Obstructive Sleep Apnoea Syndrome
Among Taxi Drivers:
Consequences and Barriers to Accessing Health Services

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

In

Public Health

at Massey University, Sleep/Wake Research Centre

Wellington Campus

New Zealand

Ridvan (Riz) Tupai-Firestone

2006

ABSTRACT

Untreated Obstructive Sleep Apnoea Syndrome (OSAS) increases the risk of motor vehicle accidents and morbidity. Its prevalence among taxi drivers is unknown. The goals of this thesis were to: (1) estimate the prevalence of OSAS symptoms and risk factors among taxi drivers; and (2) identify the barriers to accessing health care services for the diagnosis and treatment of OSAS.

Between June and July 2004 questionnaires were mailed to 651 taxi drivers from two Wellington taxi companies (response rate 41.3%, n=241). Excessive daytime sleepiness (ESS>10) was reported by 18% of drivers. The estimated proportion with a pre-test risk of OSA (RDI≥ 15/hour) was 15%, according to a questionnaire-based screening tool. Pacific drivers were more likely to report OSAS symptoms than people of "other" (non-Māori) ethnicities. Logistic regression analyses identified the following independent risk factors for OSAS symptoms: increasing neck size, age groups: 46-53 years and 61-76 years, and self-reported snoring 'always'.

Three focus groups were conducted in November 2004. Thematic analyses identified the following barriers to accessing health care: (1) sleepiness was not a perceived health problem; (2) personal demands; (3) industry demands; and (4) driver avoidance and dissatisfaction with general practitioner's services. Detailed examination of these themes indicated that drivers were deterred from seeking care by limited knowledge and awareness of OSAS, confusion about responsibility for health and safety, medical costs, and the risk of finding out about other health conditions. General practitioners reportedly failed to screen for OSAS symptoms and demonstrated little knowledge about sleep health. These barriers are a major cause for concern, and they are used to support the belief that earning a living is more important than personal health and safety. The key finding is that improving drivers' knowledge is unlikely to change their behaviour, without concurrent measures to address systemic issues in the taxi industry and in the health care system.

ACKNOWLEDGEMENTS

I saw this project as a journey with three goals in mind: (1) a means of developing public health research skills, quantitative and qualitative; (2) an opportunity to do sleep research; and (3) a gate-way of developing myself as a Pacific Researcher by establishing many networks nationally and internationally. With the HRC PhD Pacific scholarship I have completed all three of these goals, and for that I am grateful.

There are many people that have helped me on my journey, and this is a chance for me to acknowledge them. I am grateful to *Prof. Philippa Gander* who has given me this research opportunity, and especially for allowing me the flexibility in my work (having a baby). Thank you to *Dr Angela Campbell*, my HRC Academic Mentor, and to *Dr Margaret Southwick* and *Dr Marg Gilling* who have guided my qualitative work. I would like to acknowledge my colleagues: *Dr Leigh Signal*, *Dr Kara Mihaere*, *Dr John Matthewson*, *Dr Sandy Garden*, *Dr Nathaniel Marshall*, *Sarah-Jane Paine*, *Margo van den Berg*, *Allison Clark, Noemie Traviers*, *Naomi Brewer and Heather Purnell*. *Dr Kara Mihaere* requires particular acknowledgement. Thank you for being such a good friend, fixing computer, statistical problems, and formatting this thesis. I have also enjoyed our raving reviews of our favourite trashy-TV programmes which has always been a great distraction *kia ora!* I would also like to acknowledge my close friends: The *Anorpong Family* and the *Zemke-Smiths Family* for all the love and support you have showered upon my family – I consider you all as part of my fanau. I am grateful to the inner-most important circle of support, *my fanau*. To my parents, *Noa* and *Tua Tupai, Sylvia Barrett, Alexander* and *Judith Firestone* – thank you for being such wonderful parents, you are all pillars of strength. To my brother and sisters: *Aubrey, Antonia, and Sala* for your love and support. Finally, I wanted to acknowledge my dearest husband *James* and my beautiful daughter *Justice.* You have both been the true source of inspiration and my twin towers of support and strength. Thank you for grounding me during the hard times, and for reminding me why I pursued this pathway in the first place– for a better start in life, for a better education, and as 'education is knowledge' it is the knowledge that I want to give back to my people (Pacific peoples). I dedicate this thesis to you both.

TABLE OF CONTENTS

Appendices

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS & GLOSSARY

%	Percentage
AASM	American Academy of Sleep Medicine
AHI	Apnoea-Hyponea Index
BMI	Body Mass Index. Measured in kilograms divided by height in metres squared (kg/m)
BP	Blood Pressure
CI	Confidence Interval
nCPAP	Nasal continuous positive airway pressure
CSA	Central Sleep Apnoea
CSC	Community Services Card
CVA	Cerebrovascular Accident
CPS	Cycles per second - measurement for EEG waves patterns
CVD	Cardiovascular Disease
ECG	Electrocardiogram
EDS	Excessive Daytime Sleepiness
EEG	Electroencephalogram
ES	Effect size. The size of effect on a given measure divided by the background standard deviation of that measure. Yields the magnitude of the effect.
EMG	Electromyogram
ESS	Epworth Sleepiness Scale
EOG	Electrocculogram
FOSQ	Functional Outcomes Sleep Questionnaire. Sleepiness related quality of life measure
HSE Act	Health and Safety in Employment Act 1992, Amendment Act 2003
Hyperlipidemia	An excess of concentrated fat in the blood
ICSD	International Classification of Sleep Disorders
Incidence	The number of new events within a specific period of time
LTNZ/LTSA	Land Transport New Zealand, former name was Land Transport Safety Authority
MAP	Multivariable Apnoea Predictive test
MCI	Myocardial infarction
MESAMIV	Madaus Electronic Sleep Apnoea Monitor 4
MSLT	Multiple Sleep Latency Test
MVA	Motor vehicle accidents
MWT	Maintenance of Wakefulness Test
NREM	Non-Rapid Eye Movement sleep
NZE	New Zealand European group
NZTF	New Zealand Taxi Federation
OA	Oral appliance
ODI	Oxygen Desaturation Index
OECD	Organisation for Economic Co-operation and Development
OR	Odds ratio
OSA	Obstructive Sleep Apnoea

OSAHS	Obstructive Sleep Apnoea-Hypopnea Index
OSAS	Obstructive Sleep Apnoea Syndrome
Prevalence	The number of events of a given disease or condition in a given population at a designated time
PSG	Polysomnography
RCT	Randomised controlled trial
RERAs	Respiratory effort related arousals
REM	Rapid eye movement sleep
RTS	Return to sender
RDI	Respiratory Disturbance Index
SAS	Sleep Apnoea Syndrome
SD	Standard deviation
SDB	Sleep Disordered Breathing
SHHS	Sleep Health Heart Study
SWS	Slow wave sleep or deep sleep. Stages 3 and 4 of sleep marked by the predominance of delta waves in EEG (0-2cps)
SNZ	Statistics New Zealand
SWRC	Sleep/Wake Research Centre
Shift-work	Work hours outside the regular work times 0800-1700
SSS	Stanford Sleepiness Scale
TIB	Time in bed
UAR	Upper Airway Resistance
UARS	Upper Airway Resistance Syndrome
UPPP	Uvulopalatophyrangoplasty
US	United States
Fanau	Family, extended family - Samoan
Māori	The indigenous people of New Zealand
TRRHAEP	Te Rōpū Rangahau a Eru Pōmare
Whānau	Family, extended family - Māori

CHAPTER 1
INTRODUCTION

Like food and water, sleep is also vital for functioning in all aspects of daily activity (Roehrs, Carskadon, Dement, & Roth, 2005). Cognitive and behavioural functioning is impaired when sleep quality is disrupted and the quantity of sleep is reduced. A common cause is known as Sleep Disordered Breathing (SDB), when abnormal respiration occurs during sleep (Roth & Roehrs, 2000). Within the spectrum of SDB there is a condition called obstructive sleep apnoea (OSA), defined by having at least five or more respiratory disturbances per hour of sleep (RDI≥5). OSA syndrome (OSAS) is when the individual with OSA exhibits hypersomnolence, because the quality of sleep is disturbed and fragmented (Guilleminault & Bassiri, 2005).

There are a growing number of studies examining the prevalence of OSAS. In New Zealand, a study by Mihaere (2004) found that OSA, defined as having more than five respiratory disturbances per hour of sleep, (RDI≥5) is prevalent particularly among men (47.3%) compared with women (24.9%). This study developed a screening tool to predict the probability of OSA for use in a primary care setting. A companion study by Harris (2003) demonstrated that the symptoms of and risk factors for OSAS are highly prevalent in the general population. Moreover, the risk factors were more prevalent among Māori than non-Māori. Internationally, the most widely quoted prevalence rates for OSAS among middle-aged men is 4% and 2% for women. This was based on OSAS being defined as having more than five apnoea-hypopnoea events per hour of sleep (AHI≥5), plus the symptom of daytime sleepiness. These rates are based on an overnight diagnostic sleep study (polysomnography), thus they are acceptably accurate estimates (Young et al., 1993).

This thesis is interested in taxi drivers for several reasons: (1) little is known about them; (2) the taxi industry is predominantly a middle-aged, male-based occupation; and (3) taxi drivers can work flexible, extended hours which places a degree of risk on personal health and passenger safety. The study used the research tools and information from the aforementioned New Zealand studies. It extends the knowledge-base of OSAS by estimating the prevalence of OSAS risk symptoms in a group of professional taxi drivers. The current thesis goes beyond the realm of the traditional quantitative research methods by identifying factors that inhibit professional taxi drivers from accessing health care services for OSAS. The latter part of the study offers new information, as little is known about barriers to care for professional drivers.

It is envisaged that the findings of the study will contribute to informing health service providers and physicians, by improving their clinical awareness and management of professional taxi drivers, and other commercial drivers who may present with symptoms and risk factors of OSAS. Furthermore, the findings will also inform policy makers in the transport and health industries with guidance for better assessment and treatment opportunities for drivers at risk of OSAS.

1.1.1 Summary of chapters

This thesis is composed of two studies. First, the survey questionnaire study sets out to identify the prevalence of OSAS risk factors and symptoms as a basis for the second study, which uses focus groups to draw out information that has not previously been explored. Each study is presented separately in the following manner:

The Questionnaire Study

Chapter Two (Background) – This chapter provides an overview of the physiology of sleep and the effects of sleep loss on waking function. A comprehensive overview of the pathophysiology, diagnosis of, and treatment options for, OSAS is given, along with a review of the epidemiological literature pertaining to prevalence rates, risk factors for the disorder, and associated motor vehicle accident risk. The chapter concludes with a brief background to the study along with the aims and hypotheses.

Chapter Three (Methods) – This chapter describes the methods of the questionnaire study, which includes a detailed description of the survey questionnaire tool, data collection, data management procedures and a description of statistical analyses.

Chapter Four (Results) – The results describe the sample, prevalence of risk factors and OSAS symptoms, and the pre-test risk of OSA is presented.

Chapter Five (Discussion) – This chapter is separated into three sections. The first section outlines methodological issues associated with the chosen research method. This sets the context for the subsequent discussion of the results. The second section reviews and provides a summary of the descriptive and logistic regression analyses. The third section discusses the implications of the results.

The Focus Groups Study

Chapter Six (Background) – This chapter outlines the methodologies used to inform the Focus Groups study. The rationale underlying the qualitative nature of the study is outlined along with the hypotheses of the study.

Chapter Seven (Methods) - This chapter provides an extensive description of the procedures, the tools used to record the focus groups discussion, and the selection criteria for the study.

Chapters Eight to Ten (Findings) - These chapters presents the findings from each focus group separately in the order that each group occurred: New Zealand European, Māori and Pacific people, and people of "other" ethnicities. Analyses of the main themes from each focus group are illustrated by quotations from each group's discussions.

Chapter Eleven (Interpretation) – This chapter is divided into two parts. Part one evaluates the predominant themes across the focus groups, discussing the impact of the themes on drivers. The limitations of the study are also outlined. Part two highlights the ethical concerns in the current study.

Chapter Twelve (Conclusions & Recommendations) –This chapter summarises the key findings from both studies, and concludes with practical recommendations for improving access to care, along with recommendations for future research.

CHAPTER 2
BACKGROUND

2.1 Introduction

This chapter provides a review of the literature in the following areas. (1) a brief overview of the physiology of sleep is given to provide an understanding of the disorder in question; (2) an overview is given of OSAS, diagnostic and treatment options, along with its effects on waking function, to provide insight on how OSAS can affect the individual in daily activities and its impact on overall health; (3) epidemiological information is also provided so the magnitude of OSAS as a public health problem is appreciated; (4) an outline of the background information about the study is given as a means of setting the research context; and finally (5) the goals of the study are listed with specific objectives and hypotheses.

2.2 Basic Sleep Physiology

According to Carskadon and Dement (2005) sleep can be defined behaviourally as, "a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment" (p 13). Various physiological and behavioural anomalies of sleep exist that are of interest to the sleep research community. For the current thesis, the sleep anomaly of interest is related to the combination of breathing and sleep as vital processes for survival. However, it is first necessary to describe briefly the characteristics and functions of sleep.

2.2.1 Sleep architecture

There are three principal physiologic correlates that characterise different states of sleep and wakefulness, they are: (1) electroencephalogram (EEG) measures brain wave activity; (2) electrooculogram (EOG) measures eye movements, and (3) electromyogram (EMG) measures muscle tone (Siegel, 2005). These measures are used to describe and differentiate between sleep states.

Sleep is comprised of two very different physiological states. The first state is known as Rapid Eye Movement (REM), commonly referred to as REM sleep. It is characterised by bursts of rapid eye movements, muscle atonia and heightened autonomic activity. Cardiorespiratory irregularities and muscle twitches usually accompany the bursts of REM sleep. The behavioural pattern of short-lived tonic events, followed by intervals of inactiveness, is a distinguishing marker of REM sleep (Carskadon & Rechtschaffen, 2005). Interestingly to note, during REM sleep, motor activity is inhibited. The nucleus pontis oralis is the site which is responsible for initiating muscle atonia during REM sleep. The inhibitory neurotransmitter is glycine (Chase & Morales, 2005). Motor paralysis can be viewed as a protective mechanism, preventing individuals 'acting-out' their dreams (Gander, 2003). REM sleep is usually referred to as 'paradoxical sleep', the paradox being high brain activity coupled with muscle atonia (Siegel, 2005). Finally, vivid dreams have been most commonly reported during REM sleep (Hobson, Pace-Schott, & Stickgold, 2000).

The second physiological state is known as non-REM sleep (NREM). There are four arbitrarily defined stages (stages 1, 2, 3 and 4), which are on a continuum described in parallel to the depth of sleep. NREM and REM sleep occur throughout the night in a cyclic fashion.

Stage 1 NREM is light sleep. In duration it can take seconds to minutes, and awakenings occur with the gentlest stimuli (e.g., closing the door). Electrical brain activity is in the range of 8-13 cycles per second (cps) which is categorised as the frequency band alpha (Carskadon & Rechtschaffen, 2005). Thus, stage 1 is usually a transitory stage throughout the night because of its low threshold to stimuli. Eye movements, characterised by EOG recordings of slow rolling horizontal movements, are another feature that classifies stage 1 NREM sleep. Muscle tone is usually maintained throughout all NREM sleep stages.

Stage 2 emerges as an individual descends into deeper sleep and slow rolling eye movements disappear. This stage occurs for a longer period of time (10-20 minutes). The striking features of stage 2 NREM sleep are bursts of quicker waves known as *sleep spindles* and spontaneous *K-complexes* evoked by auditory stimuli, but not resulting in awakenings. The latter feature (K-complexes) is a distinguishing feature of mammalian sleep with EEG activity in the range of 12-14 cps (Carskadon & Rechtschaffen, 2005).

Stage 3 NREM sleep is identified by the presence of high voltage slow waves (SWS), defined by EEG activity less than 2 cps, that occupy less than 50% of an epoch (typically 30 seconds). SWS (also known as delta or deep sleep) dominates the first third of the night and is commonly denoted as 'deep sleep' because the level of arousal required to wake is greater than from stage 1 and stage 2 sleep. The EEG is synchronous with little, fragmentary, mental activity (Carskadon & Rechtschaffen, 2005).

Stage 4 NREM sleep comprises more than 50% of high voltage slow wave EEG activity. Eye movements are not common during stages 3 and 4 sleep, although muscle activity may be active (Carskadon & Rechtschaffen, 2005).

The first cycle of NREM and REM sleep lasts on average for about 70-100 minutes. The first REM sleep occurrence is usually very short. Successive NREM/REM cycles increase in duration across the night, lasting up to 90-120 minutes from the beginning of one REM period to the next. Towards the early morning there are longer and more intense bouts of REM sleep. The last NREM/REM sleep cycles are predominantly made up of short NREM stages 1 and 2 and long bouts of REM sleep (Carskadon & Rechtschaffen, 2005).

In normal sleep, fragmentation of NREM and REM sleep cycles is characterised by frequent arousals to a lighter stage of sleep, or to wakefulness, thus disrupting the restorative capacity of sleep. There are multiple reasons why sleep may be disrupted, such as aging, changes in the circadian rhythm, temperature, medication and pathology. Pathologic processes such as OSAS can alter the cycles of sleep significantly.

2.2.2 Sleep regulation

Sleep is controlled by at least two independent processes: the sleep homeostat, and the circadian process. These interact in a complex manner to control vigilance states and sleep timing.

The sleep homeostat

The homeostatic sleep drive is also referred to as 'process S'. It responds primarily to changes in the timing and history of sleep and wakefulness (Dijk & Franken, 2000). In effect, when prior sleep has been restricted or inhibited, the homeostatic process responds by a greater pressure for sleep. In the opposite manner, it reduces sleep propensity as sleep accumulates (Jenni, Achermann, & Carskadon, 2005). Using EEG, it is depicted by the Slow Wave Activity[1] (SWA) that correlates with sleep intensity, which is determined by the duration of prior sleep and wake (Borbely & Achermann, 2000).

The circadian process

Circadian rhythmicity is the result of a pacemaker in the suprachiasmatic nuclei (SCN) of the hypothalamus, which interacts with homeostatic changes in sleep drive (Borbely & Achermann, 2000). It is also referred to as 'process C'.

