SLEEP IN PRIMARY SCHOOL AGED CHILDREN

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Introduction: Childhood sleep disordered breathing (SDB) has detrimental effects on cardiovascular health, evidenced by the development of hypertension, increased blood pressure variability and decreased nocturnal blood pressure dipping. During sleep, heart rate variability (HRV), which reflects autonomic nervous system activity, may signal the onset of cardiovascular effects. We aimed to determine whether HRV was altered in primary school aged children with various severities of SDB compared to controls.

Methods: 60 children (7–12 y) referred for assessment of SDB and 20 age-matched controls with no history of snoring were studied. All children underwent overnight polysomnography (PSG). Subjects were grouped according to their obstructive apnoea hypopnoea index (OAHI): primary snoring (PS, OAHI ≤ 1 event/h), mild OAHI (OAHI > 1–5 events/h) and moderate/severe OAHI (M/S; OAHI > 5 events/h). All 30s PSG epochs containing ECG artefact, arousals or movements were removed. HRV was analysed by power spectral analysis during Wake, NREM1&2, SWS and REM, using Chart software (ADInstruments, Sydney, Australia). Statistical analyses were performed using Kruskal-Wallis one way ANOVA on Ranks and Dunn’s Method post hoc analyses.

Results: There were no significant differences between groups during any sleep stage for low frequency (LF), high frequency (HF), total power, or the LF/HF ratio. LF power during SWS was significantly lower than during NREM1&2 in the PS, M and M/S groups and also during REM in the M/S group. There were no significant differences in HF power between sleep stages in any group. Total power during SWS was significantly lower during NREM1&2 in all groups, the LF/HF ratio was significantly lower during SWS than during Wake and REM, in Control and M, LF/HF during NREM1&2 was lower than during Wake, in PS, M and M/S, LF/HF was lower during SWS than NREM1&2.

Discussion: Our findings suggest that the autonomic nervous system regulation of heart rate during sleep in children remains unaffected by SDB. We speculate that the blood pressure changes in children with SDB occur independently of major changes in autonomic control of heart rate. Rather, autonomic control of childhood heart rate during sleep is dominated by sleep-related influences which overshadow any effects of SDB.

P094

IMPACT OF ACUTE CHANGES IN CPAP ON VENTILATORY INSTABILITY IN PATIENTS WITH HEART FAILURE

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Introduction: Cheyne-Stokes respiration (CSR) is common in patients with congestive heart failure (CHF), and is a powerful independent predictor of mortality. In an attempt to avert its adverse health outcomes, patients with CSR are treated with continuous positive airway pressure (CPAP), a treatment which is effective in only 50% of patients. The reasons for the ineffectiveness of CPAP in non-responders, and the mechanism/s by which CPAP stabilises breathing, remain poorly understood. In the current study, we assessed whether our new method to quantify the severity of ventilatory instability, called ‘loop gain’ (LG), provides insight into the effectiveness of CPAP in resolving CSR. We hypothesised that CPAP has limited capacity to reduce LG in patients with CSR, and it stabilises breathing only when LG is near the threshold for stability (LG < 1). Accordingly, we aimed to quantify the impact
discharge pattern (e.g. inspiratory tonic) were identified. 7 were inspiratory loads of 5, 10, 15 and 20 cmH2O/l/s for 1 minute following incremental CPAP titrations on ventilatory instability (loop gain) during CSR.

Methods: A retrospective analysis was performed in six CHF patients with CSR who were administered CPAP during their routine clinical assessment. To be included in the study the epochs of CSR had to occur during stage 2 non-REM sleep and to contain sufficient cycles of CSR to allow LG to be estimated during the 3 cycles immediately preceding an increase in CPAP, and during 3 cycles afterwards. Linear regression was used to identify any potential impact of initial CPAP level, initial LG, and cycle duration (surrogate of left ventricular function).

Results: The inclusion criteria limited the number of CPAP transitions available for analysis to 16. The average CPAP level prior to the included transitions was 7.4 cmH2O (range 4.5–10.6), and each CPAP transition was 1.0 cmH2O. CPAP increments reduced LG from 1.15 ± 0.03 to 1.09 ± 0.04. Overall, CPAP reduced LG by 0.064 ± 0.014 per cmH2O (p < 0.001), with no significant impact of initial LG, starting CPAP level, or cycle duration. CPAP increments of 1 cmH2O terminated CSR in just 3 cases in which LG ranged from 1.002–1.055.

Discussion: CPAP diminishes LG in heart-failure patients with Cheyne-Stokes respiration. Based on our evidence that LG falls by 0.64 when 10 cmH2O of CPAP is administered, the use of CPAP is likely to be limited to resolving CSR in patients with LG < 1.6. For highly unstable CHF patients, other treatment modalities will be required.

P096

UPPER AIRWAY STRUCTURE AND LUNG VOLUME IN MILD-MODERATE OBSTRUCTIVE SLEEP APNOEA

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Introduction: The majority of patients with obstructive sleep apnoea (OSA) have a mild-moderate form of the disease. It is well recognised that these patients manifest heterogeneous clinical and polysomnographic features. The mechanisms contributing to obstruction in these patients is likely to be varied.

Methods: We selected patients with specific phenotypes of mild-moderate OSA based on in-lab polysomnography. The patients selected had either:

1. “Supine Isolated OSA” with a supine:non-supine ratio of respiratory events of >2:1, with a non-supine apnoea-hypopnoea index (AHI) of <5/hr.


Patients underwent assessment including:

• Anthropomorphic measurements.
• Lung volume determination while supine and in the right lateral position using a gas dilution technique (oxygen wash-in and washout).
• Upper airway imaging while supine and in the right lateral position via a Toshiba 320-slice dynamic computed tomographic (CT) scanner.

Results: 2 Patients have been examined to date, one in each arm. The “Supine Isolated” subject had no change in airway parameters while lung volumes reduced significantly from seated (2.16 L) to lateral (1.77 L) to supine (1.55 L).

The “REM Isolated” subject had a significant change in upper airway shape from supine to lateral position, adopting a more circular shape in the lateral position. While lung volumes did not significantly change seated to lateral (1.589 L) to supine (1.558 L).

There are no significant trends in terms of anthropomorphic measurements at this early stage.

Conclusion: Early data suggests that the mechanisms contributing to specific polysomnographic phenotypes of OSA are varied and include both body position dependent lung volume changes and upper airway shape and size.

P097

THE INFLUENCE OF BODY MASS INDEX (BMI) ON THE LUNG VOLUME CHANGE FROM LATERAL TO SUPINE POSITION

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Introduction: Lung volume has recently been recognised to be an important contributor to upper airway collapse and is therefore thought to be important in OSA. Increasing lung volume by 600–700 mL has been found to reduce AHI and decrease the CPAP required to treat OSA.
Functional Residual Capacity (FRC) is known to be reduced when healthy weight individuals move from the sitting to supine position, but is partially restored in the lateral position. In contrast, morbidly obese individuals have been found to have no change in FRC from supine to the lateral position. Whether there is a change in lung volume from supine to lateral position in non-morbid obesity is not clear. Many individuals with OSA are non-morbidly obese, and lung volume changes from supine to lateral position in such individuals may be an important determinant of change in OSA severity with body position. We therefore aimed to determine whether the change in FRC from the supine to lateral position is related to BMI in non-morbidly obese individuals.

Methods: 15 healthy subjects with no cardio-respiratory disorders and a range of BMIs were studied. Both individuals with and without OSA participated. After measurement of the height, weight and supine sagittal abdominal diameter, a full face mask was attached and lung volumes were measured with the multiple breath helium dilution technique three times in both the supine and the right lateral position in a random order.

Results: Data were obtained in 13 subjects aged 43 ± 3 years. Their BMIs ranged from 18.8 to 31.0 with a mean of 25.4 ± 0.16 kg/m². FRC fell from 3.30 ± 0.16 L in the supine position to 2.90 ± 0.13 L supine (p = 0.05). There was no significant relationship between BMI and change in FRC from supine to lateral position (linear regression p = 0.6, r² = 0.03).

Conclusions: There is no association between BMI and change in lung volume from supine to lateral position in the BMI range studied (18.8 to 31.0). Further data from individuals with non-morbid obesity are required to determine the BMI at which lung volume changes with body position no longer occur.

P098

IMPAIRED CORTICAL RESPONSE TO A RESPIRATORY STIMULUS IN UNTREATED SEVERE OBSTRUCTIVE SLEEP APNOEA

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Introduction: The pathogenesis of obstructive sleep apnoea (OSA) is thought to be multifactorial and a deficit in sensory processing of respiratory stimuli has been proposed as a possible contributor. Respiratory Evoked Potentials (RREP) are the averaged cortical response to a respiratory stimulus; the early components (N1, P1) are thought to reflect arrival of afferent information at the somatosensory cortex. Although previous studies have examined RREPs in OSA, this study is unique in that it examines the RREP in response to inspiratory resistive loads of varying intensity, spanning inconsistent findings, this study is unique in that it examines the RREP in response to inspiratory resistive loads of varying intensity, spanning the threshold of conscious detection. This may be important as impaired detection and response to minor upper airway threat may lead to worsening collapse which is difficult to remedy.

Methods: Seven untreated severe OSA patients (all with AHI > 30, SpO2 < 90% for >5% of total sleep time) and 5 age and gender matched healthy controls participated. Participants were awake, seated and had EEG and EOG recorded (Fz, Cz, Pz referenced to linked ears). They wore a nasal mask connected via a non-rebreathing valve and tubing to a resistive loading manifold, located in a room adjacent to the participant. Various resistive loads (approx. 0, 1, 2, 2.2, 3, 3.0, 6.2 cmH2O/L/sec), as well as manifold occlusion were presented approximately 90 times each during mid-inspiration, every 2–4 breaths and in a random block design. Participants were cued prior to stimulus presentation and signalled conscious detection (yes/no) with a button press.

Results: The early positive RREP peak (P1(Cz)) increased in amplitude with increasing load magnitude (p = 0.018). There was a trend for reduced P1 amplitude in OSA subjects vs. controls. Also, for the lower resistive loads (1.2, 2.2, 3.0 cmH2O/L/sec) mean P1 amplitude appeared to increase with load magnitude for control but not OSA participants.

Conclusion: These preliminary results suggest impaired sensory processing of respiratory stimuli in OSA, such that OSA patients may have difficulty distinguishing varying respiratory loads of low intensity. Further data collection is underway, including examination of whether treatment eliminates any impairment.