The word circadian originates from the Latin term '*circa*' which denotes 'about', and the term '*dies*' meaning 'a day' (Mistlberger & Rusak, 2005). The circadian pacemaker is in the bilaterally paired SCN located in the anterior hypothalamus. The SCN is receptive to light input via the retinohypothalamic tract which is a monosynaptic neural pathway that informs the SCN about the environmental light-dark cycle (Czeisler, Buxton, & Khalsa, 2000; Vitaterna, Pinto, & Turek, 2000).

Without the presence of external time cues, the circadian pacemaker is said to 'free-run' with a period that is typically longer than 24 hours (Mistlberger & Rusak, 2005). In normal conditions, time cues (e.g., light) and non-photic zeitgebers[2] (e.g., exercise) play an important role in synchronising the circadian pacemaker to a 24-hour sleep-wake cycle. This process is known as entrainment. Light is the primary zeitgeber which can induce circadian phase shifts[3] depending on the intensity, duration and timing of exposure (Czeisler, Buxton, & Khalsa, 2000; Saunders, 1977). A circadian phase delay is caused by bright light exposure late in the day or early evening, with the effect of lengthening the circadian cycle. In the opposite manner, light exposure early in the day leads to a phase-advance response, thus shortening the circadian cycle (Czeisler, Buxton, & Khalsa, 2000; Mistlberger & Rusak, 2005). Exposure to light during the middle of the day has been found to have minimal effect on phase-shifting (Mistlberger

---

[1] Slow Wave Activity (SWA) is a measure of the strength of SWS in the EEG (Gander, 2003)
[2] Zeitgeber is the general term for environmental synchronizers.
[3] The circadian pacemaker can be phased delayed or phase advanced, depending o n when it is exposed to a zeitgeber.

& Rusak, 2005). Other zeitgebers such as behavioural factors like eating, exercising and socialising also influence the circadian pacemaker, but to a lesser degree (Harrington & Mistlberger, 2000).

Under a forced desynchrony protocol[4], the circadian-influenced drive for sleep is easily observed. When close to the nadir of core body temperature, the drive to sleep increases. Alternatively, as the sleep drive diminishes, and core body temperature rises, there is an increasing drive from the circadian clock to wake (usually peaks 6 hours after the lowest point of core body temperature), and effectively the individual is programmed for wake mode (Czeisler, Buxton, & Khalsa, 2000). Forced desynchrony protocols have shown that the duration of sleep, and the time leading up to onset and length of REM sleep, are all dependent on when in the circadian cycle the individual falls asleep (Gander, 2003).

The sleep homeostatic process and the circadian process interact to affect the structure and timing of sleep. For sleep at night, sleep onset and SWS are mainly determined by the sleep homeostatic process, which peaks in the first half of the night. As the strength of the homeostatic sleep drive declines, the circadian process dominates the latter half of the night with the drive REM sleep peaking just after the body temperature nadir (Czeisler, Buxton, & Khalsa, 2000; Czeisler, Zimmerman, Ronda, Moore-Ede, & Weitzman, 1980).

2.2.3 Shift-work and the implications for sleep

Shift-work is described as work hours outside the normal work day (Monk, 2005). Therefore, sleep becomes displaced from its usual night time position which poses problems for cognitive and neurobehavioral functioning. Shift-workers tend to self-select their sleep-wake schedules because of their work, which disrupts the circadian system including physiological variables (e.g., hormonal levels) and desynchronises the internal structure of sleep. This results in sleep deprivation, fragmented sleep, and complaints of excessive daytime sleepiness (Czeisler, Buxton, & Khalsa, 2000).

---

[4] Forced desynchrony protocols place participants in artificial 'days' that are too long (e.g., 28 hours) or too short (e.g., 20 hours) for the circadian clock to follow, so that people end up sleeping across all phases of the circadian clock cycle.

The issues around shift-work are a complex web of circadian, sleep, and social factors, with each influencing the other and impacting on the ability to adapt and cope with the pressures of shift-work (Monk, 2005). When there are regular changes in the pattern of work and rest, this sends conflicting messages to the circadian pacemaker. For instance, when a person works night-shift, work activities dictate wakefulness and physical activity, yet unchanged time cues in the environment are informing the circadian clock otherwise. In shift-work, the sleep-wake pattern which drives the sleep homeostat and SWS drive can be out of step with the circadian pacemaker, which drives REM sleep propensity (Monk, 2005; Sallienen et al., 2003).

With regards to sleep timing, at the completion of a night-shift, the worker attempts to sleep after finishing work when the core body temperature is rising. At this point, the circadian wake drive is increasing, thus effectively shortening sleep (Monk, 2005). This comes primarily from a reduction in stage 2 and REM sleep, however it is an issue of sleep maintenance as opposed to sleep onset (Akerstedt, 1988). Other zeitgebers such as noise and mealtimes can influence daytime sleep reduction (Monk, 2005). In the end, the duration of sleep is typically reduced by two to four hours as a consequence of night work (Sallienen et al., 2003).

2.2.4 Effects of sleep restriction

Sleep is vital to how we function during wakefulness. On the other hand, impaired performance and alertness are indications of insufficient sleep (Carskadon & Roth, 1991). The optimal amount of sleep needed is a debated subject among the sleep research community. There are two viewpoints. One view is that of Webb and Agnew (1975), who asserted that the majority of society is chronically sleep deprived. This was based on their study of college students who extended their habitual sleep duration by two hours increasing their total sleep time to 9-10 hours. The opposite view held by Horne (1991), suggests a core amount of sleep between four to six hours per night is sufficient for adequate functioning. He further stated that any extended sleep greater than the core amount does not reflect sleep need or sleep debt, because research has indicated that oversleeping the core amount does not result in one feeling refreshed (Carskadon & Dement, 1982). Carskadon and Roth (1991) do not advocate for a single value that defines optimum sleep, rather they suggest that the optimum requirement for sleep lies somewhere between these two viewpoints. Additionally, how much sleep one needs varies between individuals and age-groups. Klerman and Dijk (2005) studied differences in sleep duration and its relationship to sleep need. Their results indicated a wide range of sleep between six to ten hours. They also found that inter-individual differences in sleep reflected how one voluntarily restricts sleep and extends wakefulness.

Implications for performance and safety

Shift-work can prevent the attainment of normal daily sleep. The consequences can be seen in sleep structure, performance and safety. The effects of sleep restriction on sleep structure can be seen in decreased amounts of NREM stages 1 and 2, and eventually REM sleep, when up to 4 hours of sleep is permitted. Conversely, the recovery of sleep is characterised by rapid sleep onset, increased SWS, and greater REM sleep than baseline, if sleep is extended (Carskadon & Dement, 1982; Carskadon & Roth, 1991; Horne & Wilkinson, 1985).

There has been research that has shown impaired performance as a result of short-term sleep restriction. Some studies (Belenky et al., 2003; Dinges et al., 1997; Van Dongen, Maislin, Mullington, & Dinges, 2003) have examined the cumulative deficits of experimental sleep restriction on waking neurobehavioral functions and psychomotor vigilance performance. Dinges et al. (1997) restricted the sleep of 16 young adults for seven days in a sleep laboratory (restricting sleep to approximately five hours a night for seven nights). They found that acute sleep restriction resulted in significant degradation and linear trends across the seven days in: subjective sleepiness, reduced alertness, fatigue, mood disturbance, stress and performance lapses (using the Psychomotor-Vigilance Test). Across the seven days there was a continued growth of deficit in all performance and mood profiles. They further reported that a single recovery night may be inadequate, although the reasons remain unclear.

A study by Belenky et al. (2003) of 66 healthy participants (aged 24-55 years) restricted sleep for seven days with three, five, seven, and nine hours time in bed (TIB) with a fixed wake up time at seven in the morning. A three-night adaptation and training period before the protocol (eight hours TIB) was carried out, and baseline data was collected on the third night. The sleep restriction protocol was followed by four recovery nights of eight hours TIB. The PVT was used to examine the effects of restricted sleep on performance. The results showed a dose-response pattern across seven days of restricted sleep, with declining psychomotor vigilance performance. This was most obvious in the three hours TIB group (severe sleep restriction) where reduced speed of responses and increased reaction times continuously declined across the seven days. In contrast, the mild-to-moderate sleep restricted group (five and seven hours TIB groups), observed an initial decline in speed which then stabilized at a level lower than baseline. The nine hours TIB group showed no effect on performance over the experimental period. The authors concluded that less than four hours of sleep per night can result in daily decrements in performance capacity. This supports Horne's (1991) hypothesis (see section 2.2.4) about the physiological tolerance limited to four hours of sleep. Moreover, for all sleep-restricted groups in the recovery phase of the study, return to baseline levels on the PVT was not achieved. This suggests that brain adaptive changes to chronic sleep deprivation precluded rapid recovery, resulting in persistent low performance levels.

Moreover, Van Dongen et al.'s (2004) experimental study of 21 adults, found substantial systematic and trait-like susceptibility from sleep loss that may help explain inter-individual differences in neurobehavioral deficits (subjective sleepiness, fatigue, mood, cognitive processing, and sustained attention). However, it remains unclear as to what the neurobiological markers of trait-like differential vulnerability are, which in turn could be useful in understanding the relationship between the severity of impaired daytime functioning and OSAS severity.

In a shift-work context, there are a variety of factors that need to be considered including sleep loss prior to a work period, the amount of sleep debt accrued across consecutive days, and changing work schedules (Rosekind, 2005). For instance, in a study of long-haul truck drivers, the average hours of total sleep obtained was 3.8-hours during an 8.6-hour rest period after a 13-hour evening drive (Mitler, Miller, Lipsitz, & al., 1997). Safety risk arises when acute sleep loss and accumulated sleep debt lead to impaired performance and decreased alertness (Rosekind, 2005).

A complicated task such as decision making involves a range of cognitive abilities (e.g., arithmetic, lateral thinking) (Harrison and Horne, 2000; Horne, 1988). It is thought that the negative effects of sleep loss on such skills are a result of frontal lobe impairment resulting from failure to obtain core sleep (Horne, 1991). The use of neuropsychological tests has been popular in this area of sleep research. Recent evidence suggests that even after one night of sleep loss this region is affected (Horne, 1988; Drummond et al., 1999; Drummond et al, 2000). The skills affected are as follows: delayed response timing, perseveration, voluntary eye gaze, increased distractability from irrelevant stimuli, impaired short-term memory, decreased word fluency, impaired planning ability, including planned voluntary mobility, impaired spatial orientation, and reduced spontaneous behaviours (Horne, 1991). Examining the abilities of individuals using neuropsychological tests can be misleading, because they do not differentiate between impairment of frontal lobe functioning and lack of motivation and interest in completing the task.

Sleep-related motor vehicle accidents (MVAs) have been shown to be a direct consequence of restricted sleep (Lyznicki, Doege, Davis, & Williams, 1998). There are a number of factors that increase the risk of driving-related accidents, including driving during the period when optimal sleep is best obtained, reduced sleep prior to driving, irregular shift-work patterns, and underlying sleep conditions such as OSAS. For professional drivers, not only is performance output a concern, but safety is a significant aspect (Akerstedt, 1991). There have been numerous studies that have pointed to the role of insufficient sleep as a predisposing factor for sleep-related MVAs, although the cross-sectional designs limit their interpretation (Connor, Norton, & Jackson, 2001; Marshall, Bolger, & Gander, 2004; Maycock, 1996; Yee, Campbell, Beasley, & Neill, 2002). A study by Stutts et al. (2003) in America examined drowsy drivers. Cases comprised sleep crash drivers (n=312) and fatigue crash drivers (n=155), and controls (n=529) comprised of non-sleep and non-fatigue crash drivers. They found a strong association of increased risk of MVAs among drivers who: regularly drive at night, work night-shift, average less than six hours sleep per night, drive after having less than five hours sleep the previous night, driving after being awake for more than 15 hours, extended duration of driving, and drivers taking sleepiness-induced medications. This study was based on police reports and driving records, which introduces bias and limits the accuracy of the results. However, its results are consistent with Connor et al.'s (2002) study (see section 2.3.8).

2.3 Obstructive Sleep Apnoea (OSA)

According to the International Classification of Sleep Disorders (ICSD) manual (2005):

> ***Obstructive sleep apnoea*** *is characterised by repetitive episodes of complete (apnoea) or partial (hypopnoea) upper airway obstruction that occur during sleep and are usually terminated by brief arousals from* sleep (p.51,(American Academy of Sleep Medicine, 2005).

Obstructive sleep apnoea (OSA), upper airway resistance syndrome (UARS), and central sleep apnoea (CSA) are separate entities on a continuum of sleep disordered breathing (SDB) (Guilleminault & Bassiri, 2005). A thorough investigation of the pathogenesis of these disorders is important to establish a differential diagnosis, and thus implement appropriate treatment.

Polysomnography (PSG) is the most accurate clinical test used in the diagnosis of OSA. It is considered the gold standard test as it allows for the evaluation and quantification of brain wave activity (EEG), eye movements (EOG), muscular tonicity (EMG), cardio-respiratory rhythms, blood oxygen levels and lower-limb characteristics that are etiologically related to sleeping complaints. Although there are many clinical protocols, a diagnosis of OSA can be confirmed with a single night in the laboratory. However this test is not infallible, because of differences in scoring as a result of human and mechanical errors, and night-to-night variability of sleeping patterns (Chervin, 2005). From a pragmatic perspective, PSG poses some limitations such as: issues of access to, and through the initial sleep diagnostic service (Banno & Kryger, 2004); it is time consuming; costly (for sleep services and work absences); and it can be socially intrusive (i.e., limited adaptation to sleeping in the laboratory) (Flemons & Whitelaw, 2002). At the same time, the long-term benefits of diagnosis and appropriate treatment outweigh short-term costs.

There are other objective methods for identifying OSA. A split-night PSG study comprises of a partial night of assessment and diagnosis, followed by subsequent treatment using Continuous Positive Airway Pressure (CPAP). This approach is less time consuming, more cost-effective, and is considered efficacious in utilising resources efficiently (Rodway & Sanders, 2003). Other methods of diagnosing OSA include the use of portable PSG monitors. The American Sleep Disordered Association in 1994 classified portable monitors in the following way:

TYPE 1
Standard polysomnography
TYPE 2
Comprehensive portable polysomnography
TYPE 3
Modified portable polysomnography
TYPE 4
Continuous single or dual bioparameters

Figure 2.1 Types of studies to monitor OSA (source: Flemons et al. 2003)

Type 1 is considered the reference standard against which other types are compared. Other portable monitoring devices record some of the following channels: EEG, EOG, EMG, heart-rate, airflow, respiratory effort, and oxygen saturation. Some of the advantages of using a portable device are: (1) it can be used in various settings (e.g., clinical, university, or naturalistic); (2) if used at home, it allows for a realistic evaluation of a patient's sleep without them having to adapt to a different environment such as the clinical setting; (3) the portable device can be left unattended over night; and (4) it is cost-effective by reducing hospital waiting lists for the reference PSG (Flemons et al., 2003). The disadvantages of using portable devices are: (1) not all portable monitors allow for sleep staging, thus the severity of OSA can be underestimated; and (2) sleep quality is not usually measured, and sleep duration is unknown (Whittle, Finch, Mortimore, MacKay, & Douglas, 1997).

Other methods of screening for OSA include questionnaires and interviews. These tools are efficient because they are non-intrusive, cheap and easy to administer. They are also likely to be used in a clinical environment at primary care level, thus reflecting the tools' pragmatic and practical use. Information on anthropometry, social and medical history, lifestyle factors relating to sleep hygiene[5] and occurrence of MVAs can be

[5] Sleep hygiene is the term used to denote lifestyle (e.g., diet, substance use) and environmental (e.g., light, noise, temperature) factors that describe an individual's sleep routine (Morin, 2005 in Kryger, Roth & Dement).

obtained. However, the sensitivity and specificity of such methods pose limitations in detecting OSA, due to the subjective nature of the assessment.

2.3.1 Nocturnal symptoms of OSAS

The symptoms of OSAS are generally the cause of complaints by the sleeping partners of OSAS sufferers. Complaints of nocturnal symptoms are generally accurate signs of OSAS, they are: snoring, choking, and witnessed apnoeas, and they can be a cause of daytime somnolence (Guilleminault & Bassiri, 2005). There are other nocturnal symptoms (nocturia, enuresis, arousals and diaphoresis), however the prevalence of these symptoms has not been well studied, nor have they been found to discriminate between patients with or without OSAS (Flemons & Whitelaw, 2002). The symptoms, snoring, witnessed apnoeas and choking have been found to be the best predictors in defining varying levels of respiratory disturbance (Redline & Strohl, 1999).

Daytime manifestations of OSAS are considered the consequence of nocturnal symptoms. They include: (1) daytime sleepiness, which is the most commonly reported complaint; (2) drowsiness indicative of fragmented sleep; (3) cognitive processing impairment including high level problem solving and memory retention abilities; and (4) morning or nocturnal headaches. These are common symptoms that often present together, although, they form part of a wide range of daytime complaints (Guilleminault & Bassiri, 2005).

Nevertheless, it is the nocturnal symptoms that best predict the likelihood of OSAS, as they are OSAS-specific. Therefore they will be briefly described along with their functional impact on sleep (American Academy of Sleep Medicine, 2005; Guilleminault & Bassiri, 2005).

Loud snoring in all positions along with excessive daytime sleepiness is the most commonly presented symptom of OSAS (Neill & McEvoy, 1997). Snoring is considered the hallmark symptom of OSAS because it reflects its underlying pathophysiology (Flemons & Whitelaw, 2002). That is, snoring negatively impacts on the critical pressure required to close the airway, thus it results in narrowing of the upper airway. Snoring is not always a determinant for diagnosis because OSAS sufferers may under-report this symptom. Moreover, not all OSAS sufferers snore, and not all snorers have OSAS. A more useful approach in measuring snoring is to collect information of snoring frequency and intensity, rather than just inquiring about snoring in a dichotomous manner (i.e., yes versus no) (Flemons & Whitelaw, 2002; Hoffstein, Mateika, & Hanly, 1995; Viner, Szalai, & Hoffstein, 1991).

Witnessed apnoeas can be described by what happens physiologically at the onset of sleep. Negative critical pressure is required to completely collapse the upper airway (Malhotra & White, 2002). The risk of upper airway collapse is increased by the following variables: upper body obesity, positioning of the mandible, unstable neuromuscular activity, and an increased tongue size. The absence of neuromuscular reflexive compensation during wakefulness suggests that the biomechanics and the neuromuscular activity of the upper airway are abnormal in people with OSAS (Malhotra & White, 2002).