P099

THE EFFECT OF ABDOMINAL COMPRESSION ON OBSTRUCTIVE SLEEP APNOEA SEVERITY

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Background: Obstructive sleep apnoea (OSA) is a common respiratory disorder that is particularly prevalent in the obese male population. Increased intra-abdominal pressure, also common in obese males, may reduce upper airway (UA) ‘stretch’ during sleep due to cranial displacement of the diaphragm and interdependent intrathoracic structure. A recent study showed that abdominal compression increased upper airway collapsibility during sleep in obese male OSA patients. The purpose of this study was to determine the effect of abdominal compression on OSA severity.

Methods: Thirteen middle-aged (51.3 ± 3.1 years), obese (31.2 ± 1.0 kg m⁻²) male OSA patients participated. Patients wore a nasal mask fitted with a pneumotachograph. Two balloon catheters were used to assess gastric and oesophageal pressures (Pp, Poo). UA resistance (RUA) was determined from airflow and mask-epiglottic pressure, while transdiaphragmatic pressure (Pdi) was calculated from Pp - Poo. Abdominal compression was achieved via inflation of a pneumatic cuff wrapped around the abdomen. Three cuff conditions were examined: deflated (D), intermediate (I) and maximum (M) level believed tolerable during sleep. Cuff pressure was changed in random order every 10 min irrespective of stage sleep, and sleep posture remained fixed within each patient. AHI during stage 2 sleep was calculated as the total number of respiratory events divided by total sleep time in which there was at least 5 min (10 epochs) of stage 2 sleep. Pp, Poo and RUA were calculated breath-by-breath for each cuff state during periods of stable stage 2 sleep.

Results: Abdominal compression significantly increased Pp, (D: 11.2 ± 1.7, I: 15.4 ± 1.9 and M: 18.6 ± 2.1 cmH2O, p < 0.001) and Poo (D: 4.5 ± 2.2, I: 7.5 ± 2.7 and M: 9.9 ± 2.8 cmH2O, p < 0.001). While not statistically significant, there was a strong trend for an increase in AHI with abdominal compression (D: 35.0 ± 7.8, I: 37.5 ± 9.7 and M: 49.9 ± 6.9 events h⁻¹), cuff condition, p = 0.055). RUA was not significantly different between cuff states (D: 13.7 ± 3.1, I: 12.0 ± 3.4 and M: 15.4 ± 5.6 cmH2O L⁻¹ s⁻¹, cuff condition, p = 0.92).

Conclusion: These preliminary data suggest that abdominal compression may increase OSA severity.
P100
QUANTIFICATION OF NECK TISSUE VIBRATION DURING SIMULATED SNORING
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Introduction: We have previously shown relationships between snoring and carotid intima-media thickness (IMT) in humans, and demonstrated induction of carotid endothelial dysfunction with snore-like pericarotid tissue vibration energy in rabbits. The aim of the present study was to develop methodology for non-invasive measurement of snore related peri-carotid tissue vibration energy in humans.

Methods: Six supine, healthy, awake subjects (4 females, 2 males; age = 31 ± 4 yrs [mean ± SD]; neck circumference = 35.9 ± 5.2 cm; BMI = 24 ± 3.3 kg/m²) performed 5 individual simulated inspiratory snore sounds (SS) at three targeted loudness levels (room sound level meter at 10 cm distance; soft = 55–65 dB, medium = 65–75 dB and loud = 75–85 dB). Simultaneously, tissue vibrations were recorded (sample rate 10 kHz) using a calibrated (gravitational units, g) lightweight, 3-dimensional-axis (3D) accelerometer (range: ±1.5 g, size: 3 mm × 5 mm × 1 mm; weight: 30 mgm) taped to the skin surface of the subject’s neck approximately at the level of the left carotid bifurcation. Signals from each accelerometer axis were analyzed (power spectral analysis) in the frequency domain for peak power and then expressed as a single calculated resultant vector using 3D vector analysis. Individual snore data were pooled for each subject and condition.

Results: SS was associated with peak tissue vibration power at 47.8 ± 0.2 Hz for soft snores, 57.5 ± 1.0 Hz for medium snores and 71.4 ± 4.5 Hz for loud snores (all p < 0.0001; ANOVA, Tukey’s Multiple Comparison Test). Log peak power increased significantly from −3.56 ± 1.01 g² for soft snores to −2.75 ± 0.89 g² for medium snores and −2.09 ± 0.85 g² for loud snores (all p < 0.0001).

Conclusion: During SS in humans, vibrations can be detected and quantified at the skin surface of the neck and demonstrate increased peak power and frequency levels according to the loudness of the sound generated. We conclude that 3D accelerometer measurement provides a methodology for quantifying snoring associated tissue vibrations.

P101
METHODOLOGICAL ISSUES IN MEASURING CRITICAL CLOSING PRESSURE (Pcrit) TO ASSESS UPPER AIRWAY COLLAPSIBILITY
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Introduction: The pharyngeal critical closing pressure (Pcrit) is becoming a popular metric to describe the collapsibility of the human upper airway. It is calculated by extrapolating the linear relationship that exists between inspiratory flow (Vi) and airway pressure (Pmask) for flow limited breaths to derive the airway pressure at which flow ceases (= Pcrit). The within-breath profile during flow-limitation can be variable, often with a high peak transient followed by a plateau. Hence the value of Pcrit could vary, depending on whether peak flow (Vi peak) flow at the mid point (Vi mid) or mean flow (Vi mean) is used for the extrapolation. The aim of this study was to determine the effect on Pcrit of using these different flow values.

Methods: The studies were performed under general anaesthesia to ensure a stable hypotonic airway. Pressure-flow assessments were obtained in ten healthy volunteers (7 male, aged 38 ± 11 yrs). Anaesthetic depth was sufficient to abolish upper airway muscle activity whilst maintaining spontaneous breathing. Pcrit was calculated using Vi peak, Vi mid and Vi mean. Comparisons were made between the three methods using repeated measures ANOVA.

Results: Pcrit calculated using Vi peak (~1.2 ± 0.9 cmH2O, (mean ± SD) was significantly more negative than when calculated using Vi mid (~0.2 cm ± 0.4 cmH2O) (p = 0.001). Neither measure was significantly different to Pcrit calculated using Vi mean (~0.5 ± 0.3 cmH2O).

Discussion: The choice of method of measuring inspiratory flow can alter Pcrit by up to 1.0 cmH2O in the same individual. However, this difference may be clinically insignificant, being less than the reported difference in Pcrit between non-apnoeic snorers and obstructive sleep apnoeics1.

Reference:

P102
CARDIOVENTILATORY COUPLING DURING SLEEP: ASSOCIATION WITH AGE AND GENDER
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Cardioventilatory coupling is the temporal entrainment of the respiratory rhythm by cardiac activity. It is present in infant and adult humans, as well as in other mammals, and occurs during spontaneous breathing general anaesthesia, sleep, sedation and in the awake resting state.

After screening for known respiratory, cardiac and sleep disorders, level II polysomnographic studies were conducted on 22 adults (11 male, 11 female) aged 18–35 years and 8 adults (4 male, 4 female) aged 60–75 years. R wave times were determined from the ECG signal, and I times (onset of inspiration) from the nasal pressure signal, in order to calculate the time interval between the onset of inspiration and the immediately preceding R wave (RLi interval). Cardioventilatory coupling was quantified by measuring the consistency of the RLi interval using proportional Shannon entropy. In addition, a surrogate time series of RLi intervals was used to calculate a 5% statistical threshold for Shannon entropy, and the amount of time spent below this threshold was determined.

Statistically significant cardioventilatory coupling was evident in all individuals, although the proportion of the night spent coupling varied greatly. There were no significant differences in strength of coupling across the sleep period, or time spent coupled, by age or gender. While coupling was evident in all stages of sleep, there were no statistically significant differences in coupling between sleep stages within individuals.

Cardioventilatory coupling is a transient phenomenon, not generally associated with particular sleep stages, age or gender.
P103

UPPER AIRWAY FAT TISSUE DISTRIBUTION DIFFERENCES IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND CONTROLS AS WELL AS ITS EFFECT ON RETROPALATAL MECHANICAL LOADS

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Objectives: To validate the assertion that fat tissue accumulation adjacent to the upper airway (UA) contributes to a predisposition of obstructive sleep apnea (OSA) irrespective of body mass index (BMI) as well as investigate the effect of obesity on pharyngeal mechanical loads.

Methods: Pharyngeal anatomy; the fat tissue volume in the retropalatal region and retroglossal region were evaluated using magnetic resonance imaging. The difference in fat tissue distribution between patients with OSA and BMI-matched controls was investigated.

Results: Significant differences occurred between controls and patients with OSA in volumes of parapharyngeal fat pad (t = -4.101, p = 0.001), fat of soft palate (t = -3.004, p = 0.010), as well as proportion of the parapharyngeal fat pad to the volume of total lateral pharyngeal soft tissues (t = -3.477, p = 0.004). The volume of pharyngeal cavity, neck circumference, and volume subcutaneous fat tissues were not significantly different statistically (p > 0.05). The volume of fat in the soft palate (t = -3.301, p = 0.003) and parapharyngeal fat pad (t = -3.424, p = 0.002) was higher in participants with positive retropalatal closing pressure; participants with positive retroglossal closing pressure had increased volumes of the tongue (t = -2.612, p = 0.015) and the parapharyngeal fat pad (t = -3.771, p = 0.004).

Conclusions: Patients with OSA have more fat tissue adjacent to the pharyngeal cavity than BMI-matched controls. Fats deposited around the UA add to the collapsibility of retropalatal and retroglossal airway in both patients and controls.

P104

MULTI-PARAMETRIC SNORE ANALYSIS IN OSA DIAGNOSIS

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Introduction: Snoring is one of the earliest symptoms in Obstructive Sleep Apnea (OSA). Almost all OSA patients snore, but not all snorers have the disease. Snore sounds carry vital information on OSA, but quantitative analysis of snore sounds is not currently used in clinical OSA detection. Thus, the vast potential of snoring in the diagnosis/screening of the OSA remains unused. In this paper we present several snore based features developed by us for OSA/non-OSA classification and propose to combine these features to improve the classification accuracy.

Methods: Snore sounds were recorded simultaneously with routine PSG using non-contact microphones placed approximately 50 cm away from patients. Following features were computed from the snore sounds of each subject; Intra-Snore Pitch Jump probability (ISP), Ff*, Formant frequency (Ff), Total Airway Response (TAR) and Non-Gaussianity Index (NGI). Ability of each feature (or combination) to discriminate OSA/non-OSA at the RDI threshold γ was tested.

Results: Table summarises the OSA classification results using different snore based features. According to the table, NGI is the best individual classifier (accuracy = 97%) to separate OSA patients from non-OSA at low RDI decision thresholds, e.g. γ = 10. NGI, however, deteriorates in performance at higher decision thresholds. ISPJ feature carries information on OSA, but performs best when combined with other snore features.

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<td>ISPJ</td>
<td>29, γ = 10</td>
<td>91</td>
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<td>ISPJ + Ff</td>
<td>51, γ = 15</td>
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<td>PJ* + TAR</td>
<td>41, γ = 10</td>
<td>96%</td>
<td>89.3</td>
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<td>NGI</td>
<td>86, γ = 10</td>
<td>97%</td>
<td>93.2</td>
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Discussion: Results show that snore sound carries vital information on the state of the upper airways, allowing us to diagnose OSA. The non-contact instrumentation used in snore acquisition makes the method an excellent candidate for population screening and paediatric use. In the future, we propose to derive extra features targeting low and high RDI regions and then systematically combine all features for best diagnostic outcomes.

P105

AASM CRITERIA FOR SCORING RESPIRATORY EVENTS: IS THE ORO-NASAL THERMAL SENSOR NECESSARY?

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Introduction: AASM guidelines require the use of an oro-nasal thermal sensor (TH) rather than a nasal pressure sensor (NP) to detect apnoea. TH is more sensitive to low flow rates and therefore apnoea index (AI) measured by TH is expected to be less than NP. However, apnoea-hypopnoea index (AHI) may not be different as events scored as apnoea with NP may be scored as hypopnoea with TH.

Results: Table summarises the OSA classification results using different snore based features. According to the table, NGI is the best individual classifier (accuracy = 97%) to separate OSA patients from non-OSA at low RDI decision thresholds, e.g. γ = 10. NGI, however, deteriorates in performance at higher decision thresholds. ISPJ feature carries information on OSA, but performs best when combined with other snore features.

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Discussion: Results show that snore sound carries vital information on the state of the upper airways, allowing us to diagnose OSA. The non-contact instrumentation used in snore acquisition makes the method an excellent candidate for population screening and paediatric use. In the future, we propose to derive extra features targeting low and high RDI regions and then systematically combine all features for best diagnostic outcomes.
Method: 164 consecutive diagnostic PSG scored using TH or NP for apnoea detection and both AASM recommended and alternative hypopnoea definitions.

Results: The NP derived index is shown plotted against the TH derived index in the figures. Small but significant ($p < .0001$) differences were observed between all TH and NP derived indices (Median and inter-quartile range shown on figures). With TH as the gold standard, at AHI cut points of 15 and 30/hr, the sensitivity and specificity of NP for OSA diagnosis was >98% except with the AASM recommended hypopnoea definition at 15/hr where specificity was 89%.

Discussion: AI and AHI are significantly greater when using NP rather than TH to detect apnoea but differences in AHI are unlikely to be clinically significant. This suggests that TH could be omitted where there are limits to the number of channels recorded, for example, in portable devices. Differences are likely to be less when using the AASM alternative definition of hypopnoea.
sleep medicine is unclear, perhaps due to the low temporal resolution of commercial measurement systems available. Such systems typically monitor only a single location and do not record data synchronised with PSG systems meaning that temporal correlation between events observed in other channels and actigraphy is difficult to ascertain. Further, conventional actigraphy records only summarised activity counts, implying that morphologically different movements may result in the same or similar activity counts. The aim of this technical case-study was to directly compare data recorded using a Continuous Multisite Accelerometry System (CMAS) to an Actiwatch (TM).

Method: A male test subject wore an Actiwatch MiniMotionlogger (TM) on the left wrist, and the CMAS with accelerometers located on left wrist and middle finger, left ankle and great toe, and the sternal notch for an overnight sleep period.

Results: A number of interesting features were identified including (A) Movement recorded on ankle and toe, in absence of movement from other channels indicating a lack of that leg, (B) Movement recorded on finger in absence of wrist movement indicating a finger twitch; (C) Movement in all accelerometry channels with a change in posture; and (D) Series of movements recorded only in toe accelerometry channel.

Discussion: CMAS was able to identify and characterise subject movements, which were not able to be differentiated using the Actiwatch (TM). The multisite nature of the system detects movements which are not observed on Actiwatch.

P108

LEVEL 3 AND 4 HOME SLEEP STUDIES IN A NEW ZEALAND MULTI-ETHNIC PATIENT GROUP: AN ANALYSIS OF FACTORS INFLUENCING STUDY FAILURE

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Introduction: Level 3 and 4 home sleep studies (HSS) are used as the initial sleep study in most patients presenting to our sleep clinic with suspected Obstructive Sleep Apnoea Syndrome (OSAS). Patients are instructed on study setup at the clinic, but set up the device themselves at home. Study failure is an obvious concern with this approach in an often low socioeconomic, multiethnic group of patients.

Methods: A retrospective study was carried out of 299 consecutive patients undergoing a first HSS for the assessment of suspected OSAS during 2006 and 2007. Demographics and basic clinical data were recorded, as well as results of first and final sleep studies. A determination on study failure was made by reviewing the original physician’s report. Studies were designated as either A: Adequate and no further study required, B: Adequate, but a higher level study is required, or C: Technically failed and a repeat study is required. Group C were designated as failed studies (F), A and B combined as Not Failed (NF). Univariate and multivariate analysis was used to investigate the associations between study failure and both patient factors (age, sex, ethnicity, BMI, AHI) and non-patient factors (level of study, reporting physician).

Results: The study failure rate was 17% (95% CI 13%–21%). A further 8% required a higher level study despite an adequate HSS. Failure was significantly associated with increased age (Mean 53.6 yr for F, 48.8 yr for NF, p = 0.008), and European ethnicity (23% vs. 12% in other ethnicities combined, p = 0.009). The study failure rate was 10% in Maori, 13% in Pacific Islanders, 9% in Asians. Europeans were older (Mean 53.0 yr, Mean 46.7–48.0 yr in the 3 other groups). Multivariate logistic regression with age and European ethnicity suggested that both variables significantly contributed to study failure. Non-patient factors, and other patient factors, did not appear to influence study failure.

Discussion: This is a ‘real-world’ study looking at study failure as defined by the reporting physician. The study failure rate appears acceptable and similar to that reported by Whittle et al. In our multi-ethnic sleep clinic population, age and ethnicity influence failure of level 3 and 4 home sleep studies. European and older patients have higher study failure rates.

Reference:

P109

COMPARISON OF PIEZO LEG SENSORS AGAINST ANTERIOR TIBIALIS ELECTROMYOGRAM IN THE SCORING OF PERIODIC LIMB MOVEMENTS

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Introduction: Anterior tibialis electromyogram (EMG) recording is the gold standard for detecting periodic limb movements (PLM) during sleep. Our aim was to compare the Compumedics piezo leg sensors to EMG in the detection of PLMs.

Methods: Simultaneous recordings of leg sensor and anterior tibialis EMG were collected during overnight PSG according to standard procedures. A single scorer analysed all PSGs; limb movements were scored twice displaying one signal type at a time. Paired t-tests and Bland-Altman plots were used to compare the PLM Index (PLMI) derived from the two methods.

Results: In 21 consecutive PSG recordings there was a trend towards higher PLMI as measured by EMG (Leg sensor 13.7 ± 21.1 vs EMG 16.3 ± 21.1, p = 0.078). The mean difference was 2.6 (95% CI −0.14 to 5.35). The limits of agreement show that 95% of the differences were between −9.98 to 15.19.
Discussion: Leg sensors may underestimate EMG derived PLMI but as the limits of agreement are wide, individual responses are varied. Differences may occur in the interpretation of PLM severity depending on the type of sensor used. More data is being collected to determine clinical relevance.

P110

A RETROSPECTIVE ANALYSIS OF SPLIT-NIGHT SLEEP STUDIES COMPARED WITH SEPARATE DIAGNOSTIC AND TREATMENT SLEEP STUDIES

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John Donoghue, S Gyulay, J Pretto, M Hensley

Split-night (S-N) sleep studies where both diagnostic and CPAP titration studies are performed in one night expedite treatment of OSA, and are used where pre-test probability is high. We aimed to compare diagnostic yield, quality of sleep and of CPAP titration during S-N studies compared with separate diagnostic (D) and titration (T) studies.

Methods: We retrospectively analysed sleep time, staging, scoring and titration data in consecutive S-N studies compared with D studies where T studies were performed within 7 days. Subjects were allocated by age or sex. Significant OSA (AHI ≥ 30) was defined as acceptable if treatment AHI was < 10.

Results: There were no significant differences between S-N and D/T groups in age or sex. Significant OSA (AHI > 10) was detected in 88% of S-N studies (with 70% of studies having AHI > 30). Compared with D/T studies, the S-N group had greater BMI (p = 0.005), higher AHI (p < 0.001 for D, p = 0.005 for T), reduced sleep efficiency (p < 0.001 for D, p < 0.001 for T), lower percentage of studies meeting minimum diagnostic criteria (p < 0.001), and lower rate of acceptable titration (p = 0.002).

Discussion: Unsurprisingly, split studies do not provide as good diagnostic data or acceptable titration yield as D/T studies. However this approach in selected patients proved to be a reliable treatment model in 72% of cases. Utility of S-N studies is dependent upon the balance between diagnostic accuracy, reliable titration, cost effectiveness and timeliness of treatment.

Reference:
Poster presentations

P112
ORONASAL CANNULAE CANNOT DISTINGUISH MOUTH BREATHING FROM APNOEA
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Introduction: The accurate measurement of airflow is important in the diagnosis of Sleep Disordered breathing. AASM guidelines recommend the use of both nasal pressure and oronasal thermistors. Nasal pressure is more sensitive than thermistor at detecting changes in airflow (Heitman et al., 2002; Norman et al., 1997; Hernandez, 2001) although is unable to differentiate oral flow from apnoea (series and Marc, 1999). Oronasal pressure cannulas are marketed as a solution to this problem. In this project we assess an oronasal cannula in the measurement of airflow during quite awake breathing in consenting participants to assess the suitability of an oronasal cannula for the detection of airflow.

Methods: Six consenting participants simultaneously wore a nasal cannula (aerflo), an oronasal cannula (Brachon 0589) and a thermistor whilst breathing solely via the nasal or oral route. The thermistor was attached near the mouth to detect oral breathing. ProTech PTAF Lite sensors were used to record airflow. The peak to peak amplitude of ten clear breaths was compared during nasal and during oral breathing.