Nocturnal choking or gasping occurs as a direct response to apnoeic events. Over the course of the apnoeic event, the development of hypoxia and hypercapnia increases until the OSAS sufferer is abruptly awoken by a burst of dilator muscular activity, which then re-establishes airway patency (Malhotra & White, 2002).

Apnoeic events occur more frequently in stage 1 and stage 2 NREM and REM sleep. Apnoeic events are thought to be longer in duration (apnoeic event >10 seconds) and linked to a reduction in oxygen saturation during REM sleep (American Academy of Sleep Medicine, 2005). The cyclic process of OSA is schematically presented below, and it can repeat several hundred times over the course of the night.

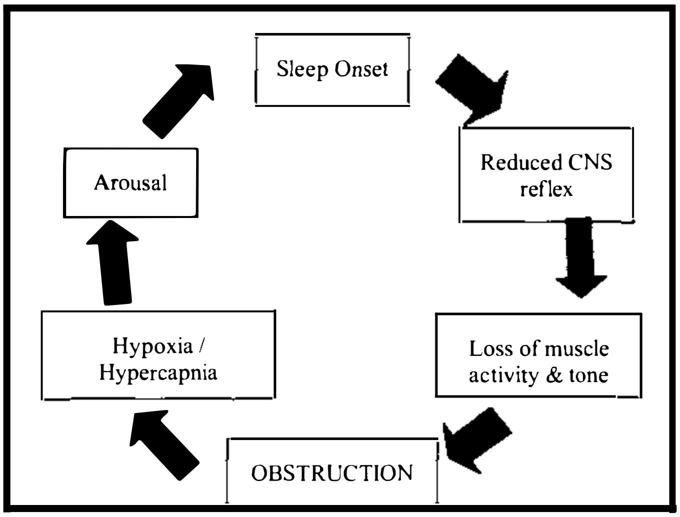

Figure 2.2 Pathophysiology of OSA

Figure 2.2 was adapted from Neill and McEnvoy (1997). The cycle begins from the onset of sleep, when the reflexive mechanism responsible for maintaining upper airway patency reduces or disappears. The absence of this reflex is thought to be sleep-induced, but evidence is lacking (Ayappa & Rapoport, 2003). This then results in the lack of tonus and activity of the pharyngeal musculature, which is usually the primary reason for pharyngeal collapse, marked by a partial or complete obstruction which may last up to a minute, if not longer. It sometimes causes turbulent flow and snoring vibration (Riyamb, Rawas, & Hassan, 2000). This occlusion of the airway is followed by a series of physiological and cellular events related to oxygen desaturation. When the sufferer becomes hypoxemic, this is likely to have an effect on the existence of any co-morbid lung conditions, thus it may lead to hyperventilation. Hypercapnia may also occur and is likely to worsen during REM sleep (American Academy of Sleep Medicine, 2005). The sufferer eventually awakens and the upper airway re-establishes patency (Malhotra & White, 2002). Thereafter, the cycle repeats continuously over the course of the night, leaving the sufferer feeling un-refreshed as a direct result of the disruption and fragmentation of the normal sleep patterns.

2.3.2 Diagnostic criteria for OSA and OSAS

For an adult to have a diagnosis of OSAS they must fulfil the following criteria A, B, and D, or C and D (American Academy of Sleep Medicine, 2005):

A. At least one or more of the following applies:

   i. Complaints of unintentional sleep episodes, excessive daytime sleepiness, poor quality of sleep, fatigue, or insomnia

   ii. Awakes holding breath, gasping or choking

   iii. Bed partner complains of, or reports loud snoring, breathing interruptions, or both during the patient's sleep

B. Polysomnographic study indicates five or more respiratory events per hour of sleep (RDI≥5). Of note, respiratory events are defined as apnoeas, hypopneas, or RERAs. Respiratory effort related arousals are verified via an oesophageal manometer.

OR

C. Polysomnography shows:

   i. Fifteen or more scorable respiratory events as described above.

   ii. Evidence of RERA during all, or a portion of, each respiratory event.

D. The disorder cannot be explained by a co-existing sleep disorder, medical or neurological disorder, medication or substance use disorder.

Severity of OSAS

The severity of OSAS involves two components: (1) the aspect of daytime sleepiness thought to be related to fragmented sleep secondary to recurrent arousals, and possibly related to hypoxemia; and (2) the aspect of nocturnal symptoms.

Apnoea events in adults are periods of breathing cessation of ten seconds or more. Hypopnoea is a reduction (50-90%) in breathing for ten seconds or more. The summation of the number of apnoeas and hypopnoeas is divided by the number of hours of sleep, which subsequently provides the index of disease severity known as the Apnoea-Hypopnoea Index (AHI) (American Academy of Sleep Medicine, 2005).

The criteria for sleepiness based on the AASM (1999) are given below as follows:

1. Mild Sleepiness: defined as 'unwanted sleepiness or an involuntary sleep episode that has a propensity to occur during activities that require *little attention'*. For example, watching television.

2. Moderate Sleepiness: defined as 'unwanted sleepiness or an involuntary sleep episode that has a propensity to occur during activities that require *some attentiveness'*. For example attending conferences, concerts, or meetings.

3. Severe Sleepiness: defined as 'unwanted sleepiness or an involuntary sleep episode that has a propensity to occur during activities that require more *active attention'*. For example, walking, driving, or while eating.

The second component of the severity criteria involves the frequency of obstructive breathing events during sleep:

1. Mild: defined as 5-15 events per hour

2. Moderate: defined as 15-30 events per hour

3. Severe: defined as being greater than 30 events per hour

Young and colleagues' (1997) Wisconsin Sleep cohort is cited as the justification for use of the criteria described above. A lack of other well-planned prospective studies precludes further comprehensive validation of criteria.

In earlier research, there is a wide range of OSAS prevalence rates reported. This discrepancy can be explained by the different population groups studied, differences in screening methods, different AHI thresholds used to define OSA and OSAS, and whether the gold standard PSG was used for an accurate diagnosis compared to other methods (outlined in Figure 2.1).

Later studies standardised this definition by utilising the AHI also referred to as the Respiratory Disturbance Index (RDI) (Redline et al., 2000). This index (RDI) categorises the number of apnoeas and hypopnoeas observed per hour of sleep. The AHI cut-off for OSA was then set at five arbitrarily (AHI$\geq$ 5), and this quickly became internationally accepted (American Academy of Sleep Medicine, 1999; Bittencourt et al., 2001; Stradling & Davies, 2004).

To reiterate, *OSA* is defined by the number of apnoea and hypopnoea events per hour of sleep. The AHI quantifies the severity of the disorder. *OSAS* is defined by an AHI$\geq$ 5 together with excessive daytime somnolence (American Academy of Sleep Medicine, 1999, , 2005; Flemons et al., 2003; Young, Blustein, Finn, & Palta, 1997; Young et al., 1993; Young, Peppard, & Gottlieb, 2002).

2.3.3 Health effects of sleep disruption due to OSAS

Sleep restriction can cause changes that affect various physiological functions including neurological, autonomic, immunological, and overall health.

Neurological: Sleepiness induced by sleep deprivation reduces upper airway muscle activity and ventilatory responses to hypercapnia and hypoxia (Roehrs, Carskadon, Dement, & Roth, 2005). Neurologically, the effects of sleep loss can be quickly reversed. Reportedly, prolonged sleep deprivation can result in nystagmus, hand tremors, dysarthria, and hyperactive gag reflex. All these are indicative of transient physiological impairment (Bonnet, 2005).

More recently, sleep loss secondary to SDB has been implicated in the pathogenesis of cerebrovascular accidents (CVA) and cardiovascular disease (CVD). Research has linked SDB as a modifiable risk factor for stroke, because of its interactive relationship and association with obesity, coronary artery disease and hypertension (Bassetti, 2005). The prevalence of SDB among stroke patients is reportedly high (between 60%-70%) at three months post-recovery (Bassetti, Aldrich, Chervin, & Quint, 1996; Dyken, Somers, Yamada, & al., 1996). It is possible that SDB may have preceded the onset of CVA (Bassetti, 2005; Bassetti, Aldrich, Chervin, & Quint, 1996; Dyken, Somers, Yamada, & al., 1996; Phillips, 2005). Any causal relationship between sleep loss and CVA is not well understood due to limited study designs that lack historical information about SDB and prior sleep history (Mohsenin, 2004).

Autonomic: During REM sleep there is increased sympathetic activity which elevates blood pressure, heart rate and arrhythmogenesis. In stage 1 NREM sleep, striking sinus arrhythmia can develop particularly in young people, and with the onset of stage 2, bursts of sympathetic activity occur with K-complexes, in parallel to transient increases in heart rate and blood pressure. Stages 3 and 4 NREM sleep (SWS) are considered to be the most restorative for cardiovascular functioning, and typically heart rate and blood pressure levels are at their lowest (Phillips, 2005). The impact of OSA on the sympathetic nervous system, and of the vagal withdrawal on the cardiovascular system, is loading conditions and hypoxia on the failing ventricle (Phillips, 2005). Such high sympathetic drive can lead to heart failure and mortality. In the Sleep Health Heart Study (SHHS), OSA conferred an increased risk of over 200% in the likelihood of heart failure independent of known risk factors (Shahar, Whitney, Redline, & al., 2001). There is growing evidence to support the notion that OSA is a risk factor for the development of CVD (Ayas et al., 2003; Bradley & Floras, 2003; Bradley & O'Neill, 2005; Merrit, 2004; Pack, 2006; Parish & Somers, 2004; Patel et al., 2004; Phillips, 2005).

Immunity: Benca and Quintans (1997) posited that sleep restriction suppresses the immunity system. Hence, sleep restriction impairs the functioning of host defence mechanisms, thereby increasing the susceptibility to pathogens. More recently, two experimental studies support the hypothesis that optimal sleep is necessary to resist microbial infections. Spiegel et al. (2002) examined the effect of restricted sleep response to influenza vaccination among 25 healthy young males. Of these, eleven cases had their sleep restricted to four hours of TIB (0100-0500) for six nights, followed by seven recovery nights (12 hours TIB). The control group (n=14) slept normally (averaged 7.5-8.5-hours time in bed) throughout the protocol. The results showed, ten days post-immunisation (given on the fourth night), that the average antibody titre among the sleep deprived cases was less than half that of the controls. Three to four weeks following vaccination, there were no differences observed between both groups. Similarly, Lange et al. (2003) examined the response of the immune system to Hepatitis A inoculation given to 19 healthy adults. One group underwent a single night of total sleep deprivation, while the other group slept from 2300-0700 hours. Four weeks later, the sleep deprived group had a 50% decrease in antibody response, compared to the non-sleep deprived group. These studies have demonstrated that sleep changes associated with infection can impact on immune function.

Health status: Sleep loss can induce transient mood changes such as irritability, fatigue, perceptual distortion and disorientation. However, pathologically it depends on the length of sleep deprivation endured along with other environmental influences (Bonnet, 2005). Strine and Chapman (2005) reported 26% of adults who experience more than two weeks of inadequate sleep self-reported poor health status, regularly experienced mental and physical distress, depressed symptoms, anxiety and pain. As a consequence, individuals with insufficient sleep were significantly more likely to smoke, have limited physical activity, be obese and drink heavily. Therefore, the effects of sleep restriction have major implications on harming health status, inducing poor health behaviours and negatively impacting on quality of life. Other studies have found that sleep loss impacts more on the health of younger persons than in older people (Bonnet, 1985; Brendel et al., 1990).

Morbidity: There is recent evidence that suggests a relationship between self-reported sleep duration with obesity. Studies have shown that some obese people report short sleep duration, while others report longer sleep duration. However, reasons underlying the differences between the two is not known. In the Wisconsin Cohort study, there was a linear relationship between short habitual sleepers and increasing BMI, independent of age and sex. Furthermore, there was a U-shape curve between self-reported average sleep length and BMI (Taheri, Lin, Austin, Young, & Mignot, 2004). These findings are consistent with that found by Vorona et al.'s (2005) primary care population-based study, who reported decreasing sleep time in overweight and obese patients compared to normal BMI, and increased sleep time among the extremely obese patients. Ayas et al. (2003) followed over 70,000 women since 1986. The authors reported an association between self-reported sleep duration and the incidence of coronary heart disease. Women who reported ≤5-hours sleep, the adjusted odds ratio for coronary heart disease was 1.45 (95% CI: 1.10-1.92). Furthermore, for women, who reported sleep ≥ 9-hours of sleep, the adjusted OR was 1.38 (95% CI: 1.03-1.86).

Mortality: There is research to show that people who sleep outside the range of seven to eight hours have an increased risk of mortality (Kripke, Klauber, Wingard, & al., 1998). Kojima et al. (2000) surveyed 5,322 residents from Gifu Prefecture, Japan and found both long sleepers (RR: 1.94 for ≥ 10 hours) and short sleepers (RR: 1.90 for <7.0 hours) had an increased risk of mortality, compared to people who self-reported sleep duration was 8-hours. This was significant for men only. The risks remained significant even after adjusting for sleep duration and other confounds. In the Nurses Health study, Patel et al. (2004) also support previous findings indicating a significant association between self-reported sleep duration and mortality risk. After adjusting for confounding factors, the risk of mortality for women sleeping $\leq$ 5-hours was 15% greater than those sleeping 7-hours. Likewise, sleeping $\geq$ 9-hours was associated with a 42% increase in mortality risk. However, the relationship between long sleepers and mortality is more likely to be due to an underlying medical pathology rather than fatigue per se (Partinen & Hublin, 2005).

2.3.4 Treatment options for OSAS

Continuous Positive Airway Pressure (CPAP)

Nasal Continuous Positive Airway Pressure (CPAP) is the most effective treatment option available for severe OSAS sufferers. CPAP was initially described in 1981, however it was not until 1985 that CPAP was recognised as a suitable treatment option (Grunstein, 2005). CPAP delivers air through a mask, providing a pneumatic splint that inhibits pharyngeal collapse by continuously flushing elevated critical (i.e., positive) air pressure in the oropharyngeal airway, thus reversing transmural negative pressure that resulted in an imbalance prior to pharyngeal collapse (Grunstein, 2005; Marshall, Neill, Campbell, & Sheppard, 2005). Other forms of CPAP include: (1) BiLevel-PAP using different pressure levels for inhalation and exhalation; and (2) AutoPAP which automatically titrates the therapeutic pressure as required throughout the night, and is more commonly used to avoid complex investigation and to maximise its therapeutic use in a clinical environment; and (3) C-Flex, a CPAP device that reduces pressure in response to exhalation (Marshall, Neill, Campbell, & Sheppard, 2005).

Whilst CPAP is an effective form of treatment for OSAS, there are practical issues that hinder access to treatment. These barriers are: (1) access to specialist physicians trained in sleep medicine, (2) side effects such as skin abrasions or rash from the mask, (3) nasal congestion or dryness, (4) chest discomfort from the continuous air flow, and (5) noise and partner intolerance (Pepin et al., 1995). Patient compliance raises complex issues for the physician and technologists particularly in terms of prescription, adherence, usage and tolerance of CPAP (Engleman, Martin, & Douglas, 1994; Kribbs et al., 1993; Neill & McEvoy, 1997). It is thought that compliance is not related to age, sex, educational level, economic status, personality, or characteristics of the disorder (Grunstein, 2005). This makes it difficult to determine which patients will benefit from CPAP, which can lead to ethical issues for treatment providers.

Oro-facial devices

Oro-facial appliances are typically used in the treatment of mild OSAS, and are worn during sleep (Ferguson & Lowe, 2005). The devices are tailor-made to the anterior oro-facial area to effect change in the position of the mandible and tongue, affecting upper airway muscular activity that is prone to pharyngeal collapse. There are two general types: (1) mandibular advancing appliances (fitted to the upper and lower teeth to sustain anterior mandibular position); and (2) tongue advancing devices. The degree of advancement is individualised according to patient comfort and tolerance. Ferguson et al.'s (2006) review of the literature on oral appliances, found that this form of treatment is preferred over CPAP, as indicated by patient compliance because of its reduced intrusiveness. However, it is less effective in treating severe OSAS.

Surgical management

Previous to the invention of CPAP, OSAS was treated via tracheotomy which provided a 100% cure. May patients were deterred from this form of OSAS treatment, because it is an intrusive procedure, and required ongoing monitoring to maintain airway patency. Tracheotomy is presently offered to severe OSAS patients with cardiovascular conditions who are unable to tolerate CPAP (Powell, Riley, & Guilleminault, 2005).

Current surgical procedures focus on anatomical abnormalities that cause airway obstruction by excision or repositioning of the abnormal tissues of the nose, palate or at the base of tongue region. Surgical procedures include: adenotonsillectomy which is the minimisation or removal of the tonsils and or adenoids; and uvulopalatopharyngoplasty (UPPP), which modifies the mandibular and maxillary regions. These procedures are used to treat any anatomical abnormality causing OSAS, thus controlling the disorder (Powell, Riley, & Guilleminault, 2005). Little research has followed up patients that have taken this route of treatment in terms of measuring improved quality of life, reduced risk of MVA, or improved cognitive performance (Phillips & Kryger, 2005).

Conservative management

This form of treatment relates to modifying lifestyle factors that could ameliorate the impact and risk of OSAS (Strollo, Atwood, & Sanders, 2005). Intervention is focused on behavioural factors such as weight loss, and education on body positioning during sleep (i.e., avoiding a supine position). Appropriate information is given on improving sleep hygiene practices, such as avoidance of smoking, alcohol and other stimulants that increase the risk of OSAS, and education on the impact of sleep deprivation which may prolong apnoeic events by depressing the arousal response (Strollo, Atwood, & Sanders, 2005). However, little is known about the effectiveness of such advice and whether compliance promotes good quality sleep.

2.3.5 Effective treatment

As previously mentioned, CPAP is the gold standard method for treating predominantly severe OSAS (AHI≥ 30). Randomised control trials (RCT) have been used to assess the efficacy of CPAP in moderately-severe OSAS patients. Studies have shown its effectiveness in reducing daytime somnolence and blood pressure (Becker et al., 2003; Patel, White, Malhotra, & al., 2003; Pepperell, Ramdassingh-Dow, Crosthwaite, & al., 2002). On the other hand, the effectiveness of CPAP treatment in mild OSAS patients who may be asymptomatic is somewhat controversial. There is evidence to suggest that despite the gold standard treatment, cognitive and neurobehavioral deficits persist. Part of the problem lies in the use of different types of placebos (e.g., sham-CPAP versus tablets), which make it difficult to track clear changes in treatment outcomes (Weaver & George, 2005). Offering placebo and actual treatment also raises ethical issues, by not providing the appropriate treatment to OSAS sufferers who would most benefit from it. Sub-optimal compliance, length of treatment, and study design issues also affect the results (Weaver & George, 2005).

Patel and colleagues' (2003) meta-analysis of CPAP trials in OSAS did not find any clear evidence that CPAP reduced daytime sleepiness in patients with mild to moderate OSAS. This finding is also supported by other studies (Barnes, McEvoy, Banks, & al., 2004; Pepperell, Ramdassingh-Dow, Crosthwaite, & al., 2002; Tipton & Hall, 2001). Thus, CPAP may not necessarily be the optimal treatment for mild OSAS sufferers. Nonetheless if a pragmatic approach was adopted, by explaining to the patient that the outcome of CPAP treatment is not guaranteed, then this may risk losing a patient who is more likely to respond well to treatment. It has been suggested that a pre-test sleep study that identifies a successful CPAP trial is necessary (Stradling & Davies, 2004). A study by Bennett et al. (1998) found 40% of sleep clinic patients responded to CPAP when evaluated by a sleep study. This suggests objective measures of sleepiness and trialling CPAP (on its own) is the only way to be sure of testing the efficacy of reducing symptoms. In contrast, Marshall et al. (2006) carried out a meta-analysis of randomised controlled trials comparing CPAP to a placebo or to conservative management in the treatment of mild-moderate OSAS (AHI:5-30/hr). They found CPAP significantly reduced subjective and objective daytime sleepiness as determined by the Epworth Sleepiness Scale and the Maintenance of Wakefulness Test, respectively. However, CPAP did not improve objective daytime sleepiness as measured by the Multiple Sleep Latency Test (MSLT) (Marshall et al., 2006). They further concluded that the findings demonstrated small effect sizes that could not clarify whether CPAP benefits all patients across the mild-moderate OSAS spectrum, or whether there is a clinical severity point at which CPAP can be therapeutic or hamper good sleep. Moreover, they suggested that objective tools such as the MSLT may not be useful in discriminating the effects of sleepiness.

2.3.6 Effects of OSAS on sleepiness

The quality of sleep is chronically disturbed in individuals with OSAS. Disturbed sleep can lead to reductions in cognitive functioning, problem solving ability, sustained attention, and increased risk of MVA (Weaver & George, 2005). Each will be discussed separately below.

Sleep deprivation among individuals with OSAS is likely to have a greater effect, particularly as their sleep is more fragmented than non-sufferers. Daytime sleepiness is thought to be secondary to the recurrent arousals and hypoxemia. Based on the definition given in the ICSD, sleepiness encompasses drowsiness, low vitality, tiredness, and uncontrollable sleepiness. It is based on the behaviour of falling asleep, but also includes difficulty in alertness, wakefulness and difficulty in unintentional sleeping (American Academy of Sleep Medicine, 2005). There are various objective and subjective tools to measure sleepiness. The present study used the Epworth Sleepiness Scale (ESS).

Subjective tests

Epworth Sleepiness Scale (ESS)

The ESS is a validated specialised tool that measures the likelihood of 'dozing' in eight scenarios with different propensity for sleepiness (Johns, 1991). There is a 4-point rating of the chance of dozing (0=none, 1=slight, 2=moderate, and 3=high). The summation of the scores provides an overall score between 0 and 24. Daytime sleepiness is defined as having an Epworth score greater than ten (ESS>10). The advantages of using this scale are: it is validated, quick, and easy to use. The disadvantages are: re-administration over a short period is limited because it is not sensitive to circadian rhythm influences, and the effect sizes for acute sleep deprivation and use of stimulants are not known. Furthermore, it is susceptible to bias, particularly as it is based on self-reported behaviours, and the limited range of scenarios requires individuals to experience the eight specific conditions. For instance, it measures the likeliness of dozing if you were a *passenger in a car for an hour without any breaks*, which is not common daily experience (Johns, 1992, , 1994). Nevertheless, this tool was used in the current study because of the aforementioned advantages, and it was one of the main independent risk factors in the multivariate predictive tool used to detect a pre-test risk of OSA (Mihaere, 2004).

Stanford Sleepiness Scale (SSS)

Utilising a 7-point likert scale (1=fully alert, 7=struggling to remain awake), the SSS assesses the immediate state of sleepiness at different times of the day. Its advantages are: easy administration, succinctness, and its effective repetitive use. The disadvantages are the: inability to form the basis for clinical judgement, and lack of normative data to compare sleepiness between individuals (American Academy of Sleep Medicine, 2005; Mitler, Carskadon, & Hirshkowitz, 2005).

Objective tests

Multiple Sleep Latency Test (MSLT)

The most effective in measuring the ability to fall asleep is the MSLT. Conducted two hours after waking in the morning over a series of four to six napping opportunities at two hourly intervals, participants are instructed to: *to allow themselves to fall asleep* under favourable conditions. The test is based on the assumption that physiological sleepiness decreases sleep latency (Arand et al., 2005; Bonnet & Arand, 2005). PSG is recommended to be performed the night before to test prior sleep quality and quantity. Electrophysiological activity is used to evaluate and quantify sleep onset and staging during the MSLT. The MSLT has clearly defined levels of severity. Severe sleepiness requires an average score of five or less minutes in sleep latency across all tests, indicating a pathological cause. Moderate sleepiness is between five and ten minutes in sleep latency (Mitler, Carskadon, & Hirshkowitz, 2005). Studies have shown the MSLT is sensitive to both state and trait levels of central nervous system arousal such as psychological aspects (e.g., anxiety and depression), common co-morbidities, and personal motivation (Arand et al., 2005). On the other hand, the MSLT does not correlate well with the severity of night time symptoms in OSAS, and it is questionable whether it is useful for these patients, considering that the aim in assessing people with OSAS is to determine the effects on waking function (Mitler, Carskadon, & Hirshkowitz, 2005).

Maintenance of Wakefulness Test (MWT)

This test measures the ability to stay awake in soporyphic conditions. The instructions given to individuals are to *remain awake*. Testing begins two hours after waking from the previous night's sleep. Sleep onset (EEG) is monitored during four to six sessions at two hourly intervals. It is based on the assumption that the volitional ability to stay awake is important to know in some situations (Arand et al., 2005; Mitler, Carskadon, & Hirshkowitz, 2005). Doghramji and colleagues (1997) provided the first normative data of wakeful functioning among 30 to 69 year old male and female subjects. The MWT is regarded as a relevant objective test of sleepiness. It can reflect severity among clinical OSAS patients, and it is sensitive enough to discriminate treatment changes in participants receiving CPAP treatment (Haakanen, Summala, Partinen, Tiihonen, & Silvo, 1999; Poceta et al., 1992). Marshall et al.'s (2006) meta-analysis of the literature, found test results of the MWT improved following CPAP treatment in mild-moderate OSAS sufferers, whereas the MSLT scores did not show significant improvement.

Performance and vigilance tests

Tasks that are sensitive to sleep loss tend to be tedious, repetitive, long and non-stimulating, and can be clinically relevant for individuals with sleep disorders. There are a variety of tasks available, however the most commonly used and reported is the psychomotor vigilance test (PVT) developed by Dinges and colleagues at the University of Pennsylvania (Mitler, Carskadon, & Hirshkowitz, 2005). Such tests are used to evaluate sustained attention, providing measures such as time on task, speed of response, and response lapsing (Mitler, Carskadon, & Hirshkowitz, 2005). Other forms of performance and vigilance tests appropriate for OSAS and other sleep disordered patients include driving tests on simulated highways, rural, inter-city or long-distance driving.

2.3.7 Effects of OSAS on cognitive functioning

The negative consequences of untreated OSAS on cognitive functioning have been well established, particularly among individuals with severe OSAS (Weaver & George, 2005). When sleep has been chronically disrupted, the effects can include: a decrease in cognitive performance indicated by the inability to make analytical and synergistic judgements, inattentiveness indicated by slowed responses on tasks and greater false responses demonstrating the lack of behavioural inhibition, difficulty with working memory, which precludes the ability to make appropriate decisions or inferences in a timely manner, executive functioning, which impairs self-regulation of mood, affect, and arousal. Planning, motivation and flexibility may also be hindered (Weaver, 2001; Weaver & George, 2005). The majority of experimental research carried out in this area uses total sleep deprivation, and so the literature is not necessarily useful when examining the effects of OSAS, where sleep only is disrupted and fragmented.

It is also important to note that when sleep is restricted, there is variability between individuals in their performance responses. Van Dongen and colleagues (2003) controlled for inter-individual variability in 48 healthy people aged 21-38 years, and exposed to 14 consecutive days restricting sleep to four, six, or eight hours TIB. There was a significant cumulative decrease in all cognitive tasks, suggesting a clear dose-response relationship between severity of sleep deprivation and deterioration in daytime functioning. The authors also reported that being awake for more than 15.5-hours resulted in accumulated cognitive deficits over the course of the experiment. Thus, the optimal sleep time necessary for maintaining cognitive function equates to approximately eight hours per 24 hour period, in this group.

Cognitive impairment

Cognitive impairment refers to the inability to process information, increased response time on tasks, and increased errors. Common tests used to identify cognitive deficits in OSAS individuals are self-paced tasks such as arithmetic calculations and concept attainment (Dinges, 1992).

Using several neuropsychological tests measuring basic cognitive and motor abilities, Greenberg et al. (1987) highlighted global neuropsychological impairment among 14 OSAS patients compared to two control groups: (1) 14 healthy participants and (2) 10 patients with other disorders of excessive somnolence. Severe nocturnal hypoxemia was significantly correlated to deficits on motor tasks and perceptual organisation abilities. With this finding, it was suggested that people with undiagnosed and untreated OSAS, and who operate non-verbal positions such as professional drivers, may demonstrate work-related problems. This finding was consistent with that reported by Engleman et al. (2000).

Engleman and colleagues (2000) reviewed clinical and experimental studies to examine similarities and differences in findings relevant to the causes and reversibility of cognitive deficits in OSAS. The effect sizes (ES)[6] of decrements were large in executive functioning (ES≈0.9) and sustained attention (ES≈1.0). The magnitude of improvement due to CPAP was small and inconsistent across different measures of function. Thus, it was posited that cognitive damage caused by OSAS may not be reversible with CPAP. However, CPAP non-compliance, and the study samples reviewed (predominantly mild-OSAS cases) may have had limited impairment at pre-treatment.

Individuals with OSAS have impaired cognitive processing when compared to healthy people that are matched in age and education (Weaver & George, 2005). In contrast,

---

[6] By 'expressing the mean difference in performance scores between cases and controls as a proportion of the controls' standard deviation, effect sizes for impairment, quantifying the extent of cognitive decrement can be calculated' (p.S103) (Engleman, Kingshott, Martin, & Douglas, 2000).

Kim et al. (1997) examined psychomotor efficiency among participants in the Wisconsin Sleep Cohort. Participants with less SDB, who obtained education at college or postgraduate levels, were generally female and younger. They rated better in psychomotor efficiency compared to those who obtained high school level qualifications or less. This suggests that people with higher education may be more adaptable and flexible when faced with cognitive processing challenges. However, in the performance of attention and executive functioning, between group analyses found people with significant SDB (AHI$\geq$ 5) under-performed relative to those without significant SDB. This indicates that individuals with less severe SDB may compensate better than those with significant SDB.

Sustained attention

Sustained attention refers to the ability to maintain focus over time. This can be seen by increases in response time, increased errors, delayed responses (lapses), false responses (a response to stimuli when none are presented), and the inability to respond to more than one task (divided attention). Common assessments used to measure this ability in OSAS are the PVT, short duration tasks (less than 30 minutes), and driving tasks (Dinges, 1992). Sustained attention has been used interchangeably with concentration. It is the most common faculty used in assessments of daytime sleepiness, and in OSA studies it is considered the underlying cause contributing to MVAs (Weaver & George, 2005).

Otmani et al. (2005) examined partial sleep deprivation and driving among 20 healthy male drivers aged 25-55 years. Participants were awoken between 0300-0700 hours preceding the driving test. Sleep restriction was significantly associated with more rapid deterioration in the time on driving task, which is indicative of low level alertness on driving performance, and sleepiness. Subjective ratings of sleepiness (Karolinska Sleepiness Scale, KSS) however did not match the decline in the performance measure. The study did not control for inter-individual variability, which may have explained the vulnerability to impairment, secondary to sleep loss. This was consistent with other studies using subjective measures (Incalzi et al., 2004). Moreover, this study is in line with results reported by Philip et al. (2003), where reaction time worsened as a function of hours of driving when sleep was restricted.

A small study compared the performance of OSAS patients (n=6) to normal controls (n=7) matched for age and sex on two separate driving simulators: (i) highway driving on a film simulator and (ii) city and rural driving on a personal computer simulator, at pre- and post-treatment stages (Findley et al., 1989). Results indicated that at the pre-treatment stage, participants with untreated severe OSAS independent of age and sex, performed significantly worse on the film simulator compared to controls. This was indicated by a greater number of errors in steering, signalling, braking, accelerating and speeding. On the personal computer simulator, the OSAS group again performed significantly worse than the control group, as demonstrated by hitting a higher number of obstacles in a 30-minute period. There was no interaction with age, sex, or time of testing. At the post-treatment stage, driving simulation performance improved. These results demonstrated that the ability to maintain attention over time and to react to more than one activity was impaired due to sleep fragmentation from OSAS. However, CPAP treatment significantly reversed these affects.

In Denmark, 120 night-shift taxi drivers (mean age 33.6 years, range 21-65 years) were approached on the roadside to participate in a study testing visual reaction time as an indication of tiredness using a simple visual reaction test in the taxi (Corfitsen, 1993). This test was used as it was thought to correlate well with increased reaction time and sleep deprivation. Different drivers were approached and tested every hour. The results showed a modest increase in reaction time for all drivers across the night, suggesting adaptation to night-shift work patterns. The authors concluded that 2.5% of taxi drivers can be expected to be at risk of an accident as indicated by uneven performance and increases in reaction times. The number of lapses in attention implied the presence of micro-sleeps, which in turn suggested prior restricted sleep. In contrast to other studies, subjective ratings of sleepiness and fatigue were consistent with objective data.

The difficulty with simulated driving ability and sleep restriction studies is that they are prone to learning effects, and studies that do not control for inter-individual variability can under-estimate or over-estimate effects, as functionally relevant traits versus states are not considered.

Memory impairment

Impaired memory is defined as the inability to register, store, retain, and retrieve information (Weaver & George, 2005). In sleep research, tests usually involve short-term memory tasks up to 10 minutes in duration such as free recall of words, digits, paragraphs or figures (Dinges, 1992). Reduced alertness in an individual with OSAS impacts on their ability to retain and internalise information readily for action (Weaver

& George, 2005). However, studies investigating memory function in OSAS sufferers have been fraught with inconsistencies (Beebe, Groesz, Wells, Nichols, & McGee, 2003; Engleman, Kingshott, Martin, & Douglas, 2000; Rouleau, Decary, Chicoine, & Montplaisir, 2002) due to differences in population groups studied, disease severity, and differences in the use of comparative groups. This is an area where additional research is needed.

One study by Roulcau and colleagues (2002) compared procedural learning abilities in 28 OSAS patients and 18 healthy volunteers matched for age and level of education. A Neuropsychological Test Battery which included several standardised tests of intellectual abilities was used. The results did not show deficits in attention, memory or executive functioning in the OSAS group compared to the normal group. However, there were significant differences between the two groups in the verbal and performance tests, especially among patients over 40 years of age. This may be explained by pre-frontal lobe dysfunction associated with OSAS, which is consistent with Incalzi et al.'s (2004) findings. Results of Rouleau's study were possibly limited by the combined effect of age, duration of illness, and hypoxemia, rather than age per se. This is consistent with a recent study by Naegele et al. (2006). They found memory impairment in patients with moderate-severe OSAS, however only specific aspects of procedural, episodic and working memory were mildly affected.

Executive dysfunction

Executive functioning is the ability to function independently, plan and activate a task in sequence. Testing this skill can involve a planning component, a volitional component, or an intentional component (e.g., explain what makes you angry) (Dinges, 1992). It is thought that this operative skill represents frontal lobe functioning (Weaver & George, 2005). Satiea (2003) identified motor speech impairment, poor sequential thinking, and impaired constructional abilities evident in people with OSAS, hence executive dysfunction.

More recently, Incalzi et al. (2004) examined whether a distinctive pattern of cognitive dysfunction was associated with OSAS. Cases involved 49 people with untreated mild and severe OSAS (28-79 years). In the analysis, the OSAS group was separated into two groups based on their performance on the cognitive tests: (1) OSAb=better group (n=35), BMI mean 31.5 kg/m^2, sd=6.9, and (2) OSAw=worse group (n=14), BMI mean 39.8 kg/m^2, sd=12.1. Comparative groups consisted of 27 multi-infarctual dementia

(MID), 31 mild-moderate dementia of Alzheimer type (DAT), and 63 patients with severe chronic obstructive pulmonary disease (COPD). Participants were matched for age and education. The Mental Deterioration Battery included various standardised neuropsychological tests of memory, constructional praxis, language, and intelligence tasks. Skills requiring verbal attainment and immediate memory were comparatively impaired in the OSAw group. This group did not demonstrate complete normal neuropsychological patterns, which points to a distinctive psychological profile separate from patients with severe COPD, DAT, and MID. The profile involves major dysfunction of inductive and deductive thinking and constructive ability, suggesting sub-cortical damage. The results of this study are representative of a clinical population, thus it cannot be generalised to the general OSAS population. Moreover, the authors could not exclude the likelihood of participants having mixed apnoeas and CSA, and the unavailability of a sleep study inhibited discrimination between sleep fragmentation and neuropsychological deficits.

2.3.8 Motor vehicle accident (MVA) risk

Sleepiness and risk of MVA

Motor vehicle injuries are one of the major causes of ill health and mortality in New Zealand when compared to other Organisation for Economic Co-operation and Development (OECD) countries (National Health Committee, 1998). From Connor et al.'s (2001) review of the literature, estimates of the proportion of MVAs that are fatigue-related ranged from 1-3% for the United States, to 25% for drivers in the Australian State of Victoria.