Results: The signal obtained from the oronasal cannula during oral breathing was difficult to distinguish from noise. The peak to peak amplitude of the oronasal cannula was on average 0.47% of the peak to peak amplitude of the thermistor (p<0.001). During nasal breathing, the oronasal cannula was observed to have a peak to peak amplitude approximately 25% of the peak to peak amplitude of the nasal cannula (p<0.01).

Discussion: The oronasal cannula was unable to differentiate oral breathing from no flow, and thus is unable to differentiate mouth breathing from apnoea. The oronasal also compares poorly to nasal cannula being significantly smaller than the nasoral cannula peak to peak amplitude. As such the oronasal cannula is an inadequate replacement for nasal cannula and thermistor.

Heitman, S. J., R. S. Atkar, et al. (2002). “Validation of nasal pressure to peak amplitude of the thermistor to peak amplitude. As such the oronasal cannula is an inadequate replacement for nasal cannula and thermistor.” Sleep 20(12): 1175–84.

P113
SLEEP INERTIA AFTER NAPS IS SHORT-LIVED AND NOT PERCEIVED
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Sleep/Wake Research Centre, Massey University, Wellington, New Zealand

The transitory confusion, groginess, low arousal and reduced functioning that can be experienced on awakening is known as sleep inertia. It is a paradoxical state, as most individuals perform poorly despite the recent “recovery” opportunity of sleep. Findings are mixed, but indicate that sleep inertia can last from a few minutes to several hours. Because this interim state has serious implications for people required to perform safety critical tasks immediately upon waking we aimed to determine the duration of sleep inertia after naps at different times of the day and under differing levels of homeostatic pressure.

The present study involved two within-subject protocols. Protocol 1 (P1) consisted of naps of 20, 40 and 60 min ending at 0200 after ~20 hrs of wakefulness (n=12, all male, mean age 25.08 yrs). Protocol 2 (P2) incorporated identical length naps ending at 1200 after ~30 hrs of wakefulness (n=12, all male, mean age 23.6 yrs). Both protocols included a control condition of no nap. At either 0200 or 1200, and immediately after waking, participants completed a 6-min test battery for the next 3 hrs (Karolinska Sleepiness Scale (KSS), 4-min 2-back working memory task (NB), 90 sec of controlled EEG recording). Data from the KSS and NB during the first hour following the nap are presented here.

Results from mixed model analyses of variance indicate that KSS ratings do not differ at any one test time by study condition. Mean reaction time on the NB task was slower (F12,103 = 3.13, p<.001, P2 F12,131 = 4.01, p<.001) and the number of correct matches and non-matches were less (P1 F12,110 = 3.89, p<.001, P2 F12,165 = 3.10, p<.001) immediately after a 40 and 60 min nap compared to the no nap condition. The number of omissions on the NB task was greater immediately after waking from the 60 min nap compared to the no nap condition only in P2 (F12,173 = 2.92, p=.001). For all NB variables there were no significant differences between study conditions in the test battery completed 15 min after waking.

These findings indicate that at adverse times in the circadian cycle and under conditions of high homeostatic pressure, individuals do not perceive a sleep inertia effect. However, sleep inertia is evident when measured by working memory performance but the detriment in performance is short lived (less than 15 min).

P114
A LONGER NAP FOLLOWING EXTENDED WAKEFULNESS SUSTAINS PERFORMANCE WHILE A SHORT NAP DOES NOT
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Sleep/Wake Research Centre, Massey University, Wellington, New Zealand

Napping in the workplace is an effective countermeasure to fatigue, but under conditions of extended prior wakefulness, longer naps are considered potentially problematic due to the increased likelihood of sleep inertia immediately upon waking.

The present study investigated the duration of sleep inertia and the subsequent benefits associated with naps of various lengths at different times of the day and under differing levels of homeostatic pressure. It included two within-subject protocols. Protocol 1 (P1) consisted of naps of 20, 40 and 60 minutes ending at 0200 after ~20 hours of wakefulness (n=12, all male, mean age 25.08 years, range 20–33 years). Protocol 2 (P2) incorporated identical length naps ending at 1200 after ~30 hours of wakefulness (n=12, all male, mean age 23.6 years, range = 20–29 years). Both protocols included a control condition of no nap.

Data presented here are from the KSS, 2-Back Working Memory task and 10-minute PVT, administered from 1.5 hours to 6.0 hours after waking from naps.

Results from mixed model analyses of variance indicate that KSS ratings were significantly lower (F12,131 = 4.52, p=.0073) following the 60-minute nap in comparison to no nap in P2, but there were no differences by study condition in P1. Significantly fewer omissions on the 2-Back task (F12,165 = 5.86, p=.0011) were made following the 40- and 60-minute nap in comparison to no nap in P2, but there were
Sleep, Science and Research

no differences by study condition in P1. The slowest 10% of reaction speed on the PVT was significantly better (F(1, 104) = 4.64, p = 0.0057) after the 60-minute and 40-minute nap in comparison to the no nap condition in P2, while in P1 performance was significantly better after the 60-minute nap in comparison to no nap, and better after the 40- and 60-minute nap in comparison to the 20-minute nap. In addition, fewer lapses on the PVT were made after the 60-minute nap when compared to the 20-minute nap in P1.

These findings indicate that unlike the 20-minute nap, the benefits of longer naps (40- 60-minute) are sustained at adverse times in the circadian cycle under varying levels of homeostatic pressure. Thus the potential long term benefit of longer naps needs to be carefully weighed against the duration of possible sleep inertia.

P115
NIGHT WORK IS AN INDEPENDENT RISK FACTOR FOR REPORTING INSUFFICIENT SLEEP AND SHORT USUAL SLEEP DURATION
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Aim: Night work displaces sleep to sub-optimal times in the circadian cycle. The aim of this study was to investigate the relationship between night work exposure and self-reported insufficient sleep and abnormal usual sleep duration, on both scheduled and free days.

Method: A New Zealand version of the Munich Chronotype Questionnaire was mailed to a stratified random sample of 3,000 Māori and 4,100 non-Māori adults, aged 20–59 yrs, obtained from the electoral rolls. (response rate = 58%). Respondents were asked how many times in the previous 4 weeks they: (1) went to bed after midnight, (2) got up before 5 a.m., and (3) did not sleep at night, because of work. Responses were combined to generate a night work exposure variable ranging from 0 (no night work) to 9 (extremely high exposure to night work). Exposure scores were categorised in approximate quartiles as: 1 = extremely low exposure; 2 = moderately low exposure; 3 = slightly low exposure; 4–9 = high exposure. The duration of the main sleep period and total sleep (TST/24 hr) were examined on both scheduled and free days. Multivariate analyses were performed to examine whether night work exposure was an independent risk factor for insufficient sleep (change in sleep duration between scheduled and free days 22 hrs), or short (<7 hrs) and long (29 hrs) sleep durations on scheduled and free days separately. Other variables included in the models were ethnicity (Māori vs. non-Māori), sex, age group (in decades), socioeconomic deprivation (using NZDep2006 deciles), and chronotype.

Results: The high exposure group were more than twice as likely to report insufficient main sleep and TST/24 hrs compared with non-night workers, after controlling for ethnicity and sex (both p < 0.001). The likelihood of reporting short sleep increased with increasing degree of night work, with the high exposure group 4.5 times more likely to report short main sleep and 4.1 times more likely to report short TST/24 hrs on scheduled days. A similar relationship was seen on free days, with the high exposure group 2.4 times more likely than non-night-workers to report short sleep duration (p < 0.0001).

Conclusion: This study has demonstrated a dose relationship between night work exposure and both insufficient sleep and short sleep duration. It has the particular strength in that it has controlled for other known demographic risk factors for insufficient and short usual sleep.

P116
AN OVERVIEW OF PUBLICLY FUNDED ADULT SLEEP SERVICES IN AOTEAROA/NEW ZEALAND
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Current demand for sleep services (SSs) is expected to escalate with increasing obesity and awareness of the importance of sleep disorders. The Ministry of Health provides funding for SSs, but how it is being used by District Health Boards (DHBs) is unclear. The aim of this study was to provide an overview of the scope and scale of publicly funded SSs in Aotearoa/New Zealand.

Methods: Three questionnaires were developed to gather information on the range of SSs currently available, with two questionnaires tailored for public and one for paediatric SSs. This presentation will focus on the adult data. The questionnaires requested information on patient trajectories, tools and procedures used to investigate and treat patients with sleep apnoea, and patient statistics for the 2008/9 financial year. A lead clinician and a business manager in 19/21 DHBs identified through ‘cold calling’, networking and snowballing techniques, were sent questionnaires via email or post (response rate = 100%).

Results: Taling discrepancies and missing data in patient statistics in to consideration, the number of patients diagnosed per year ranged from as low as 10–15 in one DHB to a 1000 in another. Level 3 sleep studies were used most commonly (14/19 DHBs) followed by level 1 (9/19 DHBs). This was further supported by patient statistics data. Three DHBs stated that they do not provide any sleep studies. The most common treatment for sleep apnoea was CPAP (17/19 DHBs) followed by lifestyle modifications (15/19 DHBs), upper airway surgery (13/19 DHBs), and mandibular advancement splint (9/19 DHBs). Sixteen out of 17 DHBs provided diagnostic services for sleep apnoea, while 15/18 DHBs provided treatment and 13/17 DHBs conducted long-term follow-up of patients. Overall, 11/17 DHBs provided all of diagnosis, treatment and follow-up within their DHB. Of these, 3 DHBs also on-referred select patients for diagnostic, treatment and follow-up services for sleep apnoea.

Discussion: This study provides the first comprehensive information on publicly funded SSs in New Zealand. Key informant interviews that are being conducted alongside the DHB survey seek to gain additional information on adult SSs delivered by privately funded services and through primary care providers. Our findings will contribute to identifying key areas where action is needed to develop services tailored to population needs and help map the way forward for SSs.

P117
SLEEP RESTRICTION AND CIRCADIAN DISRUPTION: EFFECTS ON APPETITE, SNACK CHOICE AND CRAVINGS
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Introduction: Sleep restriction and circadian disruption may contribute to the development of obesity. Studies have shown alterations in appetite hormones and an increase self-reported hunger, snack consumption and cravings for calorie rich foods following a period of sleep restriction. In addition, hormones involved in appetite regulation are influenced by endogenous circadian rhythms. The purpose of this study was
to examine the combined effects of appetite, snack choices and cravings in a sleep restricted forced desynchrony protocol.