In New Zealand, according to Yee et al. (2002), 35% of drivers admitted to the Emergency Department, Wellington Hospital, following an MVA were found to have OSAS after referral for an overnight PSG. Moreover, they reported 22% of drivers were either chronically sleep deprived, or they had another sleep disorder. They further reported 15% of drivers with OSAS had a severity index (AHI$\geq$ 15) that was shown to correlate with a heightened risk of MVA. This finding is consistent with other studies that suggest sleep disorders do have an impact on accident rates (Teran-Santos, Jimenez-Gomez, Cordero-Guevara, & Burgos-Santander., 1999).

A case-control study of injury car crashes on the Auckland metropolitan region, found after controlling for age, education, ethnicity, and alcohol consumption, the risk of a car crash resulting in serious injury or death was associated with: (1) driving between 0200 and 0500 hours (OR 5.6, 95% CI 1.4-22.7); (2) acute sleepiness (OR 8.2, 95% CI 3.4-19.7); and (3) driving with less than five hours sleep in the last 24-hours (OR 2.7, 95% CI 1.4-5.4). Interesting to note, symptoms of OSAS (regular, loud snoring and witnessed apnoeas) did not increase the likelihood of accidents. However, this could be explained by the younger age group represented in the crash group (15-24 years), compared to the non-crash group who represented middle-aged drivers (characteristic of OSAS). They further concluded that reducing the proportion of these three behaviours could reduce the incidence of injury or MVA by up to 19% (Connor et al., 2002). Akerstedt et al.'s (2005) study of ten night-shift workers adds support to Connor's group work by demonstrating an increased risk of MVA in connection to early morning driving.

A recent publication by Marshall et al. (2003) found chronic sleepiness independently increased the risk of self-reported accidents in the past three years among middle-aged adults (30-60 years). After controlling for age, sex, weekly mileage, ethnicity, neck circumference, smoking and alcohol consumption, any chance of *falling sleep in a car while stopped for a few minutes in traffic as a passenger* (ESS, question 4) and *falling sleep in a car while stopped for a few minutes in traffic* (ESS, question 8), significantly increased the likelihood of reporting an accident (OR 1.22 95% CI 1.03-1.44 and OR 1.46 95% CI 1.09-1.96, respectively), compared to never falling asleep in these situations. Furthermore, they reported OSAS risk factors such as snoring always and larger neck sizes were not significant predictors of accident involvement. Despite this, their findings suggested sleep disorders may play a role in increased accident risk. This contrasts with Maycock's (1996) study, which reported that among 4,621 British male drivers who snored every night, there was a 30% increased risk of reporting a MVA.

OSAS and risk of MVA

There is a wealth of research indicating that sleepiness secondary to OSAS increases the risk of MVAs (Aldrich, 1989; Baulk, Reyner, & Horne, 2001; Bearpark et al., 1995; Cassel et al., 1996; Charlton, Baas, & Alley, 2003; Connor et al., 2002; Connor et al., 2001; Connor, Norton, & Jackson, 2001; Findley et al., 1989; Findley & Suratt, 2001; Findley et al., 1995; Findley, Unverzagt, & Suratt, 1988; Gander, Marshall, Harris, &

Papaarangi, 2005; George, 2004; George & Smiley, 1999; Howard et al., 2004; Lyznicki, Doege, Davis, & Williams, 1998; Marshall, Bolger, & Gander, 2004; Marshall, Gander, & Neill, 2003; Maycock, 1996; Stoohs, Guilleminault, Itoi, & Dement, 1994; Stutts, Wilkins, Osberg, & Vaughn, 2003; Stutts, Wilkins, & Vaughn, 1999; Teran-Santos, Jimenez-Gomez, Cordero-Guevara, & Burgos-Santander., 1999; Wu & Yan-Go, 1996; Young, Blustein, Finn, & Palta, 1997).

The Wisconsin Sleep cohort study provides the best epidemiological data on accident risk among undiagnosed mild to moderate SDB workers. Young et al. (1997) found, after controlling for age, gender, mileage and alcohol, that males who were habitual snorers, or had an AHI≥ 5, were three times more likely to have had at least one MVA (95% CI 1.8-6.9), compared to non-SDB workers and non-habitual snorers. For an AHI≥ 15, men had more than 11 times the risk for multiple accidents than non-SDB male workers (95% CI 1.1->25). For men and women combined with an AHI≥ 15, there was more than seven times the risk of multiple vehicle accidents, compared to non-SDB workers (OR 7.3, 95% CI 1.8->25). Most major confounds were controlled for, including BMI and education. A significant weakness of this study was that driving exposure was not controlled for. There are several other weaknesses inherent in Young et al.'s (1997) study. First, the limited statistical power resulted in weak precision of the point estimates, which makes it difficult to state with certainty whether accident risk varies by AHI severity. Second, the response rate was not reported in this publication, although in an earlier paper (Young et al., 1993) it was reported that 82% responded to the questionnaire, and 43% of respondents were successfully recruited for PSG. Therefore, the true odds of an objective association between SDB and MVA may have been under-estimated or over-estimated. Third, there was no statistically significant indication of accident risk among women with SDB. Possible reasons for this could be due to the limited numbers of women in the study, the lower prevalence of OSAS among women, and the lower likelihood of women having MVAs. Finally, there were no significant associations between measures of sleepiness and MVA. It is possible that the type of sleepiness relevant to motor vehicle driving is *situation specific*, meaning tools such as the ESS or the MSLT do not capture aspects of sleepiness that are relevant to driving. It should be noted that, realistically, sleepy drivers tend not to perceive or recognise their sleepiness, in some cases due to an accumulated effect of chronic sleep deprivation (Bradley & O'Neill, 2005; Devoto, Lucidi, Violani, & Bertini, 1999). Therefore, poor perception masks the true effect of sleepiness in undiagnosed people with SDB, which could be considered a limitation in the Wisconsin study. As outlined earlier, a New Zealand study emulated Lindberg et al.'s (2001) analysis by considering the driving-related questions from the ESS (question 4 and question 8). The results identified significant associations between being sleepy in a motor vehicle and the likelihood of reporting accidents, compared to using the scale as a whole (Marshall, Gander, & Neill, 2003).

Findley and colleagues (1988) carried out a small (n=64) case-control study comparing the driving records of polysomnographically identified OSAS cases (n=29) to controls without OSAS (n=35). Their review of the driving records found that the proportion of people with OSAS having one or more accidents per year was 31% ($p<0.01$) compared to non-OSAS people (6%). Furthermore, the proportion of persons at fault for the accident(s) was higher among OSAS people compared to non-OSAS people (24% versus 3%, $p<0.02$). The authors did not control for potential confounds, which is a significant limitation of the study. Moreover, the rate of accidents among the control group was significantly less than licensed drivers in the US State of Virginia (3.7 million drivers, rate 0.16 over a 5 year period, $p<0.05$). Thus, it is questionable as to whether the control group was representative of all Virginia drivers. Driving records are not necessarily reliable, as they are typically incomplete, and self-reported information on exposure also affects the internal validity. This limited the ability to generalise results. Several other studies have also been weakened by introducing bias through the use of self-reported exposures, as well as differences in, or lack of, exposure measurements in their comparison groups (Aldrich, 1989; Findley et al., 1989; Findley et al., 1995; Young, Blustein, Finn, & Palta, 1997).

Teran Santos et al. (1999) reported one of the better quality case-control studies, and provided strong evidence of a relationship between OSAS and the risk of traffic accidents. One hundred and two OSAS drivers and 152 non-OSAS drivers (matched by age and sex) were selected by way of emergency hospital admissions post-MVAs (89% response rate). They found apnoeic drivers with an AHI>10 had a crude odds ratio of 6.3 (95% CI 2.4-16.2) for a MVA. This risk increased (OR 7.2, 95% CI 2.4-21.8) after adjusting for alcohol use, drowsiness secondary to medication, BMI, driving exposure, visual disorders, age, a history of traffic accidents, and sleep schedule. Analyses comparing non-respondents and respondents found no differences in terms of age, sex, or city of origin, adding support to the association between OSAS and risk of accidents.

The exclusion of the most severe accidents may have precluded an even stronger association. The magnitude of their results was similar to that reported by Young et al. (1997).

Wu and Yan-Go (1996) applied a two stage sampling process to examine self-reported car crashes. Phase one was a cross-sectional study of 295 potential OSAS patients (referred to Sleep Disorders Centre, UCLA) surveyed about sleepiness and driving. They obtained a response rate of 85% (n=253) who were subsequently referred for a single night PSG study. Of the 253 participants, 68% had OSAS, and they were predominantly male and within the range of 20-64 years of age. Phase two of the study stratified participants according to OSAS diagnosis (cases 173, controls 80). The analyses were based on self-reported MVAs. Multivariate logistic analyses indicated a strong association between MVA and patient characteristics. After adjusting for covariates (sex, age, shift-work, alcohol, coffee, daytime nap, history of dizziness, Parkinson's disease, seizures/epilepsy, and loss of consciousness, history of passing destination, and falling asleep at inappropriate times) patients with OSA had more than a two-fold increased risk of self-reported accidents (OR 2.58, 95% Cl 1.06-6.31), compared to controls. Alcohol consumption among OSAS cases trended towards enhancing the possibility of MVAs (OR 2.07, 95% Cl 0.99-4.36), and falling asleep at inappropriate times further increased the risk of MVAs by more than 500% (OR 5.72, 95% Cl 2.39-9.21). Thus, the results are indicative of an association between OSA and self-reported MVA among a group of diagnosed OSAS patients. Limitations of the study include: (1) lack of definition of the outcome measure (self-reported accidents); (2) uncontrolled confounding by mileage and driving duration; (3) the use of a small sample of clinic-based participants as cases and controls, which precluded the generalisability of the results as controls did not necessarily represent the population from which the cases came.

More recently, a study by Howard et al. (2004) surveyed commercial vehicle drivers from a single company to assess individual and work factors associated with accident risk. Of the 3, 268 drivers, 2,342 drivers participated in the MAP[7] questionnaire (72% response rate), and another 161 drivers consented to overnight PSG (66% response

[7] MAP: Multivariable Apnea Prediction questionnaire used to assess the probability of having SDB. A score (≥0.5) indicates a positive predictive value of 0.74 for at least mild SDB (RDI≥5) and negative predictive value of 0.57.

rate). Similarities of characteristics between both groups included: (1) similar chronic excessive sleepiness scores (ESS$\geq$ 11) 24.1%; (2) they were predominantly male (99%); and (3) they were obese BMI (PSG group=29.7 kg/m^2 and MAP group=29.0 kg/m^2). However, the MAP group was significantly younger (42.4 years) than the PSG group (47.8 years) ($p<0.01$). Multivariate logistic regression analyses of the MAP sample showed an association between accident risk and chronic sleepiness. The risk of a single accident was high among those with symptoms of OSAS and scoring $\geq$ 0.50 on the MAP (OR 1.63, 95% CI 1.08-2.48). Using the ESS and FOSQ[8], the sleepiest 5% of drivers had a two-fold increased risk of a single accident, and the effect strengthened with multiple accidents. The authors also identified a relationship between narcotic analgesic (OR 1.84, 95% CI 1.08-3.12) and antihistamine use (OR 2.64 95% CI 1.19-5.84) with multiple accidents, independent of age, alcohol, driving exposure and sleepiness. In the PSG sample, there was no relationship between SDB and accident risk (OR 0.82, 95% CI 0.15-3.57). On the other hand, variables such as having more sleep on days off work, working night shift and driving rurally or inter-state, lowered the risk of accidents. The limitations evident in this study relate to the use of subjective tools measuring sleepiness. It is possible that drivers may have under-reported sleepiness in order to protect their job security. Furthermore, self-reporting of accidents has the potential to introduce bias, as drivers may have under-reported accidents, therefore under-estimating the risk. Conversely, the sample may be affected by survival bias, where less serious and non-fatal accidents were reported. Finally, prior history of sleep patterns was not controlled for due to the shift-work nature of the participants' job and irregular sleeping patterns.

Stutts et al. (2003) identified a decreased risk in sleep-related MVA if driving was actually part of one's job. They further reported that increased driving exposure correlated with decreased risk, therefore few crashes were identified. This reduced risk could probably be explained by several factors: (1) commercial drivers are more skilled at driving; or (2) accidents that occurred during work time, especially the more severe ones, were not reported for fear of drivers losing their livelihood; or (3) commercial drivers identified in their study were a survivor population especially tolerant of working long hours and/or in a shift-work capacity. This is an interesting finding

[8] FOSQ: Functional Outcomes of Sleep Questionnaire used to measure the impact of sleepiness on daily activities (Chervin, 2005).

because it suggests that sleepiness and risk of accidents are not necessarily related to OSAS per se, but that one needs to consider multiple facets of sleepiness and other issues relating to work scheduling.

Given the wealth of research examining OSAS and the risk of MVA, there is limited robust epidemiological evidence for a relationship (Teran-Santos, Jimenez-Gomez, Cordero-Guevara, & Burgos-Santander., 1999; Wu & Yan-Go, 1996; Young, Blustein, Finn, & Palta, 1997). In summary, the highest risk of MVAs occurred among young drivers. However, among middle-aged people, OSAS does appear to increase accident risk. Sleepiness and MVAs also appear to be strongly associated, however, measurement issues mean that this relationship is not well quantified. The problem lies in identifying who is at greater risk of having an accident, because there still remains no clear evidence of a dose-response relationship between increasing severity levels of OSAS and increased risk of MVAs.

2.3.9 Effects on health

The progression of OSAS from mild-moderate to severe can occur in a short period of time, therefore, should screening for this disorder not be available, or early detection be dismissed, individuals may develop potentially adverse health consequences. OSAS is associated with several medical conditions such as diabetes, hypertension, coronary artery disease, myocardial infarction, heart failure and stroke. However, the relationship is likely to be due in part to risk factors commonly associated with all these conditions (Young, Peppard, & Gottlieb, 2002). Due to co-existing morbidities, OSAS sufferers utilise more health services. Ronald et al. (1998) found that 181 OSAS patients used twice the rate of health services as far back as ten years prior to diagnosis, compared to controls (matched by age, sex, and geographical region). The main reasons were due to cardiovascular disease and hypertensive conditions (Bahammam et al., 1999; Ronald, Delaive, Roos, Manfreda, & Meir, 1998).

Cardiovascular disease (CVD)

OSAS is associated with cardiovascular risk factors such as obesity and hyperlipidemia. Apnoeic events result in acute and chronic hemodyanmic changes during wakefulness (e.g., increased sympathetic tone, decreased stroke volume and cardiac output, increased heart rate, vasoconstriction and vasodilation), which suggests possible causal mechanisms for increased daytime hypertension levels (Merrit, 2004; Parish & Somers, 2004).

Hypertension

There are robust findings indicating that OSAS is a risk factor for hypertension. The effects of hypoxia, hypercapnia, elevated pleural pressure, and increased sympathetic nervous system activity associated with OSAS, are thought to be etiologically associated with hypertension[9] (Stradling, Pepperell. J., & Davies, 2001). More recently, it has been shown that it is biologically plausible that recurrent nocturnal episodes of OSAS are associated with elevated daytime systemic and pulmonary arterial blood pressure (Verrier & Mittleman, 2005). Studies that looked at hypertensive women and patients with type I diabetes indicated nocturnal increases in blood pressure as potential markers of cardiovascular complications (Lurbe, Kesani, & al., 2002).

There is evidence that supports the suggestion that individuals with hypertension are also at greater risk for sleep disordered breathing. The Wisconsin Sleep cohort followed 709 men and women (30-65 years) for eight years, and found compelling evidence that after controlling for age, sex, and body habitus measures, there were statistically significant associations between OSAS (determined by PSG) and hypertension. The four year incidence of developing hypertension was: for an AHI<1.0 (9.7%), AHI: 1-5 (17.1%), AHI: 5-15 (31.5%), and with AHI≥ 15 (32.1%). From the four to eight year follow-up, after controlling for possible confounders, the odds of developing hypertension increased twofold with an AHI: 5-15 and AHI≥ 15 the odds increased three-fold, compared to that at baseline (AHI<1.0). Thus, this was the first substantial epidemiological evidence of a linear relationship between OSAS severity and hypertension (Young, Peppard, & Gottlieb, 2002). Later, cross-sectional analyses (Peppard, Young, Palta, & Skatrud, 2000) of the Wisconsin Sleep cohort also showed strong evidence of an association: AHI: 1-4.9, OR 1.2 (95% CI 1.1-1.8), AHI: 5-14.9 (OR 2.0, 95% CI 1.3-3.2), and AHI≥ 15, OR 2.9 (95% CI 1.5-5.6).

Similarly, findings from the southern Pennsylvania cohort (made up of two US counties) of 741 men and 1,000 women (20-100 years) also indicated an independent

---

[9] Hypertension defined as systolic blood pressure at least 140mmHg, diastolic blood pressure at least 90mmHg

association between SDB and hypertension in young to middle-aged adults, after adjusting for age, sex, BMI, menopause, alcohol use, smoking and ethnicity (Bixler et al., 2001). For one county, at the average age of 46, and with an average BMI of 30, the relative risk of hypertension was 1.8 (AHI≥ 15 versus AHI<1.0). For the other county, the average age of 53 also with an average BMI of 30, the relative risk of hypertension was 2.4 (AHI≥ 15 versus AHI<1.0) (Bixler et al., 2000).

Further evidence comes from The Sleep Heart Health Study (SHHS) undertaken by Nieto et al. (2000). This large multi-centre study included data from 6,119 participants from eight existing cohort studies. The aim of their study was to investigate the relationship between SDB and cardiovascular disease. Complete data from 5,615 community dwelling adults was collected using a short questionnaire on sleep characteristics, measures of neck circumference and weight, and in-home PSG. This study showed that SDB was highly prevalent among commuity-dwelling adults, and the overall prevalence of SDB in this sample was 18% with an AHI≥ 15. Controlling for variables of increasing BMI and male sex eliminated differences between various ethnic groups (Young et al., 2002). After adjusting for anthropometric and demographic factors, the risk of hypertension compared to AHI<1.5 was: AHI=1.5-4.9, OR 1.1 (95% CI 0.9-1.3), AHI=5-14.9, OR 1.2 (95% CI 1.0-1.4), AHI=15-29.9, OR 1.3 (95% CI 1.00-1.56), and AHI≥ 30, OR 1.4 (95% CI 1.0-1.8). Similar to the Wisconsin and Pennsylvania cohorts, a dose-response relationship was observed between AHI and hypertension. Associations of hypertension and SDB were observed in men and women, in younger and older age groups, all ethnic groups, and among normal-weight and obese people (Nieto et al., 2000).