**Methods:** 14 healthy males (21.8 ± 3.8 yr) spent 12 consecutive days in a time isolation laboratory. The protocol consisted of 3 × 24 h adaptation days (16 h wake, 8 h sleep opportunity), followed by 7 × 28 h forced desynchrony days (23.3 h wake, 4.7 h sleep opportunity). Self-reported hunger, satisfaction and cravings were assessed using visual analogue scales every 2.5 h during wake. Participants were provided with three standard meals and six snack opportunities at the same elapsed time into each wake period. Snacks were divided into three categories: sweet, savoury and healthy. Core body temperature was continuously recorded with rectal thermistors and was used to determine circadian phase.

**Results:** Data were assigned a circadian phase (CP), a post meal segment (PMS) (time after breakfast, lunch and dinner) and a time since meal (TSM). Hunger and satisfaction data were analysed using linear mixed model analysis. Snack and cravings data were analysed using binary logistic mixed effects regression. A main effect of PMS and TSM was found for hunger, satisfaction and snack choice (p < 0.05). Sweeter snack choices increased and healthy snack choices decreased across the day. There was a significant main effect of CP for hunger, satisfaction, snack consumption and cravings (p < 0.05). Hunger, snack consumption and cravings were lowest and satisfaction was highest around the circadian nadir.

**Discussion:** These results suggest individuals experiencing sleep restriction are more likely to snack on sweet rather than healthy snacks as the waking day progresses. Individuals experiencing sleep restriction may make poorer food choices due to an increasing lack of restraint with prior wake. Future investigations should examine the role of restraint and other psychological variables such as mood and health orientation in food selection when sleep is restricted.

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**P119**

**THE EFFECTS OF COLD WATER IMMERSION ON THE AMOUNT AND QUALITY OF SLEEP OBTAINED BY ELITE CYCLISTS DURING A SIMULATED HILL-CLIMBING TOUR**

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**Introduction:** In recent years, the popularity of post-exercise recovery strategies has remarkably increased. Anecdotal evidence indicates that athletes’ experience enhanced sleep quality and quantity following hydrotherapy (cold water immersion), yet no studies have examined the influence of hydrotherapy on the amount and quality of sleep obtained by elite athletes. The aim of the present study was to examine the impact of hydrotherapy on the amount and quality of sleep obtained by elite cyclists during a simulated hill climbing tour.

**Method:** Ten male professional road cyclists (21.1 ± 1.7 years) from the Australian Institute of Sport were monitored for 8 consecutive nights during a simulated hill climbing tour. Athletes followed a training schedule consisting of 2 × 3 days of training (140–190 km per day) separated by one day of recovery (<60 km) and one day of testing. The experiment had a randomised cross over design. During the first 3-days of training, five subjects underwent a hydrotherapy recovery condition (cold water immersion), while the remaining five subjects completed a placebo recovery condition (sham ultrasound). After one day of recovery and one day of testing, subjects reversed conditions.

**Results:** Descriptive statistics between the two conditions (cold water immersion vs. sham ultrasound) were very similar for total sleep time (6.3 ± 0.2 hr vs. 6.2 ± 0.2 hr), bedtime (22:17 ± 8 min vs. 22:32 ± 14 min), wake up times (05:43 ± 5 min vs. 05:43 ± 5 min), sleep onset latency (14 ± 11 min vs. 18 ± 15 min) and subjective sleep quality (2.8 ± 1.0 vs. 3.1 ± 1.0). Results from the one-way repeated measures ANOVA revealed that the amount and quality of sleep obtained by elite cyclists was not significantly affected by the type of recovery strategy, F(3, 12) = 1.81, p > 0.05.

**Discussion:** Contrary to strong anecdotal evidence, post-exercise recovery in the form of cold water immersion did not enhance the amount or quality of sleep obtained by elite cyclists. Future research could address the limitations of the present study by utilising electroencephalographic sleep monitoring.
P120
THE RECOVERY OF MOOD FOLLOWING SLEEP LOSS: THE POTENTIALLY CONFOUNDING EFFECT OF THE LABORATORY ENVIRONMENT
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Existing research has indicated a significant negative impact of sleep loss on mood. Studies of mood recovery following sleep loss have generally included only brief recovery periods. The use of control conditions is also lacking. Thus, the present study sought to address the current paucity of data regarding the dynamics of mood change and recovery in relation to sleep loss and the laboratory environment. Sixty-nine (40 M, 29 F, 22.6 y ± 4 y) healthy young adults experienced a period of sleep deprivation (39–42 h or 63–66 h) and a recovery period (5 nights: 6 h Time in Bed [TIB] or 9hTIB), or a control condition (no SD, 8 nights: 9hTIB). The Mood Scale II was completed every two hours during wale periods. Overall, sleep loss was associated with significant negative mood change (p < .05). After three days in the laboratory, control participants reported increases in depression, anger and fear that were comparable to those reported by participants deprived of sleep for three days (48–63 h), suggesting a negative impact on mood of the laboratory. When defining recovery relative to both baseline functioning and non-significant difference from control the two methods agreed on recovery on only 16.6% of occasions, with recovery to baseline taking up to 5 nights longer than recovery to control. The findings of this study indicate that negative mood during sleep loss in laboratory environments may be influenced, in part, by procedural factors. Further, this may have implications for the way recovery is commonly defined. Future laboratory studies exceeding three days may need to be conservative when interpreting mood data.

P121
ENHANCING RECRUITMENT AND RETENTION IN A LARGE SCALE, LONGITUDINAL STUDY OF SLEEP AND MATERNAL HEALTH
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Recruiting participants into and managing large scale, longitudinal survey studies require carefully managed processes to ensure the study sample is representative of the intended population. Methods trialled in a feasibility study, and refined for current use in a large scale study involving pregnant and postpartum women are discussed.

The E Moē Māmā, Maternal Sleep and Health in Aotearoa/New Zealand project is currently recruiting 1,000 women (500 Māori and 500 non-Māori) to participate in research investigating aspects of sleep changes in pregnancy and early postpartum. Questionnaires are completed at 35–37 weeks gestation and 12-weeks postpartum. A telephone interview is conducted at 4–6 weeks postpartum.

No single channel exists for making contact with a diverse sample of pregnant women. A multi-method approach utilising community posters, and face-to-face contact with a member of the research team, a midwife or childbirth educator has been developed to promote awareness in a wide community sample of women. Following focus group feedback from participants in a feasibility study the use of a website, mainstream media and presence at a parenting exhibition have also been employed. Women interested in participation are supplied with a study information pack (including consent form) which can be obtained directly from their midwife or childbirth educator or by contacting the research team via free telephone or text services; a website link and email. A $20 gift voucher is offered each time a written questionnaire is returned. Reminders and participant contact at 4–6 weeks and 12 weeks postpartum are managed through a database developed for the project in Microsoft Access. To date, over eight months we have succeeded in recruiting 360 women. The retention rate in the feasibility study was high (94%). Focus group participants also commented that clear instructions, accurate estimates of time involved and personal contact with the research team enhanced commitment to complete the study.

Use of a wide range of contact management methods can be achieved at modest cost with the effect of enhancing participant retention in longitudinal studies. The commitment required by the research team to build and maintain relationships with study participants and recruitment sites is also rewarded by connecting with a broad community sample.

P122
LOW AND HIGH GLYCAEMIC INDEX MEALS ON VIGILANCE
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Vigilance is a state of sustained alertness. Vigilance tasks are mentally demanding as focused mental effort drains neural resources by decreasing brain glucose levels. Vigilance is linked to depletion of neural substrates or to decreased arousal from the understimulating nature of the vigilance task (Warm et al., 2008). Smith and Foster (2008) showed that adolescents given a high glycaemic index (GI) breakfast meal have improved mental ability, consistent with glucose availability in response to high GI (HGI) foods. However, HGI carbohydrate meals, given to healthy adults 4 h prior to their bedtime, shortened sleep onset latency (Afagh et al., 2007). The authors suggested that HGI meals increased tryptophan availability, allowing it greater ease of entry into the brain for conversion to serotonin, which regulates sleepiness, mood and satiety.

Plasma glucose appearance rate is greater following HGI compared to low GI (LGI) foods, but HGI foods increase sleepiness. This study aimed to investigate the effects of a HGI (GI = 73) compared to an isonenergetic (~1929 kJ) LGI (GI = 41) meal provided at midday to maintain vigilance. Twelve adult males participated in a crossover study of a HGI and LGI meal on two occasions. Ratings for mood, meal palatability and satiety, subjective and objective sleepiness (Alemanstedt EEG) measures, cognitive processing abilities (Paced Auditory Serial Addition Task, PASAT), and postprandial blood glucose concentrations (PBGC) were measured.

Participants reported increased vitality (p = 0.01) following LGI meals but no changes in contentment and anxiety between the meals. Meal palatability and satiety were similar for both meals. Subjective sleepiness increased after one and three hours (p = 0.002) postprandial although it was not different between meals. Differences in EEG sleepiness and the area under the curve for PBGC are still being analysed. No difference was seen in the PASAT results after LGI and HGI meals.

Preliminary data suggests that there are no significant differences in alertness or cognitive performance between HGI and LGI meals. However, both meals significantly increased sleepiness one and three...
hours postprandial and LGI meals yield higher vitality shortly after consumption.


P123

WHY SMALL EFFECT SIZES IN OBJECTIVE SLEEP OUTCOMES OF INTERVENTION STUDIES? A CASE SCENARIO

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It is common belief that exercise enhances sleep in the average sleeper; an impression up-held by large population surveys (Aritake-Okada et al. 2009). However, these subjective perceptions are not always translated into objective sleep outcomes such as polysomnography or actigraphy. We will use one case scenario to suggest a possible explanation for the discrepancy as the case is representative of 3 observed cases. Actigraphy data is shown for a sedentary adult for 32 consecutive days. Following a maximal oxygen consumption (VO2max) fitness test, the subject performed a 40-min endurance exercise bout at four different intensities (45%, 55%, 65% and 75% VO2max) in random order on separate occasions commencing 6 hours before bedtime. On the control and exercise days, sleep was at their usual bedtime and wake remained ad libidum. A standardised meal was provided on these nights. Actigraphy activity count was analysed to ensure maintenance of sedentary behaviour except during exercise sessions. Subject VO2max of 36.14 mL·kg⁻¹·min⁻¹ verified sedentary status. All variables of timing, duration and type of exercise, dietary intake, and circadian timing of sleep and waking were controlled for. Exercise at all intensities does not always demonstrate substantial improvements on total sleep time (TST) compared to the control night (Figure 1). However, a notable feature of the actigraph data is that of a cyclic pattern of TST with a cycle length of approximately 3 days with longer sleep time that follows reduced time, is strongly supportive of a sleep homeostasis model. It is possible that the exercise effect is masked by sleep homeostasis depending on timing of the exercise bout.


P124

DO THEY HAVE ENOUGH SLEEP? – AN OBJECTIVE SLEEP STUDY

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There are only few comparative studies on sleep patterns in nursing home, and it is essential to put forward an objective study to understand the quality of sleep among residents. Poor sleep can lead to serious consequences such as falls and increased agitated behaviour with dementia residents. Using a small watch-like device (wrist actigraphy), we record the pattern of sleep/wake activity and level of light exposure; actigraphic data were collected with residents of two Macao nursing home units and with forty-four nursing home residents living in dementia-care units in Sydney, Australia. The mean age of the Macao’s group (n = 8) was 78 ± 8.9 years, residents were on average 7 medications for various conditions. Compared to the Australia’s data, the mean age of the group (n = 44) was 79.9 ± 7.5 years, residents were on average 5 medication for various conditions. Also, physical differences between the nursing home settings are worth to take note, as most residents from the Macao’s data are sharing with an average of 7.5 residents, compared with only single occupancy from Australia’s data. Preliminary data suggest that most residents from the two cities have disturbed sleep, low activity level and low light exposure. Results indicated that on average, from Macao’s data; sleep onset latency (SOL) was 34.05 min, sleep efficiency (SE) was 78.12%, 250.17 for average activity/min and 123.37 for average light exposure. Whereas in Australia’s data, SOL was 47.6, SE was 66.9, 230.17 for average activity/min and 123.37 for average light exposure. These findings will have practical implications and possible solution regarding environmental and behavioural factors.

P125

CASE STUDIES OF FAMILIAL SEXSOMNIA

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Introduction: Parasomnias involve activations during either the transitions to and from sleep or during particular stages of sleep. Parasomnias
can be classified according to the systems producing activation and the particular stages of sleep in which activation occurs. This method of classification is useful because it assists in formulating treatments regimes. The prototypical parasomnias, nightmare, sleepwalking and sleep terror disorders and are often observed in children, but usually decline in frequency with maturation and occur much less frequently in adults. Reports of sexual activity occurring during sleep are not new, but the term (sexsomnia) recently coined to describe this phenomenon is new.

Methods: Two patients who reported with unusual sleep-related behaviours were interviewed and underwent overnight polysomnographic studies. The information gathered was used to diagnose and treat both patients for sexsomnia. The cases describe the diagnosis and treatment of two related individuals (a father and son) who presented with unusual sleep-related behaviours.

Results and discussion: The son, MH (age 28 y.o.), along with his female partner presented at a public insomnia clinic. His partner described MH's sleep-related sexual behaviour as consisting of rough automaton-like intercourse that usually occurred about 60 to 90 minutes after they retired for sleep. The frequency of this behaviour was almost nightly and was not influenced by scheduled sexual intercourse in the period proceeding sleep onset. Initially, conservative management was trialled for 2 months and consisted of measures designed to reduce pre-sleep arousal levels. MH was requested to follow a regular sleep schedule (i.e. avoid sleep deprivation), follow sleep hygiene rules and use a progressive muscular relaxation CD in bed just prior to sleep. The trialled treatment made little difference to the frequency of MH's sexsomnia. The recalled treatment option trialled for 20 days was a 1.0 mg dose of Clonazepam at bedtime. This proved to be efficacious in completely stopping the unwanted sexsomnia. One month after MH was successfully treated his father, 58 year old JH presented at the same clinic with a lifelong history of sexsomnia. His condition was also subsequently treated successfully with a 1.0 mg dose of Clonazepam.

Discussion: The son's sleep-related unwanted sexual behaviour was fully automated. Multiple EEG channels, if used, are expected to further improve the results. In the future we intend to further develop this technology for a full 6-sleep-stage classification and evaluate the performance on a larger patient database.


P127
EXTRACTING OSA SPECIFIC FEATURES FROM TWO-CHANNEL EEG IN ROUTINE POLYSOMNOGRAPHY
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Introduction: OSA patients suffer from hundreds of respiratory (apnea/hypopnea) and arousal events leading to significant modifications of the sleep architecture. We demonstrate that these events are associated with functional asymmetry of the brain as manifested by the asymmetry of scalp EEG. While EEG has been widely used in sleep staging, it has not been explored as a way of characterizing OSA. We illustrate that EEG carries OSA-specific information and may provide features to diagnose OSA.

Method: EEG data were recorded from 36 subjects (19 non-apneic [RDI ≤ 10] and 17 apneic [RDI ≥ 20]) during routine PSG, using symmetrical electrode positions C4, C3, A1 and A2. Montages C4-A1 and C3-A2 were derived and separated into component signals at the four frequency bands: delta (0.5–4 Hz), theta (4.1–8 Hz), alpha (8 1–12 Hz), and beta (12.1–16 Hz). Hemispherical EEG asynchrony time series were computed at each frequency band, and a set of features derived using techniques of higher-order-spectra and principal component analysis. We then designed a new measure, Inter-Hemispheric Asynchrony Index (IHSI) to classify apnea patients.

Results: A significant correlation was found between HSI and RDI (r = −0.57, p = 0.001, t = −3.48). The IHSI classified patients in the test
set into apnea/no-apnea classes with an accuracy of 91% (p = 0.0001), at the RDI threshold of 10 (sensitivity 82%, specificity 79%).

Discussion: Results suggest that hemispheric EEG asymmetry carries vital information on OSA. Potential EEG artefacts have the effect of making the results reported here pessimistic estimates. The proposed EEG technique may find uses in characterizing the illusive neurocognitive dimension of OSA.

P128
FOOD INTAKE FREQUENCY, MEAL SIZE AND TIMING IN NARCOLEPSY
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Comparisons between the eating behaviours of individuals with and without narcolepsy were investigated as part of a larger study. Number of snacks and drinks consumed and the size and number of meals were compared across groups, and evaluations made about the importance of food intake timing in relation to sleepiness. Our sample consisted of 74 individuals with narcolepsy (M = 62 yrs, SD = 18.22) and 74 controls (M = 57.52 yrs, SD = 15.00). Groups were matched on age and gender, and controls with a sleep disorder or a disorder that restricts food intake were excluded. All participants completed a one day Food and Drink Intake Diary and a newly developed Meal and Snack Timing Questionnaire (MSTQ) that consisted of six questions on the importance of timing dietary intake in relation to sleepiness. Preliminary analyses showed that individuals with narcolepsy had significantly more snacks and drinks than controls (F(1,135) = 5.287, p = .023, F(1,135) = 13.214, p = .000) but there was no significant difference between individuals with narcolepsy and controls on total number of self reported small, medium or large meals consumed. Individuals with narcolepsy scored significantly higher on all items on the MSTQ than controls, as follows (univariate MANOVA): Q. It is important that the timing of my meals/snacks ... does not increase my sleepiness when this is convenient (F(1,133) = 19.52, p = .000), does not interfere with a time to nap (F(1,133) = 29.19, p = .000), are at regular and predictable times (F(1,131) = 8.37, p = .004), helps avoid sleepiness in public places (F(1,131) = 102.45, p = .000) and helps prevent the sudden onset of sleep (F(1,131) = 75.73, p = .000). Cronbach’s alpha for the MSTQ for this sample was good (.87). Individuals with narcolepsy were more likely to consume greater amounts of snacks and drinks compared to controls, however, there was no significant difference between those with and without narcolepsy on the number and/or size of meals consumed. Interestingly, findings suggest that individuals with narcolepsy use the timing of their food intake to decrease or increase (presumably to power nap) their sleepiness as convenient. Understanding such eating patterns will help medical and mental health professionals in guiding management of narcolepsy and potentially preventing co-morbidities.

P129
PERCEIVED NEED FOR AND WILLINGNESS TO BE INVOLVED IN A CLINICAL TRIAL FOR NON-REM PARASOMNIALS: CENSUS OF AUSTRALIAN SLEEP PHYSICIANS
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Introduction: A recent systematic review indicated that there were no clinical trials of treatments for non-REM parasomnias (NPRs – most commonly sleepwalking). Thus, there is probably a need to develop randomized clinical trials to test the efficacy of, particularly commonly used pharmacologic treatments for NPRs. We aimed to ask every sleep physician in Australia their opinion on the need for better evidence to treat NPRs, how many patients they saw and whether they would be willing to enrol patients.

Methods: All currently practicing ASA members with FRACP qualifications were surveyed using a multistage mail, email, internet and phone-based questionnaire. We aimed to find patient volume and gauge perceived need for and interest in participating in clinical trials.

Results: After removal of retirees 186 physicians were surveyed with a 70% (n = 130) response rate so far. Over 80% of respondents believed there is a need for a well designed clinical trial to test clinical efficacy of pharmacological treatments for NPRs (highest 3 levels of agreement on an 11 point scale). Half of physicians indicated that they saw 1–5 NPRs patients per year and a further 40% saw more than 6 patients per year. It appears that a little under half were treated pharmacologically. More than 80% of physicians indicated they would be interested, in principle, in enrolling patients in a randomized placebo-controlled trial. A similar proportion indicated interest in non-randomized follow-up studies.

Discussion: Australian sleep physicians have sufficient clinical interaction with NPRs patients to feel a need for better treatment evidence. However, few if any physicians have sufficient clinical volume to support a single-centre clinical trial. These data provide preliminary evidence that a multi-centre clinical trial is needed, feasible and will be supported in Australia.

P130
REM BEHAVIOUR DISORDER: A CLINICAL CASE SERIES
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Introduction: The clinical impression at our tertiary referral sleep disorders unit is that despite a constant total patient load, an increasing proportion of parasomnias and complex sleep disorders are being referred, including REM Behaviour Disorder (RBD). RBD is a parasomnia characterised by violent, potentially injurious behaviour associated
with dream enactment emerging out of REM sleep. Older males are predominantly affected with an estimated prevalence of 0.5% in the general population. The diagnosis is based on clinical and polysomnographic (PSG) criteria, and there is an association with the α-synucleopathies (Parkinson’s disease/Lewy body disease/Multi-system atrophy).

**Methods:** Retrospective review of all cases of definite or probable RBD as defined by ICSD-2 criteria referred to our unit between 2003 and 2010. Cases were identified by searching outpatient clinic letters and sleep study reports using the term “REM behaviour disorder” with subsequent review of case notes. Where available PSG results for all cases were also reviewed to ensure that diagnostic criteria were met.