Duran and co-workers' (2001) investigated a sub-sample (from a larger study) of 555 men and women from Vitoria-Gasteiz, Spain, and reported a significant association between SDB and increased risk of developing hypertension, although there was no evidence of a dose-response relationship for increasing AHI levels. For: AHI=1-4.9, OR 2.5 (95% CI 1.1-5.8), AHI=5-15.9, OR 1.3 (95% CI 0.5-4.1), and AHI≥ 15, OR 2.3 (95% CI 0.9-5.7), compared to AHI<1.0.

With the exception of Duran's group, collectively there is clear evidence that a dose-response relationship exists with AHI cut-off points up to 15 or 30 (i.e., moderate OSAS severity), and the association plateaus off with more severe OSAS. Reasons for this trend remain unknown, but possible explanations include: (1) survival bias of patients with severe OSAS and CVD; (2) potential errors and differences in methods; (3) possible measurement errors at higher levels of AHI; or (4) small numbers representative of severe OSAS (Young & Javaheri, 2005). Nevertheless, the evidence points to an association between hypertension and OSAS. Moreover, in terms of treatment it is becoming increasingly acknowledged that CPAP treatment may also lessen the risk of developing CVD attributable to hypertension (Stradling, Pepperell. J., & Davies, 2001; Young & Javaheri, 2005).

Mortality

It has been postulated that the risk of mortality among OSAS sufferers increases as a result of increased co-morbidities, in particular CVD and MVAs. The notion that untreated severe OSAS can result in cardiovascular events such as myocardial infarction (MCI) or stroke, suggests increased risk of mortality (Pack, 2006). Earlier studies of mortality consisted of predominantly retrospective data which can introduce a series of biases and limits the validity of results (Redline & Strohl, 1999). Lindberg and workers (1998) prospectively followed 3,100 men (30-69 years) for 10 years, but they did not find an overall relationship between snorers (as a risk factor for CVD) and mortality. Likewise, other studies have not found significant associations between AHI and age-adjusted CVD mortality (Ancoli-Israel et al., 1996; Bliwise, Bliwise, Partinen, Pursley, & Dement, 1988). However, in a subset analysis, Lindberg et al (1998) found after adjusting for possible confounding factors, that men (<60 years) with snoring and daytime somnolence were significantly more likely to die compared to men without these symptoms (RR 2.2, 95% CI 1.3-3.8). In summary, there is limited evidence that indicates increased mortality risk among middle-aged severe OSAS sufferers (Pack, 2006; Redline & Strohl, 1999).

2.4 Epidemiology of OSAS

2.4.1 Prevalence

OSAS prevalence studies are important as they inform the wider sleep research community about the distribution of the disorder, particularly as the prevalence can change over time, from population to population, and if there are changes in the distribution of other related diseases (Rothman, 2002). Prevalence studies are also vital to assist health planners and resource allocators to make appropriate decisions concerning 'preventative' strategies for people at risk of OSAS, and concerning the level and distribution of treatment services available.

Disparate estimates of OSAS prevalence exist due to differences in the definition of OSAS, measuring techniques, and population groups sampled. Table 2.1 shows a wide range of reported prevalence rates of OSAS from relevant longitudinal and cross-sectional studies.

Table 2.1 Occurrence of Obstructive Sleep Apnoea (Syndrome)

First author and date	*Methods*	*Subjects*	*Age (yrs)*	*OSAS Criteria*	*Prevalence (%)*
Young et al. (1993)	CE, PSG *Cohort of State Employees*	352 males, 250 females, Wisconsin, US	30-60	RDI≥ 5 and hypersomnia	4.0 males 2.0 females
Bearpark et al. (1995)	MESAM4, MH *Random sample*	294 males, Australia	40-65	RDI≥ 5 Subjective EDS and RDI≥ 5	26.0 3.1
Marin et al. (1997)	HO, CH, CE *Representative population sample*	597 males, 625 females, Spain	>18	Loud SN, EDS, abnormal HO	2.2 males 0.8 females
Puvanendran & Goh (1999)	PSG, MSLT *Random sample*	106 male and females, Singapore	30-60	AI> 5 and loud habitual SN	15
Duran et al. (2001)	Q, PSG *Spanish Cohort*	2,148 (Q), Spain 555 (PSG)	30-70	AHI≥ 10 and EDS	3.4 males 3 females
Bixler et al. (2001)	PSG *Sub-sample of Cohort*	741 males and 1,000 females had PSG Pennsylvania, US	20-100	AHI> 10 + daytime sleepiness	3.9 males 1.2 females 10.5 overall
Hui et al. (2002)	Q, ESS, MESAM4, CE *Representative drivers sample*	207 males, 9 female bus drivers, Hong Kong	mean age 42.4	RDI≥ 5 and sleepiness at work RDI≥ 5 and ESS>10 RDI≥ 5	20 9.8 61
Netzer et al. (2003)	Q, CE *Mulitcentre sample of Primary care setting*	(1) 3,915 US patients (2) 2,308 Europe patients	15-98	Pre-test risk Pre-test risk	32 26.3
Mihaere et al. (2004)	MESAM IV, Q	705 Community sample 510 Clinical sample Wellington, New Zealand	30-60	RDI≥ 5 RDI≥ 10 RDI≥ 15	39.8% 31.1% 26.0%

Table 2.1 Occurrence of Obstructive Sleep Apnoea (Syndrome), continued

First author and date	*Methods*	*Subjects*	*Age (yrs)*	*OSAS Criteria*	*Prevalence (%)*
Kim et al. (2004)	PSG: lab & home *Population based study*	457 males and females, Korea	40-69	AHI≥5 and daytime sleepiness AHI≥5 and daytime sleepiness	4.5 male 3.2 females
Howard et al. (2004)	(1) MAP, ESS (2) PSG *Random sample*	(1) 2,342 (2) 161 Commercial drivers, males, Australia	16-71	High risk + ESS>10 RDI≥5	(1) 54 (2) 16

Q=Questionnaires, PH=Telephone Interview, PSG=Polysomnography, MESAM4=Madaus Medizin-Elektronik, MAP=Multivariable Apnea Prediction questionnaire, CH=Case History, CE=Clinical Examination (includes anthropometric examinations), HO=Home Oximetry, Ox=Oximetry, HS=Home Study MH=Medical History, AHI=Apnoea-Hypopnoea Index, RDI=Respiratory Disturbance Index, SN=Snoring, EDS=Excessive daytime sleepiness

The main reasons for the wide range of prevalence estimates in Table 2.1 are as follows. First, some studies focussed primarily on gender specific groups (Bearpark et al., 1995; Ferini-Strambi et al., 1999; Howard et al., 2004; Udwadia, Doshi, Lonkar, & Singh, 2004); or by occupation or status (Gurubhagavatula, Maislin, Nkwuo, & Pack, 2004; Howard et al., 2004; Hui et al., 2002); or by ethnicity or country (Duran, Esnaola, Rubio, & Iztueta, 2001; Kim et al., 2004; Marin, Gascon, Carrizo, & Gispert, 1997; Mihaere, Gander, Neill, Reid, & Harris, 2005; Netzer et al., 2003; Puvanendran & Goh, 1999). Thus it is possible that differences in ethnic and anthropometry may have accounted for the differences in estimated prevalence rates. Second, there are differences in the methods and procedures used to obtain the prevalence rate, for example, a two-stage sampling procedure versus a simple questionnaire based study. Third, there are also differences in how OSAS is defined. Some studies defined OSA as a clinical entity, while others based their prevalence estimates on the syndrome (i.e., OSA plus daytime sleepiness). Fourth, there was inconsistency in the use of AHI or RDI cut-off points to define OSA or OSAS. Fifth, different diagnostic methods were used to obtain a diagnosis of OSAS, for example PSG versus home-based studies (i.e., MESAM IV).

Longitudinal Studies

The Wisconsin Sleep Cohort: One of the most widely quoted studies and the most well-planned prevalence study, is the Wisconsin Sleep Cohort study conducted by Young and colleagues (1993). It is thought that this study provides a realistic view of actual prevalence rates for OSAS (Stradling & Davies, 2004). Participants (state employees) were issued a questionnaire, with a sub-sample of 602 participants studied by overnight PSG. The prevalence indicated by having an AHI$\geq$ 5 per hour of sleep along with daytime hypersomnolence was estimated at 2% among women and 4% among men, in the 30-49 year age range (Young et al., 1993). However, despite the high response rate (82%) of the questionnaire, only 43% responded to recruitment for PSG, thus the outcome measure may be affected by under-reporting. Furthermore, the results of the diagnostic procedures were based on a single night PSG study, thereby introducing bias by not controlling for night to night sleep variability, which may be an artefact of other potential confounders such as medications and chronic sleep deprivation. Finally, the results were based predominantly on Caucasian Americans, thus it is questionable whether they can be generalised to other ethnic groups.

The Victoria-Gasteiz Spanish Cohort: Duran et al's. (2001) randomised stratified sample of Victoria-Gasteiz residents obtained a response rate of 76.9% in the questionnaire sample. Phase one of the study involved a home survey, blood pressure measurement, and an overnight home-based study (MESAM IV) (n=2,148). In phase two of the study, suspected OSA participants were referred for PSG (74% response rate). With an AHI≥ 5, the prevalence of OSA was 26% for males and 28% for females. However, using the AHI cut-off of ten and EDS, the prevalence of OSAS was 3.4% for males and 3% for females. This is consistent with that reported by Young and co-workers (1993). Possible explanations of the difference in prevalence compared to the Wisconsin cohort may be a wider age range, variation in the definition of OSAS, and differences in health status.

The Southern Pennsylvania Cohort: Bixler's group (2001) studied 12,219 women and 4,364 men from the general population of southern Pennsylvania via a two stage process. Stage one involved telephone interviews. In stage two, 1,000 women and 741 men were referred for PSG diagnosis of OSA. With an AHI≥ 5, the prevalence of OSA for men was 17% and for women 7%. Using the definition of OSAS defined as an AHI≥ 10 plus daytime sleepiness, hypertension, or other cardiovascular complications, the adjusted prevalence rate of OSAS for women was 1.2% and 3.9% for men. When compared to the Wisconsin Sleep Cohort, these prevalence rates are lower but this may have been influenced by the broader age range (20-100 years) and a different definition of OSAS, which included comorbidities.

Another longitudinal study is worth noting here but was not included in Table 2.1, because the study focused on incidence rates. The Cleveland Family Study by Redline et al. (2003) examined the determinants of change in RDI over a five year period among 486 community members with SDB, using in-home monitoring. This family strategy study was designed to describe a life-course history of familial factors in SDB of families with and without diagnosed SDB. Participants comprised 386 white and 100 black Americans, with an average age of 31.6 years (±17.9). Control families were randomly selected from a list of names provided by an index proband of families or neighbours who had at least three living family relatives that were available for the study. All participants were studied twice at five years apart. The sample analysis included case and control study families other than the proband, or family members who had not undergone SDB treatment. SDB was defined by having an RDI≥ 15, and the prevalence of SDB increased over the follow-up period from 10.5% to 16.3%. In particular, the incidence of SDB among men increased significantly from 13.7% to 23.4% ($p<0.01$) over time. The median RDI was significantly higher among the more obese participants in the upper BMI quartile (OR 2.8), compared to those with a BMI in the lowest quartile (OR -0.1), $p<0.001$. This study provided some interesting information about participants who had not sought medical help for SDB problems, and subsequently found the RDI to increase over time. The limitations of this study can be seen in the selection of the population who were derived from neighbourhood controls and index proband families. Therefore, the results may not be representative of the general population. Furthermore, there is possible reporting bias from participants 'self-reports' of daily sleep habits, and the night-to-night variability in SDB also reduces accuracy of estimated changes over a long-term period.

Other prevalence studies

Bearpark's group (1995) found a high prevalence (26%) of OSAS among 294 Australian men aged 40 to 65 years with an RDI$\geq$ 5. Adding the criterion of daytime sleepiness defined as *"falling asleep during the day when you are not busy, not including planned naps at least often"*, the prevalence was 3.1%. The study was limited by its response rate (60%), raising the possibility of response bias. One explanation could be the fact that the study commenced at the same time as the Bussleton Health Survey, therefore the response rate may be indicative of participation attrition due to residents being over-sampled. The study was also limited by the use of a single night home-based study (MESAM IV). Therefore the impact of night-to-night variability is unknown. Furthermore, sleeping in a supine position has been shown to increase the frequency and severity of apnoea-hypopnoea events (Nankano, Ikeda, Hayashi, Ohshima, & Onizuka, 2003; Oksenberg, Khamayasi, Silverberg, & Tarasiuk, 2000) and the authors did not control for posture or sleeping position (supine), which may have affected the prevalence estimates for OSAS. Finally, this study contained predominantly white European men living in a rural area of Australia, and it would be unwise to generalise the estimated prevalence to other ethnic groups.

Marin and co-workers (1997) carried out the first prevalence study in southern Europe. The criteria for OSAS were defined as evidence of repetitive episodes of transient arterial oxygen desaturation followed by a rapid return to baseline (Marin, Gascon, Carrizo, & Gispert, 1997). By this definition, 0.8% of women and 2.2% of men met the minimum diagnostic criteria for OSAS (i.e., severe snoring, excessive daytime sleepiness, and abnormal nocturnal home oximetry). This was considered conservative by the authors, however it is similar to that reported by Bearpark's group (1995). Limitations include: (1) using home-based nocturnal oximetry, which is less reliable than polysomnography for diagnosing OSAS, and (2) the study relied on cases of somnolence and snoring complaints as part of the diagnostic approach. This introduces sampling bias as potential OSAS patients without snoring and somnolence symptoms were not included, therefore possibly under-estimating the prevalence of OSAS.

Puvanendran and Goh (1999) highlighted OSAS as being common (15%) in their Singaporean population. The frequency of snoring was also their main focus. This study obtained a 100% response rate. However, there are limitations originating from the sampling frame. That is, participants (mainly couples) were randomly recruited by visiting patients in the hospital, although the methods were not specifically outlined. The majority of participants were long time bed partners who were more aware of each other's sleeping habits. Based on the partner's perception, participants were categorised by different levels of snoring. 'Loud habitual' snorers (n=106), defined as snoring that disturbs the bed partner, were referred for PSG. 'Loud' snorers, defined as snoring every night, were referred to the sleep clinic to assess the degree of snoring. The selection process may have introduced selection bias because only people who were 'symptomatic' entered the next stage of the study. Finally, the study utilised the Apnoea Index (AI) which differs from other studies as it was exclusive of hypopnoeas which are also included in the definition of OSAS (American Academy of Sleep Medicine, 2005).

Hui et al. (2002) assessed the prevalence of OSAS in a group of Hong Kong bus drivers. They presented a wide range (9.8%-61%) of OSAS prevalence estimates based on different measurements: (1) RDI$\geq$ 5, (2) RDI$\geq$ 5 and sleepiness at work, and (3) RDI$\geq$ 5 and scoring ESS>10 on the Epworth Sleepiness Scale. The study obtained a low response rate (53%), thus these prevalence rates are not representative of the general professional driving population, as only a single company of drivers participated.

Netzer and colleagues (2003) aimed to estimate differences in the prevalence of OSA between America and European countries from patients aged 15 years and older. The target sample was obtained via primary care visits for any reason. Physicians participating at these primary care facilities used the Berlin Questionnaire to measure the symptoms and clinical features characteristic of OSA. They found that more of American participants (32%) were at risk of OSA than their European counterparts (26.3%, $p<0.01$). The pre-test risk of OSA was greater in men than in women, (37.9% versus 27.8% respectively, $p<0.005$). The large sample size of this study (6,223 respondents) was possible because of the cost-effective questionnaire approach. However, such measurement tools are prone to systematic errors. In particular, interviewer bias is possible, through physicians prompting information which may have resulted in over-reporting the symptoms of OSA. Sampling bias may also be an issue as seen in those participants that attended primary care facilities regularly due to chronic health issues, which could lead to an over-estimate of the prevalence rates. Additionally, information bias may have influenced the results as the Berlin Questionnaire may not be sensitive or specific enough to detect the risk of OSA accurately. This is the negative trade-off compared to PSG or other measures that can objectively measure sleep-disordered breathing.

Mihaere (2004) analysed questionnaire data from 705 population-based participants. Of these, 364 participants agreed to overnight sleep monitoring (MESAM IV) in their homes. A second sample included 510 patients referred to the sleep clinic for suspected OSA, who had PSG sleep studies either at home or in the clinic. The combined samples were used to develop a model for pre-test probability of OSA. The predictors entered into the final multivariate model were: age, neck circumference, observed apnoeas, EDS and habitual snoring. The optimal cut-off point (0.30) was based on evaluation of ROC curves[10]. The model correctly classified 81.1% of the overall sample (sensitivity 80.1% and specificity 81.5%), thus indicating good discriminatory power and potential usefulness in a primary care environment. There are several limitations to this study. (1) Systematic errors in the sampling frame may have introduced bias, particularly as the sample represented residents of Wellington city, which is a relatively affluent group compared to the general population. A comparison of socio-economic deprivation (NZDep96, Salmond et al. 1999) indicated MESAM IV participants (Māori and non-Māori) were over-represented in the less deprived deciles and under-represented in the

[10] ROC: Receiver Operator Characteristic curves. Non-parametric plot of the true positive (sensitivity) and false positive rates (1-specificity).

most deprived deciles. Moreover, they were significantly less deprived compared to the respondents in the national OSA survey by Harris (2003). Given this, it is unlikely that the prevalence results are generalisable to Māori in New Zealand for several reasons. (1) The limited uptake of participants agreeing to a MESAM IV study (46%) reflected potential response bias. Those who consented to a home-based study may have been concerned about the possibility of having OSA, which would lead to an over-estimate of prevalence. (2) Information based on self-reported sleep habits and demographics may also be a major source of bias. Participants may be over-reporting or under-reporting information on sleep habits such as snoring and witnessed apnoeas. (3) Measurement errors potentially introduced bias, as reportedly there were problems with the position sensor, so sleeping in a supine position could not be controlled for. (4) The screening tool (multivariate predictive model) was not evaluated in an independent group, thus this may have artificially inflated the predictive value of the tool, a phenomenon known as regression toward the mean. Developing the tool in a subset of the population and validating it in another would have been a stronger approach.