**Results:** 26 cases (23 males) of RBD were identified with 69% diagnosed since 2008. Mean age was 66 years (45–80), with a mean diagnostic latency of 7.3 years (0.5–40). Violent behaviour was present in all cases, but video monitoring demonstrated abnormal REM motor activity in only 3 subjects. Significant sleep related injury (defined as lacerations or fracture-dislocations) occurred in 31%. 10 patients had a history of mood disorder for which medication was being taken, and 42% had concurrent moderate or severe obstructive sleep apnoea (AHI ≥ 30), with persistent RBD despite effective CPAP therapy in most of these cases. Mean Epworth sleepiness score was 10 (SEM 0.89). 4 patients had definite (and 5 suspected) α-synucleinopathy at initial presentation. Clonazepam (mean dose 0.5 mg) resulted in effective symptom control in all but 2 patients.

**Discussion:** This case series highlights the increasing referral rate yet persistent long latency before diagnosis of RBD, and illustrates some key clinical associations including obstructive sleep apnoea and neurodegenerative disease. Many patients with RBD self-report excess daytime sleepiness and there is a significant incidence of sleep related injury. Low dose clonazepam is a highly effective and well tolerated treatment.

**P131**

**LOCALIZED EXCITATION DIFFERENCES IN BRAIN DURING SLEEP DISORDERS: AN EXPLORATORY STUDY**

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**Introduction:** Prospective studies have indicated the presence of functional inter-hemispheric (left and right brain) asymmetry associated with different sleep events and state transitions in OSA. The central objective of the current study is to explore whether the phenomenon of EEG coherence is specific to the two hemispheres or arising from coordinated localized processes occurring within the brain. EEG data were filtered into the following component signals: δ(0.5–4 Hz), θ(4.1–8 Hz), α(8.1–12 Hz), and β(12.1–16 Hz), and spectral coherence were calculated at each band, one epoch (30 s) at a time, between electrode groups in different regions. We displayed coherence information using topographical maps.

**Results:** Figure shows a series of topographical maps before, during and after an apnea event in the β component. Light areas show the high coherence and dark areas show decreased coherence. In the δ, α and β bands, coherence increased significantly (p < 0.05) as the state changed from WAKE (S0) to NREM (S1) (3.96 ± 2.12 in δ, 23.13% ± 1.89 in α and 91.72 ± 16.57 in β). During S1 to REM (S0) transition coherence increased for all the frequency bands. In the S0 sleep, the occurrence of events (apnea/hypopnea or arousal) were generally associated with a significantly (p = 0.05) high increase in IHA, in the α(27.98% ± 7.57), β(19.89% ± 4.75) frequency bands.

**Discussion:** Results suggest that EEG coherence is not limited to left and right hemispheres of the brain during OSA. These results need further study using larger data sets and better localization algorithms.
P133
FLEXIBLE PRESSURE DELIVERY FOR IMPROVING COMPLIANCE TO POSITIVE AIRWAY PRESSURE TREATMENT IN SLEEP APNOEA PATIENTS: SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMISED CONTROLLED TRIALS

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Introduction: Flexible pressure delivery contrasts with standard continuous positive airway pressure (CPAP) by reducing pressure for the first part of exhalation. It has been advertised as improving patient comfort and compliance and been marketed under brand-names such as C-Flex and Expiratory Pressure Relief. This technology has been available for some years and has been the subject of numerous randomised controlled trials. As such a systematic review and meta-analysis of its effects on compliance compared to standard CPAP and other additional benefits is now warranted.

Methods: A systematic literature search was undertaken using PubMed from 1 January 2000–24 May 2010. Randomised controlled trials comparing flexible and standard CPAP in OSA patients over 18 years of age for at least one week were independently identified by the two authors. The mean, standard error and sample size for the differences in all relevant outcome measures and the relevant trial characteristics were extracted by both authors. For analysis of both cross-over and parallel trials, both fixed and random effects models were applied, a Q-test for heterogeneity performed, and an I² statistic calculated. Data collection from corresponding authors of some original trials is ongoing.

Preliminary Results: 10 trials were identified (patients n = 605), all using C-Flex technology. Meta-analysis of four parallel studies indicated that C-Flex was not used more than CPAP (0.18 hours; 95% CI = 0.09 to 0.26, p = 0.21). Similarly, in the 3 crossover studies C-Flex was not used more than CPAP (0.20 hours, 95% CI = 0.28 to 0.66, p = 0.39). C-Flex was not found to be significantly better than CPAP in improving either Epworth Sleepiness Scale, maintenance of wakefulness test or psychomotor vigilance task reaction times (all p > 0.05).

Discussion: Flexible pressure modifications of CPAP do not lead to significantly better compliance with therapy, nor could we detect any other additional benefits for symptoms.

P134
BENEFITS OF HIGH CPAP COMPLIANCE ARE CAUSED BY BOTH PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS: META-ANALYSED DATA FROM TWO RANDOMISED PLACEBO-CONTROLLED CROSSOVER TRIALS

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Introduction: Some of the observed dose-dependent effect of Continuous Positive Airway Pressure (CPAP) on sleepiness in sleep apnoea patients (Weaver et al. SLEEP 2008) might be due to a placebo-like expectation of benefit, where conscious knowledge of CPAP use drives reported symptom relief in addition to physiological effects on Obstructive Sleep Apnoea (OSA). Analysis of placebo-sham–CPAP controlled trials may help quantify the relative strength of these two effects: physiological and psychological.

Methods: Two placebo-controlled cross-over trials were combined in an individual patient meta-analysis. (Trial 1: 29 mild-moderate OSA patients [Marshall et al. Thorax 2005]; trial 2: 28 moderate-to-severe patients [Phillips et al. in preparation]). Mixed model analysis of variance was used to quantify the effects of raw compliance (High vs. Low cut at 4 hours/night) and the interaction between treatment and compliance on both Epworth Sleepiness Scale (ESS) and the Functional Outcomes of Sleepiness Questionnaire (FOSQ). A significant interaction effect indicates that physiological benefits of compliance exceed psychological benefits. The analysis controlled for the regression to the mean and treatment effects (i.e. sham vs. CPAP).

Results: High compliance regardless of treatment resulted in superior improvement in the ESS (mean = 2.1 points; 95% CI = 1.0–3.3, p < 0.01). The interaction effect between compliance and treatment was significant (p = 0.03). The interaction was evidence of the effect of high use of CPAP being greater than the effect of high compliance with sham (1.8; 0.8–2.9, p < 0.01). High sham use almost had a greater effect on ESS than low sham use (1.3, −0.1–2.7, p = 0.07). High compliance improved the total FOSQ score more than low compliance, regardless of treatment (1.1, 0.47–1.7), p < 0.01). There was no significant interaction between compliance and FOSQ improvement (p = 0.16), partially because the main treatment effect was not significant (p = 0.53). Similar results were obtained for each FOSQ subscale.

Discussion: High compliance with CPAP is associated with greater symptom relief. These sham CPAP controlled trials show that some of this effect is a psychological expectation of benefit. This might be caused by high compliance or may also be a characteristic of the ‘compliant patient’.
MSLT studies were both performed following overnight in-laboratory CPAP polysomnography studies at usual fixed pressure.

**Results:** Of the study subjects, 5 were male and 3 were female (aged 57 ± 6 years [mean ± SD]; body mass index 37 ± 13 kg/m²) with an Epworth Sleepiness Score of 11 ± 4. The pre-CPAP Respiratory Disturbance Index (RDI) was 32 ± 20 events/hr (n = 7) and the Arousal Index (AI) was 29 ± 16 events/hr. For the two overnight CPAP review studies, there were no significant differences in sleep efficiency, total sleep time, % sleep stage, RDI and AI (all p > 0.1). During MSLT, there was no significant difference in SL with (8.5 ± 5.7 min) or without (8.5 ± 5.5 min) usual CPAP. Number of naps (N = 3 ± 1.4, NM = 3.3 ± 1.0) and number of arousals per nap (N = 5.7 ± 3.4, NM = 6.9 ± 4.1) were also similar.

**Discussion:** We conclude that the use of usual CPAP therapy in a sleepy treated OSA patient during an MSLT does not change the nap SL, nap propensity or nap sleep disturbance compared to MSLT performed without CPAP therapy.

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**APAP INCREASES USAGE IN PATIENTS WITH CPAP RELATED AEROPHAGIA**

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**Introduction:** The purpose of this project is to assess whether APAP will increase usage and decrease symptoms in patients with CPAP related aerophagia.

**Methods:** This is a randomised, double blinded, cross-over study. Patients who presented to the Sleep Disorders Centre with symptoms of aerophagia were recruited. Patients were randomly assigned to either fixed pressure CPAP at their recommended setting or APAP with a window of 6 to 20 cm H2O. After a two week period objective measures of usage and subjective measures of symptoms were documented and the patients crossed over to the remaining arm of the study. All parameters were re-assessed at the end of this second two week period. A single device was used for both arms of the study (with software changes to program either CPAP or APAP) in order to blind the patient to the treatment arms.

**Results:** At present a total of 33 patients have been recruited, 25 patients have completed the research protocol and 8 patients have withdrawn. Lower figures in the Visual Analogue Scale data show reduced incidence or severity of the symptoms.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CPAP</th>
<th>APAP</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage (hrs/night)</td>
<td>5.3 ± 2.2</td>
<td>6.0 ± 2.1</td>
<td>0.012</td>
</tr>
<tr>
<td>Visual Analogue Scale Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belching</td>
<td>3.2 ± 3.0</td>
<td>1.4 ± 1.2</td>
<td>0.013</td>
</tr>
<tr>
<td>Bloating</td>
<td>5.2 ± 3.5</td>
<td>2.5 ± 2.0</td>
<td>0.002</td>
</tr>
<tr>
<td>Worst episode of bloating</td>
<td>6.1 ± 6.0</td>
<td>3.2 ± 3.7</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Discussion:** The preliminary results show that APAP is an effective method of increasing usage whilst reducing symptoms in patients with treatment related aerophagia.

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**NASAL VERSUS FULL FACE. SAME PRESSURE?**

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**Introduction:** The aim of this study was to determine whether the optimal positive airways pressure requirement is altered in patients with obstructive sleep apnoea when the delivery interface is changed between a nasal interface and a full face interface. It is hypothesised that some patients will have a reduction in the airway size due to the mechanical force exerted on the lower jaw to seal a full face mask. This decrease in airway size may result in a higher pressure requirement.

**Method:** The study design was a randomised, crossover trial. Optimal pressure was determined using an APAP device with a pressure range of 6–20 cm H2O. Patients underwent two weeks treatment using a nasal interface and two weeks using a full face interface. The first interface was assigned in random order. Facial measurements such as retrogнатhia, Mallampati score and pharyngeal dimension were recorded to assess pre-disposing factors.

**Results:** The 95th centile pressure for each two week period was compared. A significant number of patients (4/10 patients) have withdrawn due to intolerance of the full face mask. Nasal mask 95th centile pressure = 11.3 ± 1.0 (SD) cm H2O (n = 6), full face mask = 11.1 ± 0.7 cm H2O (n = 6). At this stage there was no statistical difference between the two interfaces. The study is ongoing as 56 patients are required to power the study.

**Conclusion:** Interfaces are often interchanged indiscriminately to achieve the maximum comfort and seal and to minimise pressure leak due to mouth opening. This study may help identify patients who have different pressure requirements when the interface is changed. More numbers are required to conclusively confirm that changing the interface does not affect pressure requirements.

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**SLEEP APNEA CARDIOVASCULAR ENDPOINTS (SAVE) TRIAL**

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**Background:** Despite increasing evidence of a link between obstructive sleep apnea (OSA) and cardiovascular (CV) disease RCTs of OSA therapy with hard CV endpoints are needed to prove causality and before routine OSA screening of CV patients. There is concern that such trials may not be feasible: e.g. lack of clinical equipoise may limit enrolment, minimally symptomatic high CV risk patients may not adhere to CPAP therapy and control patients may cross-over to active treatment.

**Methods:** SAVE is an international, multicentre RCT of CPAP plus standard care vs standard care alone in patients with CV disease and co-existing OSA: n = 5000, follow-up 4 yrs, composite CV endpoint of

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sudden death, MI, stroke, unstable angina, TIA and heart failure. All eligible patients have a 1-week run-in phase with sham CPAP before randomisation to exclude those unable/unwilling to accept CPAP.

**Results:** SAVE began in Australia and China in Dec 2008. To date 55 sites have randomised 546 patients (95 Australia, 442 China, 9 New Zealand). 72% of patients had a baseline Epworth Sleepiness Score (ESS) ≤ 10. Average recruitment during the roll-out phase has been approximately 1 patient/site/month. CPAP adherence at 1, 3, 6 and 12 months was 5.0 ± 0.11 (n = 208), 5.0 ± 0.12 (n = 164), 4.8 ± 0.15 (n = 118) and 4.3 ± 0.33 (n = 34) h/night and was not different between sleepers (ESS > 10) and non sleepers patients (4.9 vs 5.0 h/night). In the first 18 months 18 (3%) patients withdrew and 9 of 273 (3%) in the control group crossed-over to CPAP.

**Conclusions:** There has been widespread acceptance of the trial by clinicians and patients in China and Australia and New Zealand. Recruitment rates are relatively low due to the complexity of screening but CPAP adherence is high and patient drop out and cross-over rates are low.

**P139**

**OSA SEVERITY MEASURED BY AHI DOES NOT PREDICT IMPROVEMENT IN QUALITY OF LIFE WITH CPAP THERAPY**

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**Introduction:** FOSQ is widely used as an instrument to assess how excessive sleepiness affects a patients’ ability to conduct normal activities and the extent to which these abilities are improved by effective treatment. The severity of obstructive sleep apnoea (OSA) is often quantified by the apnoea hypopnoea index (AHI) but it is uncertain how this correlates with changes in quality of life post treatment.

**Methods:** We retrospectively analysed data from all patients seen at The Princess Alexandra Sleep Disorders Centre between January–June 2010 who were eligible for provision of CPAP under the Queensland Health CPAP program. Patients were divided into groups based on severity as measured by AHI and FOSQ scores were analysed.

**Results:** Ninety six patients (56 males, mean age 56.96+9, range 26.3–78 years) with a median BMI of 39.066 kg/m2 had a median diagnostic AHI of 28.8 and mean baseline total FOSQ of 13.665 (CI 95% 11.8–15.7). Ninety six patients had mild OSA (AHI ≥ 5 and ≤ 14.9; mean AHI 10.92 ± 4.95 CI ± 1.686). 30 patients had moderate OSA (AHI 15–29.9; mean AHI 22.363 ± 95% CI ± 5.39), and 41 patients had severe OSA (AHI > 30; mean AHI 66.237 ± 5.39 CI ± 8.32). There was no significant difference in the change in FOSQ score with treatment between those with mild compared with severe OSA at baseline (p = 0.207). Total change in FOSQ score correlated poorly with diagnostic AHI (r² = 0.0491).

**Conclusion:** OSA severity as defined by the AHI does not predict improvements in quality of life with CPAP treatment. Pre treatment AHI does not predict pre treatment FOSQ scores in sub-domains of activity, intimacy and sexual relationships, social outcomes or vigilance.
 SenseAwake® or SAw). The reduction in pressure during awakenings may abbreviate the duration of the awakening and reduce wake-after-sleep-onset (WASO), or have an acute effect on sleep architecture.

**Methods:** Newly diagnosed CPAP-based trials with OSA. Apnoea hypopnoea index (AHI) > 15/hr were given in a random order conventional auto-CPAP and modified auto-CPAP (SAwOFF vs. SAwON: SleepStyle 200 Series AutoCPAP, Fisher and Paykel Healthcare, Auckland NZ), during a single in-laboratory night of each with a 1-week washout. Participants and outcomes assessors were blinded to the therapy condition. Efficacy data were measured using both in-lab polysomnography and device-derived data and the primary outcome was WASO.

**Results:** Patients who completed the trial had moderate-to-severe OSA and were moderately sleepy (mean baseline AHI 32.8 ± 19.6/hr, Epworth Sleepiness Scale 10.8 ± 8.0, n = 42 with 32 males). OSA was adequately controlled in both conditions (5.7 ± 5.9/hr SAwON v. 5.4 ± 3.8/hr SAwOFF p = 0.7). WASO was not significantly different between the two therapies (SAwON 74 ± 54 min v. SAwOFF 78 ± 51 min, p = 0.6).

Pre-specified sleep architecture measures were not affected by SenseAwake. Mean and 90% pressure were significantly reduced (mean SAwON 6.9 ± 1.9 v. SAwOFF 7.7 ± 2.5 cmH2O, p = 0.035; and 90% 9.5 ± 2.7 v. 10.6 ± 2.7 cmH2O, p = 0.011).

**Conclusions:** AutoCPAP with SenseAwake successfully controlled sleep apnoea in a one night in-lab crossover trial and reduced mean and 90% pressure. However, the SenseAwake modification did not significantly improve WASO or any other sleep architecture measure on single night testing. Longer term community-based trials are required to test whether SenseAwake causes increased adherence or acceptability with therapy and whether this translates into improved outcomes for patients.

Clinical Trial Registration Number: NCT00811213.

**P142**

**PHYSICIAN-LED CPAP ACCLIMATISATION IMPROVES CPAP THERAPY UPTAKE RATES IN PATIENTS WITH OSAS**

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**Introduction:** Obstructive sleep apnoea syndrome (OSAS) is a common chronic condition. CPAP therapy is the most efficacious and frequently used treatment for OSAS. Previous studies have reported failure of CPAP uptake as high as 1/3rd of cases, but in these studies it is unclear who cared for the patients during the acclimatisation phase. In our unit, prior to 11/10/2008 CPAP acclimatisation was industry-led care (IC), by private providers with some physician input. The physician-led care (PC) model commenced on 12/10/2008. It is a hospital outpatient based program, with support provided by a physician and a scientist who are both independent of commercial interests.

**Objective:** To examine the effect of a physician-led CPAP acclimatisation program on CPAP uptake rates compared to a historical industry-led model.

**Methods:** A chart review was performed for all CPAP naïve adult patients from 18/07/07 to 31/12/09. Multiple logistic regression was used to test the effect of PC compared to IC on CPAP uptake rates with appropriate adjustment for confounding factors.

**Results:** A total of 196 charts were reviewed and 149 met selection criteria. There were 74 IC patients and 75 in PC patients. The mean age was 55.3 ± 15.4 years, the mean BMI was 34.1 ± 7.4 and the mean Epworth Sleepiness Scale (ESS) was 11.4 ± 5.4. The mean AHI was 41.2 ± 27.6 and the total AHI was over 30 in 55.2% of patients. Males accounted for 66.4% (99/149). There were no differences in baseline characteristics between the two groups. CPAP acclimatisation was successful in 64.4% of IC patients and in 83.8% of PC patients (p = 0.007). Adjusting for age, gender, BMI, ESS and OSAS severity, IC patients were 3.1 (95% CI = 1.3, 7.6) times more likely to fail CPAP acclimatisation compared to PC patients (p = 0.01).

**Conclusion:** Physician-led CPAP acclimatisation significantly improves CPAP therapy uptake in patients with OSAS. This study confirms that the type of care patients receive during PC CPAP acclimatisation dramatically influences CPAP uptake rates.

**P143**

**ADOPTION AND DIFFUSION OF CONTINUOUS POSITIVE AIRWAY PRESSURE TECHNOLOGY IN NEW ZEALAND**

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**Introduction:** We present the results of a pilot study for a larger research project focusing on the antecedent variables relating to adoption and diffusion of Continuous Positive Airway Pressure (CPAP) technology in New Zealand.

**Methods:** The research paradigm is that of detailed in-depth case studies that will yield a rich picture of the actual process of adoption and diffusion at an individual level of analysis. The pilot study presents a qualitative analysis of responses from a follow-up questionnaire sent to 100 consecutive patients of a private sleep clinic more than 12 months after electing to commence long-term CPAP therapy for a variety of presentations ranging from simple snoring through to extremely severe sleep apnoea. The questionnaire includes an open ended question “What is the main benefit for you from using CPAP therapy?”.

**Results:** 1) (Quantitative analysis of pre CPAP and post CPAP-trial assessments of oxygen desaturation index, Epworth Sleepiness Score, snoring, nocturnal bladder pressure, daytime sleepiness, compared with quantitative questionnaire markers, to be supplied), 2) (Qualitative analysis of key concepts emerging from open-ended questionnaire also to be supplied).

**Discussion:** Despite being the gold-standard treatment for obstructive sleep apnoea and, by extension, any degree of upper airway resistance related social and/or psycho-physiological dysfunction (the so-called “Snores’s Syndrome”), few reliable disease-based determinants of CPAP adoption have been identified. Better success has been had from models of behavioural change such as social cognitive theory (SCT) and the transtheoretical model (TM), suggesting sociological instruments for research might shed even further light on understanding adoption of CPAP technology. This research will provide background for the detailed case studies from which a grounded theory will be advanced.