Kim's group (2004) studied a random sample of 457 Korean men and women, using an AHI≥ 5 threshold. The estimated prevalence of OSA was 27% and 16%, in men and women respectively. With the additional symptom of excessive daytime sleepiness, the prevalence of OSAS reduced to 4.5% in men and 3.2% in women. These findings were similar to those of Young et al.'s (1993) from the Wisconsin Sleep Cohort study. The Korean study did not report the response rate or the characteristics of non-participants, which makes it difficult to comment on selection bias. Furthermore, information on body habitus or sleep habits (e.g., snoring, witnessed apnoeas) was not collected, making it impossible to comment on the direction of any effects on the prevalence estimate.

Howard et al. (2004) examined the prevalence of SDB among commercial drivers in Australia. Two thousand three hundred and forty-two drivers were successfully recruited to be surveyed (MAP[11]), and another 161 drivers were recruited for a PSG study. In the PSG sample, the prevalence of SDB was 59.6%, and 15.8% for OSAS. The sample contained non-randomly selected drivers recruited from a single company,

[11] MAP: Multivariable Apnea Prediction questionnaire

thus they are not representative of other professional drivers. Moreover, a less than optimal response rate (66%) from drivers could mean potential differences exist between respondents and non-respondents. Information on history of sleep deprivation was not sought, which may have influenced the results as participants may be more representative of those with chronic sleep deprivation, leading to an increase in the severity of SDB.

2.4.2 OSAS and snoring

According to the ICSD 2005 edition, snoring is characterised as; *"a respiratory sound generated in the upper airway during sleep that typically occurs during inspiration but may also occur in expiration. ... The intensity of snoring may vary and often will disturb the bed partner's sleep and even awaken the patient. Snoring in this context does not cause symptoms of daytime sleepiness or insomnia in the patient." (p.204)*

Snoring and OSAS are highly associated. However, snoring is not an essential concurrent for OSAS, nor does it necessarily indicate the presence of OSAS. Generally, PSG is used to differentiate snoring from other noises during sleep, such as laryngospasms. Studies examining snoring as a potential risk factor for OSAS have yielded mixed results.

Ferini-Strambi's group (1999) randomly selected 750 Italian women (40-65 years), of whom 365 consented to a home-based study using the MESAM IV. The study reported that 54.2% of women snored for more than 10% of the night, while 7.1% snored more than half the night, thus indicating that snoring was common among this group. OSAS was also common: 79.4% of women had an RDI<5, 10.7% had an RDI=5-9, 7.7% obtained RDI=10-19, and 2.2% had an RDI>20. Reported snoring and recorded snoring correlated with RDI ($r=0.34$, $p<0.001$ and $r=0.43$, $p<0.001$, respectively). Multivariate analyses found that, after controlling for age, BMI, and menopause (yes/no), increasing neck size was the only variable significantly associated to RDI>10 (OR 1.3, 95% CI 1.1-1.6). Moreover, women who were obese were six times more likely to snore for more than 50% of the night, compared to women with normal BMI measurements (95% CI 1.5-25.0). The results support the notion that snoring is not essential for the occurrence of OSAS

Two separate studies have looked at snoring and its potential relationship to other medical conditions such as cardiovascular diseases. In the study by Hui et al. (2002) of 1,910 Asian students, they found that, while overall snoring prevalence was high (25.7%), only 9% of participants snored more than 10% of the time during their sleep period. In contrast to the definition given by the AASM (2005), they found snoring to be associated with daytime somnolence (in the absence of OSAS) and impaired performance. The authors could not detect whether this was a result of an underlying medical condition, or due to sleep fragmentation and frequent arousals. Further in-depth investigation of the effects of snoring among a younger population is necessary to determine whether this is a precursor to developing SDB at a later age.

A different cross-sectional epidemiological study by Enright et al. (1996) found from their sample of 5,021 aging adults (65 years and older), only 33% of men and 19% of women self-reported to snore loudly. The prevalence of snoring was lower among participants aged over 80 years. Snoring was associated with alcohol use in men, and for women it was associated with obesity, diabetes and arthritis. Enright and colleagues (1996) did not find snoring to be an independent risk factor for other health problems such as cardiovascular diseases in their aging group of participants. On the other hand, an earlier retrospective study by Hoffstein and workers (1995) reviewed records of over 2,000 patients who had undergone PSG recordings that included the measurement of snoring. They found snoring to be associated with arousals, although this association was fairly weak. They concluded that further prospective studies are needed for conclusive results.

The Wisconsin Sleep cohort study found that self-reported snoring was associated with OSAS. The prevalence of an AHI$\geq$ 15 increased with increasing categories of snoring frequency (12% moderate snorers, 28% habitual snorers) and snoring volume (11% little, 21% somewhat loud, 38% extremely loud). Using multiple logistic regression, after adjusting for age, sex, and ethnicity, the odds ratios of an AHI$\geq$ 15 with self-reported habitual snoring and snoring extremely loudly increased almost three fold and four fold, respectively. They further reported a significant interaction between sex and snoring frequency and loudness. For women, the proportions having an AHI$\geq$ 15 in moderate and habitual snorers were 7% and 20% respectively, and for men 18% and 33%. It is possible that men over-reported snoring symptoms compared to women. Little is known about sex differences in the validity of self-reported snoring. Moreover, there is a 1.8 fold decrease in reported habitual snoring between 50-60 years and 70-99 years. This supports the notion that SDB in older people differs to that in younger-middle-aged groups. However, caution in interpreting such data is required as older people are less likely to accurately report sleep disturbances and snoring due to hearing problems, loss of a bed-partner and age related health changes (Young et al., 2002).

2.4.3 Risk factors for OSAS

The most common risk factors reported for OSAS are: sex, age, obesity, smoking, and snoring. Because these factors usually co-exist, they collectively affect the severity of OSAS. Other risk factors that have been explored include craniofacial features, familial predisposition, nasal congestion, and ethnicity.

Sex

OSAS is commonly believed to be a disease of men. However since the rise of population-based studies, OSAS is no longer thought of as a rare disease in women (Kapsimalis & Kryger, 2002a). Recent research comparing the ratio of males to females in clinic populations (8:1) and among undiagnosed population studies (2-3:1), indicates that men are more likely to be referred and evaluated at sleep clinics than women. This suggests the source of bias stems from health practitioners favouring men over women being investigated (e.g., for snoring), and subsequently referred for OSAS diagnosis (Young & Peppard, 2005; Young, Skatrud, & Peppard, 2004). Sherpertycky et al. (2005) investigated the biases that influence whether women with OSAS are diagnosed or not. They concluded that, because women complain of depression, hypothyroidism, and their symptoms of sleep disturbance, which are described similarly to insomnia, this reduces the likelihood of physicians referring to investigate the possibility of OSAS.

Differences between men and women have also been attributed to the hormone depletion hypothesis. That is, changes in the levels of hormone production across menarche, pregnancy and menopause may influence changes in risk of OSAS in women (Young, Skatrud, & Peppard, 2004). Evidence from the Wisconsin Sleep cohort and the southern Pennsylvania cohort showed there was an increased risk of OSAS among post-menopausal women by 300% and 400% respectively, compared to pre-menopausal women (Bixler et al., 2001; Young & Peppard, 2005). In addition, the SHHS compared women using hormonal replacement therapy (HRT) to non-HRT users. Women on HRT had half the risk of OSAS compared to non-HRT users. Collectively, these results supported the hormone depletion hypothesis, which suggests that the hormone progesterone given via HRT was protective against OSAS in post-menopausal women (Young, Skatrud, & Peppard, 2004). Contrary to this, a blinded RCT study of HRT users showed a weak effect of HRT in protecting against apnoea and hypopnoeas (Polo-Kantola et al. 2003). For men, higher levels of testosterone have been linked to OSAS and associated with reduced upper airway patency in patients with OSAS (Fogel et al., 2003; O'Connor, Thornleu, & Hanly, 2000; White, Lombard, Cadieux, & Zwillich, 1985). Therefore, testosterone may play a minimal role in explaining male predominance in OSAS. Millman's group (1995) examined fat distribution measurements (subscapular and tricep skinfolds, waist to hip ratio, neck circumference, BMI) between men and women. Despite obesity being higher among women, upper body obesity is a common characteristic among men. This may help explain the higher prevalence of OSAS in men.

Overall, prevalence differences in OSAS between men and women are not yet fully explained. It seems that progesterone is protective against OSAS for women, while testosterone may facilitate the development of OSAS for men.

Age

It has been suggested that the prevalence of OSAS increases with age, with a two-to-three fold increase in people older than 65 years compared to the middle-aged group (30-64 years) (Young, Skatrud, & Peppard, 2004). This relationship suggests the possibility of a less severe form of OSAS, or a distinctively different syndrome present among the older age group. In the southern Pennsylvania cohort (Bixler et al., 2001), the authors found the prevalence of OSA (AHI≥ 10) increased with age monotonically. Furthermore, the prevalence of OSAS (AHI≥ 10 plus daytime sleepiness, cardiovascular complications or hypertension) increased monotonically across the decades from 20-29 years through to 50-59 years (0.4%, 1.5%, 2.8%, and 5.4%, respectively), but declined from 60-69 years, and 70≥ years (4.2% and 2.5%, respectively). This reflects what is typically seen in sleep disorders clinics. The reduction in clinical significance among the older age group may suggest a less severe form or different type of sleep disorder present. Further investigation among older age groups is necessary to understand age-related trends in OSAS prevalence.

Alcohol and smoking

Alcohol and smoking are also recognised risk factors for OSAS (American Academy of Sleep Medicine, 2005).

Alcohol: Ingesting alcohol, especially around bedtime, reduces the muscle activity of the genioglossus and pharyngeal dilators, which are responsible for maintaining airway patency. This exacerbates SDB, because the effect of alcohol predisposes upper airway collapse (Guilleminault & Bassiri, 2005). It is thought that alcohol affects the frequency of apnoea and hypopnoea. However, small studies (Scrima, Broudy, Nay, & Cohn, 1982; Tsutsumi, Miyazaki, Itasaka, & Togawa, 2000) have found little or no correlation between oxygen desaturations per hour post-alcohol ingestion, but that alcohol does exacerbate OSAS symptoms. Longitudinal cohort studies are needed to determine the long-term effect of consumption on the development and progression of OSAS (Young, Skatrud, & Peppard, 2004).

Smoking: It has been hypothesised that smoking exacerbates airway inflammation and that blood nicotine levels affect sleep stability. Smoking has been shown to be associated with increased risk of sleep disordered breathing after controlling for confounders in a study carried out by Wetter et al. (1994) of 844 adults enrolled in the Wisconsin Sleep cohort study. In the Wisconsin Sleep cohort, OSAS was three times more prevalent among current smokers than non-smokers (former or never smoked). It is also thought that smoking may increase susceptibility to OSAS development (Young, Skatrud, & Peppard, 2004).

Excess body weight

Multiple factors may predispose people to OSAS, however excess weight has been proven to be the strongest contributing factor (Young, Peppard, & Taheri, 2005). Different methods of measuring excess body weight include BMI[12], neck circumference and waist-to-hip ratio. However, it is not clear which body habitus measurements are most closely related with OSAS risk. Various studies using multivariate analyses reported neck size as being more closely related to OSAS severity than BMI (Davies, Turner, Crosby, & Stradling, 1994; Hoffstein & Mateika, 1992; Katz, Stradling,

[12] BMI is calculated as weight in kilograms divided by the square of height in meters. Measurements above 27 kg/m^2 are considered obese.

Slutsky, Zamel, & Hoffstein, 1990) . In Hoffstein and Mateika's (1992) study, of the 670 suspected OSAS patients, 156 were matched with controls by age and BMI. Neck circumference was significantly higher in OSAS patients (41 cm vs 39 cm, $p<0.0001$), but not abdominal circumference. Other studies have found BMI to be a better predictor of AHI.

Grunstein et al. (1993) measured 1,464 men who underwent sleep studies, and found waist circumference ($r^2=0.15$, $p<0.001$) was a stronger predictor for OSAS than neck circumference or BMI. This suggests that the relationship between OSAS and obesity is not completely explained by fat disposition in the neck region. More recently, Fogel et al. (2003) suggested specific anatomic and physiologic characteristics (shape of the pharyngeal airway and lung volume dependence of the upper airway) were better predictors of apnoea severity than obesity. However, the small sample size (n=14) and volunteer bias (participants were also evaluated for weight reduction surgery) limits the ability to generalise their results. Swab and colleagues (2003) similarly examined anatomical structures in a case control study (48 cases, 48 controls). After adjusting for ethnicity, sex, age, craniofacial size, and visceral fat in the neck, the likelihood of developing OSAS increases with a larger volume observed in the tongue, lateral pharyngeal walls, and total soft tissue.

Longitudinal studies provide some understanding on how SDB varies with weight changes over time. In the Wisconsin Sleep Cohort, at the 4-year follow up stage, an observed 10% weight gain was associated with a six-fold increase in the odds of developing moderate-severe OSAS (AHI$\geq$ 15). In the Cleveland Family Study which examined the natural history of SDB (Redline, Schluchter, Larkin, & Tishler, 2003), 486 participants (mean age 36.8 years) were visited at the five year follow-up period. The interaction of age, sex and BMI was significant in predicting AHI changes. At baseline, regardless of age and BMI, increase in weight was associated with an increase in AHI, particularly for women. Similarly, data from the SHHS examined 2,968 men and women at the five year follow-up and found that AHI was likely to increase more in men compared with women for any given weight increase. For a weight gain of more than 10kg, the odds of progressing to AHI$\geq$ 15 was 5.2 times greater (95% CI 2.4-11.5) for men, and 2.6 times greater (95% CI 1.0-6.6) for women (Newman et al., 2005). New evidence from Young et al. (2005) suggests that, among middle-aged adults, about 17% have mild SDB (AHI$\geq$ 5), and approximately 41% of those adults have SDB attributable to having BMI≥ 27 kg/m^2. Likewise, approximately 5% of adults have moderate SDB (AHI≥ 15), and 58% of those have SDB attributable to obesity. This indicates that so long as the obesity epidemic continues, the prevalence of SDB will also continue to increase, along with the proportion of SDB attributable to excess weight (Young, Peppard, & Taheri, 2005).

BACKGROUND TO THE STUDY

2.5 The Study Context

It is evident from the literature review that OSAS is a growing health problem among the general population, and that it can negatively impact on an individual's health in many ways. The current study was undertaken in the wider scope of public health to examine OSAS symptoms and risk factors among professional taxi drivers, which if left untreated, could result in increased risk of MVAs, morbidity or death. Combined with shift-work common in the taxi industry, OSAS further increases the risks for drivers' health and safety, with potential for cognitive and performance impairment, and work-related injury. A brief outline of the taxi industry, relevant studies on OSAS, and the state of sleep services in New Zealand follows, in order to justify the current study.

2.5.1 The New Zealand taxi industry

Prior to recent transport reforms, the New Zealand taxi industry was tightly regulated by the Director of Land Transport. With the aid of Transport Licensing Authorities (TLA), the Director had the authority to approve a taxi organisation, and to grant a licence to drive, and/or operate a taxi service (Soon, 1999b). The Ministry of Transport also controlled the standards of practice and driver competence. The taxi industry was deregulated under the Transport Services Licensing Act 1989, which obtained its impetus from the land transport reforms in the early 1980s. In 1983, the legislation clarified the definition of a taxi driver-operator by classifying them under the Passenger Service Vehicle (PSV) licence, known as a P-endorsement. This meant a taxi driver could 'carry up to 12 passengers and or goods for hire or reward'. Previously, taxi drivers were for 'hire or reward to any member of the public for the carriage of up to seven passengers' (Gaunt, 1996). This category change was significant because it allowed easy access for any person to obtain a licence to operate a taxi business. At the beginning of this study, there were over 15 taxi companies and more than 1,500 taxi drivers operating a service in the wider Wellington region covering a population of around 430,000 people (Reddish, 2003). Anecdotally, the increasing number of taxi drivers, together with the competitive nature of the job, has led drivers to work beyond regulatory limits[13] (Reddish, 2003). This can result in sleep deprivation that contributes to poor health and morbidity.

It has been postulated that industry demands impact on drivers' health (The New Zealand Taxi Federation Inc., 2001). Land Transport New Zealand (LTNZ) statutory requirements for a P-endorsement license demand a medical examination every five years for commercial drivers[14]. Despite the prolonged interval between health checks required by the LTNZ, individual drivers are expected to take responsibility for their personal health to ensure their own safety and that of their passengers. There are also guidelines developed by the LTNZ (2002) for medical practitioners, optometrists and occupational therapists to manage individuals who are unfit to drive. These include recommendations for short periods of driving cessation to minimise the risks for individuals with EDS, and/or with OSAS (see Appendix 1).

Responsibilities for health and safety are defined in the Health and Safety in Employment Act (1992), amended in 2003, which has extended its coverage to include taxi drivers. Drivers (employers and employees) are expected to have systems in place to ensure safety through mutually agreed procedures. However, employed drivers also have the duty to keep themselves safe where danger, stress, or fatigue as a result of their workplace and work-schedules may arise. For self-employed taxi drivers, the Act endorses the LTNZ's licensing rule, with individual drivers taking responsibility for their own health and safety.

Taxi drivers play an important role in society by delivering a safe public transport system. There is no local or national information about the prevalence of OSAS among taxi drivers. However, the literature review has highlighted that OSAS among other commercial drivers[15] is prevalent (Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997a; Howard et al., 2004; Hui et al., 2002; Ribet & Derriennic, 1999; Richardson, Miner, & Czeisler, 1989-90). The current study examined OSAS

[13] Taxi drivers subject to the driving regulation hours must: (1) not drive for any continuous period exceeding 5 hours and 30 minutes; (2) after a continuous driving period of 5 hours and 30 minutes have at least a 30 minute rest before undertaking further driving; (3) not exceed 11 hours driving in any 24-hour period; (4) not exceed 14 hours on duty in any 24-hour period; and (5) have a minimum continuous off-duty period of at least 9 hours in any 24 hour period (LTNZ).

[14] A medical certificate must be obtained from a registered medical practitioner and dated no more than 60 days before the date of the license application (Land Transport New Zealand, 2005).

[15] Commercial drivers usually refer to truck drivers, or bus drivers.

symptoms and risk factors among a sample of Wellington based taxi drivers. Previous literature has shown that professional drivers with undiagnosed and untreated OSAS are at increased risk of accidents and poor personal health. The current study also investigated what factors, if any, inhibit taxi drivers from accessing health services.

2.5.2 New Zealand sleep studies

Research on OSAS in New Zealand is emergent. Existing studies provide information on OSAS risk factors, symptoms and prevalence rates that can help health service planners and policy-makers to ensure adequate services are provided where the need is greatest. The relevant studies are briefly outlined.

Coltman et al. (2000) assessed craniofacial and anthropometric factors among Māori (n=26) and European (n=27) males with OSA RDI$\geq$ 15. Differences in cranio-facial measurements, airway size, stature, weight, BMI, neck circumference, RDI, and age were found between Māori (adjusted r^2=0.35) and Europeans (adjusted r^2=0.60). The authors suggested these features may partially explain the difference in prevalence of OSA between these two groups. However, the definition of ethnicity (by a researcher examining photographs) was likely to have introduced bias and therefore render this study difficult to interpret.

An Auckland study examined ethnic differences in 233 patients referred to the Sleep Disordered Breathing Unit, Green Lane Hospital. Baldwin and colleagues (1998) examined ethnicity as a predictor of OSAS severity among different ethnic groups (Māori n=48, European n=152 and Pacific peoples n=33). Clinically, they found a high proportion of Māori and Pacific peoples diagnosed with OSAS defined as AHI$\geq$ 10 and daytime sleepiness (85% and 94%, respectively) compared to Europeans (49%). After adjusting for potential confounding factors, they found BMI, neck size and age were independent risk factors of OSAS severity, but not ethnicity. Thus, ethnicity per se was not a predictor of OSAS, and any racial predisposition for OSAS was more likely to be a result of well known risk factors. The fact that Māori and Pacific patients were more likely to have severe OSAS suggests that they may experience barriers to accessing specialist services, compared to European New Zealanders. This is consistent with ethnic differences in accessing the health system for other conditions (Crengle, 2000; Tukuitonga & Finau, 1997).

Harris (2003) conducted a national survey of a stratified random sample of 10,000 participants aged 30 to 60 years from the electoral roll. The sample was designed to have equal numbers of Māori and non-Māori participants, and participants in each decade of age. Māori compared to non-Māori had higher prevalence of risk factors and symptoms of OSAS, including, snoring always, observed apnoeas, EDS, and large neck size. The weighted prevalence rates of four common risk factors[16] predictive of OSAS were: (1) snoring 'often or always': 35.8% for the general population compared to 44.3% for Māori; (2) EDS (ESS>10): 14.8% for the general population, 23.3% in Māori; (3) observed apnoeas: 13.1% for the general population, 20.5% in Māori; (4) mean neck size, 37.4cm for the general population, and 38.9cm for Māori. The study indicates likely differences in OSAS prevalence exist between Māori and non-Māori, which have important implications in the planning and funding of health services for Māori.

Delaibatiki (2003) analysed OSAS symptoms and risk factors among Pacific peoples[17] in the population sample collected by Harris (2003). Based on findings by Middleton et al. (2002), severe OSAS was prevalent among a Pacific Island population (Samoa). This suggested a need to identify OSAS among Pacific peoples residing in New Zealand. Delaibatiki's study found that the prevalence of OSAS symptoms was higher among Pacific peoples compared to non-Māori and non-Pacific peoples.

Mihaere's (2004) community sample of 1,200 Wellington regional residents aged 30 to 60 years was randomly selected from the electoral roll (Mihaere, 2004). Using the MESAM IV, the study's overall adjusted prevalence of OSA (RDI$\geq$ 15) was 26.0%. For all Māori the prevalence was 28.1%, and for all non-Māori 20.7%. Gender-specific estimates were also produced. The prevalence of OSA was 33.2% for men and 12.0% for women, respectively. This study endorsed Harris's (2003) findings that OSA is

[16] Risk factors: (1) Snoring 'often or always', (2) Excessive Daytime Sleepiness determined by having an Epworth Sleepiness Score greater than ten, (3) Observed Apnoeas (yes vs no), (4) Neck circumference

[17] Pacific peoples are the name given to refer to all people who identify their ethnicity as being 'Pacific Island' (SNZ, 2004).

prevalent among the adult New Zealand population. It further confirmed that disparity exists between Māori and non-Māori.

The current study adds to the two latter studies by examining OSAS risk factors and symptoms among a specific group in the population (professional taxi drivers). New knowledge in this area is provided by the introduction of qualitative research methods investigating barriers to accessing sleep health services, which has not been carried out.

2.5.3 Barriers affecting access to health care services

The patterns of health service use and outcomes are important to identify and understand the dimensions of health inequalities in New Zealand (Ministry of Health, 2002c). Barriers that inhibit access to health care are: limited finance, no transportation, geographical placement, and little or no knowledge of services and information (Ministry of Health, 2002a, , 2002c).

Research has also recognised that certain groups continue to be at a disadvantage and experience more health inequalities. The impact of factors such as poor housing and nutrition, lack of health information have resulted in health status disparities between Māori/Pacific peoples and European New Zealanders (Ministry of Health, 2004a). Evidence indicating that 'ethnicity' is a barrier to accessing health care was demonstrated by the under-utilisation of preventative and primary health care services, accompanied by high hospitalisation rates, morbidity and mortality rates among Māori and Pacific peoples, compared to the European New Zealanders (Young, 2001). Additional evidence of ethnic differences in access to, and quality of adequate health care for Māori and Pacific peoples are described in the following sources (Baxter, 2002; Ministry of Health, 2004b; Tukuitonga & Bindman, 2002; Tukuitonga & Finau, 1997; Westbrook, Baxter, & Hogan, 2000). However, it is thought that Pacific peoples experience greater barriers to care, as they are exposed to both the Western and traditional cultural influences, and the co-existence of these two sets of values imposes problems relating to cultural and family cohesion (Robinson et al., 2006).

In the Pacific Health Chart Book (2004), the added constraint of 'lack of cultural comfort' with health care providers was identified (Ministry of Health, 2004b). Reasons for not attending GP services for Pacific peoples were identified as 'high costs', 'could not get an appointment', and 'could not spare the time'. These reasons were prominent among young people and those not in the workforce. On the other hand, Māori experienced geographical and transport barriers, lack of knowledge of health issues, and cultural barriers (culturally inappropriate health information and services) (Crengle, 2000). Given the development and implementation of Māori primary health care services, the disparity between Māori and non-Māori continues (Reid, Robson, & Jones, 2000), which suggests these services have not been effective. Furthermore, it is also important to note that Māori are still seen within 'mainstream services' (Crengle, 2000).

Sleep service issues

To date, there is paucity of information available about the use and access of specialist sleep services in New Zealand (Neill, Taylor, & Whyte, 2002). However, there is some evidence that indicates barriers to care for potential OSAS sufferers. At the health service planning level, Banno and Kryger (2004) identified barriers to accessing SDB services in relation to funding. They found: (1) inconsistent universal government funding available to health resources resulted in some patients experiencing imminent care, while others remained on long waiting lists; (2) before the Wisconsin cohort published the prevalence of sleep apnoea in the community, health planners were reluctant to fund sleep apnoea because it was not originally seen as a major public health problem; (3) access to sleep services depended on what the current health system and administrators valued. This is seen in the disproportionate decision-making to fund treatment for conditions that are not necessarily rational or scientifically justified (Wittmann & Rodenstein, 2004); and (4) as sleep apnoea is predominantly characterised by obesity, often patients are discriminated against (e.g., doctors tell patients to lose weight rather than further investigating patient symptoms). In relation to the latter barrier, Banno and Kryger (2004) call for society and medical professionals to change their prejudice views of obese people, because as obesity is projected to increase so will the prevalence of OSAS, and this will only increase the barriers to specialist sleep services.

Accessing specialist sleep services is also challenged by the discrepancy between demand and capacity, although the demand is difficult to quantify due to differences in criteria used to define OSAS. In America, Flemons et al. (2004) estimated that in an 'at risk' population of moderate OSAS, it is expected that 13% could be referred for assessment, but the capacity to meet this demand is restricted. Conversely, in places where the demand is less (e.g., Belgium), it has been posited that this may be a result of primary health care physicians under-recognising OSAS (Flemons, Douglas, Kuna, Rodenstein, & Wheatley, 2004). This stance is supported by other studies (Nugent et al., 2001; Rahaghi & Basner, 1999; Reuveni et al., 2004), that reported doctors failed to enquire about EDS, and other sleep disturbances as part of their medical routine, or that doctors asked irrelevant questions. This suggests that primary care physicians lack the education and training of sleep medicine necessary to make a clinical diagnosis. On the other hand, for reasons unknown, individuals with OSAS may delay access to adequate care because they choose not to inform doctors of major OSAS symptoms (Rahaghi & Basner, 1999).

In New Zealand, services for sleep disorders are limited by the number of clinics available to provide gold standard assessments and treatment. The services are also limited by the small number of specialist physicians available to provide overall medical care. There are seven specialist sleep service centres in New Zealand's main city centres (Auckland, Christchurch, Dunedin, Hamilton, and Wellington), offering a total of 17 beds (Campbell, 2005). Thus, approximately 0.5 beds per 100,000 people are available in a population of four million. Sleep services are funded differently to other medical services. Three services receive public and private funding. Two sleep centres receive complete public funding, and provide services to surrounding hospitals, thus they are regarded as tertiary services. The other two centres are funded privately (Harris, 2003).

Furthermore, there is no standardised approach in New Zealand for the management of sleep disorders and treatment providers, hence there are marked differences in the clinical services provided and in the funding of CPAP machines (Neill, Taylor, & Whyte, 2002). This issue has been partially addressed by the Thoracic Society of Australia and New Zealand (TSANZ) and the Australasian Sleep Association (ASA), who have developed an accreditation process for sleep services and clinicians, so a standardised approach for the management of sleep disorders is adhered to. However, this process is not compulsory (Mihaere, 2004).

Apart from the limitations of specialist sleep services, there is also restricted and unequal funding available for these services in New Zealand. Approximately $5 million of public funding is allocated to sleep clinics annually by District Health Boards

(DHBs). This equates to funding for approximately 1,900 people per year to attend publicly funded sleep services (Mihaere, 2004). The amount of funding allocated to this service is inadequate as it does not cover costs for the replacement of CPAP machines (maximum life expectancy 6-8 years). This will become a mounting problem in the near future. Moreover, the limited funding does not consider the provision of future services to meet increasing patient demand, especially as the general population and health practitioners become increasingly aware of OSAS as a serious public health problem. Already, services are falling short of providing adequate diagnosis and treatment, and waiting lists are growing exponentially (Neill, Taylor, & Whyte, 2002). Evidence from international experience has shown that new knowledge about SDB and OSAS has led to a rapidly growing demand for sleep services. However, the services are not able to meet the demand, resulting in physicians resorting to non-conventional approaches to treat the flood of patients presenting with symptoms (Flemons, Douglas, Kuna, Rodenstein, & Wheatley, 2004; Pack, 2004).

Part of the problem for patients accessing specialist sleep services lies in the referral process, usually initiated at primary care level (i.e., general practitioners, (GPs)). The New Zealand health system has not yet reached the same level of problems as experienced internationally. However, the main issue at hand is that GPs may not be adequately recognising SDB symptoms. Thus, mis-diagnosis and treatment of OSAS patients could result in increasing work absences, work-related performance errors, comorbidities, increasing medical costs, and unnecessary GP visits. This issue is supported by previous studies (Banno & Kryger, 2004; Nugent et al., 2001; Reuveni et al., 2004), which suggested education programmes and professional training in sleep medicine are necessary to reduce the barriers to care. Such issues are of primary interest to the current study, which addresses the issues first-hand among local taxi drivers in Wellington.

2.6 Goals and objectives

Given the above information, barriers to accessing health services may result from limited health services available, and inadequate knowledge and poor awareness among professional drivers. Therefore, two goals of the research presented in this thesis were as follows:

1. Using a survey questionnaire, to identify the prevalence of OSAS symptoms, and the probable risk of OSA, among taxi drivers.
2. Using qualitative measures (focus groups) identify the barriers to care for taxi drivers at risk of OSAS, and to understand why drivers are not accessing health care services.

The combination of quantitative and qualitative research methods was chosen, as the findings complement each other in identifying and explaining the issues around OSAS and the utilisation of health services. They also provide specific directions for areas of further research and recommendations for future health service and industry-based service provisions for taxi drivers.

Specific objectives in the questionnaire study

- To estimate the prevalence of OSAS symptoms among taxi drivers by ethnicity: Māori, Pacific peoples and people of "other" ethnicities.
- To identify risk factors of OSAS symptoms among taxi drivers.
- To estimate the pre-test risk of OSA for taxi drivers using a multivariate predictive model developed by Mihaere (2004).

Specific objectives in the focus group study

To identify factors that might prevent taxi drivers from seeking health care services for perceived sleepiness and sleep problems.

- To identify whether there are different barriers to care for different ethnic groups (Māori, Pacific peoples and people of "other" ethnicities).

- To provide insights on how these barriers to care affect the behaviour of taxi drivers.
- To establish an appropriate research approach for future research in the transport industry.

2.6.1 Research hypotheses for the questionnaire study

- OSAS symptoms and OSA are common among taxi drivers.
- OSAS symptoms are more common among Māori and Pacific taxi drivers compared to drivers of "other" ethnicities.
- Pre-test risk of OSA is high for professional taxi drivers.

2.6.2 Research hypotheses for the focus groups study

- Barriers to accessing health care services exist for taxi drivers due to work commitments, and the potential impact on their employment of OSAS diagnosis.
- Ethnic and cultural experiences explain differences in the barriers to care.

CHAPTER 3
THE QUESTIONNAIRE STUDY

This chapter provides a detailed description of the *Questionnaire study.* A pilot of the Questionnaire study was carried out in 2003 utilising a different sampling frame (i.e., the electoral roll for the Wellington region). The pilot study, methods and results are briefly summarised in Appendix 2.

METHODS

3.1 Sampling Strategies

The target population for this study was all taxi drivers in the Wellington region. In the pilot study, the electoral roll was used as a sampling frame, but a number of problems were found.

1. Ambiguous occupational labelling, for example taxi proprietor. This could denote an administrator and/or an actual driver.
2. People listed as drivers who did not actually drive taxis although they may have purchased a taxi license to operate a business.
3. Some drivers who were listed but had retired.
4. Some drivers no longer drove taxis as their main employment.
5. Some drivers had moved overseas or were deceased.

The response rate (41%) was also low, and the inaccuracy of the denominator meant that a different sampling strategy was needed. Therefore, cluster sampling was used, with the sampling frame limited to two major taxi companies who both endorsed and participated in this study. Endorsement by taxi company managers was seen as beneficial since it was considered likely to improve driver participation.

Sampling frame

A combined institutional roll from the two taxi companies was used as the sampling frame. Information made available to the researcher did not include names and addresses. The companies provided the total number of current drivers, and one company provided information on year of birth and sex, although the information provided was incomplete. However, the other company declined to provide basic demographic information, as they deemed it a breach of driver privacy. All drivers were members of the New Zealand Taxi Federation (NZTF), thus the sampling frame addressed the target population of professional drivers.

Sample size

There was no specific method for determining an appropriate sample size for a study of this nature. Since there is no routinely collected data about taxi drivers, this hampered the estimation of an accurate denominator. The final sample frame consisted of 651 professional drivers in the Wellington region, aged between 20-80 years.

3.2 Sleep Questionnaire

The majority of questions were taken from a questionnaire used in a national survey of risk factors for and symptoms of OSA (Harris, 2003). The complete questionnaire can be found in Appendix 3. The national survey was distributed to 10,000 New Zealanders of both Māori and non-Māori descent (71% response rate). It provided the first national prevalence estimates of OSAS symptoms, and is used as a benchmark for the current study.

The same questionnaire has also been used to develop a multivariate predictive model to estimate the probable risk of OSA, defined as having an RDI≥ 15 (Mihaere, 2004). The predictive model is currently being prospectively validated.

The questions used in the original questionnaire were selected from previous studies and available literature (Harris, 2003). Some changes to the questionnaire were considered necessary for the present study, and are described below.

3.2.1 Demographics

Sex (Question 1)

The first question asks the participant to identify their 'sex' as this information was not available to us through the companies. The term 'sex' was used in preference to 'gender' as it generally denotes the 'biological' state of being male or female. In contrast, gender was not used as it signified 'social constructs' such as being in a masculine or feminine role.

Furthermore, this question was included because OSAS is more prevalent among males. The International Classification of Sleep Disorders manual indicates that the male to female ratio is about 2:1 (American Academy of Sleep Medicine, 2005).

In the 1970s and 1980s reports from sleep clinics suggested OSAS was a disease of males (Kapsimalis & Kryger, 2002a). However, these differences are likely to change over time as women become exposed to more risk factors. In addition, the risk of OSAS increases across the menopause transition so the increasing proportion of post-menopausal women in the population is expected to affect the gender distribution of OSAS (Young, 2004).

Date of birth (Question 2)

Date of birth (dd/mm/yyyy) was asked in the questionnaire to calculate accurately the participant's age. It has been found that OSAS is most prevalent among middle-aged men (Shepertycky, Banno, & Kryger, 2005; Young et al., 1993). In some cases, participants did not complete their birth dates. In these cases, age was calculated from January 1st for the year of birth provided.

Ethnicity (Question 3)

Ethnicity was regarded as an important variable in examining and planning appropriate health services for OSAS, particularly in New Zealand where there are policies in place aimed at reducing disparities in health between Māori and non-Māori (National Health Committee, 2002).

Participants were asked to self-identify their ethnic group using the question from the 1996 census. The 1996 question was used instead of the 2001 Statistics New Zealand (SNZ) Ethnicity question for two reasons. First, the original OSA national questionnaire utilised the 1996 ethnicity question (Harris, 2003). Second, it has been argued that the 1996 ethnic census question resulted in people responding by way of ethnic descent rather than by tribal or cultural affiliation (Statistics New Zealand, 2004).

Following the methods of Harris (2003), participants who identified as being Māori, either as a sole affiliation or as one of multiple ethic groups, were classified as Māori for the purposes of analysis. For example, if a participant marked Māori and Samoan, then they were categorised as being Māori. The same process was not applied to Pacific peoples. All Pacific ethnic groups were categorised solely as Pacific peoples (Harris, 2003).

Educational Qualifications (Question 4)

In the original questionnaire, a question on eligibility for a community services card (CSC) was used as a crude measure of individual socio-economic status (SES). This question was removed to allow for additional 'driver-specific' questions to be included in the present study.

However, we employed the use of an education-based question, as there is growing evidence in New Zealand that suggests education is an important factor determining people's economic, social and health position (Howden-Chapman & Cram, 1998). Question four asked participants to indicate their highest educational qualification, for example, New Zealand School Certificate, or a University bachelor's degree. This question was obtained from Statistics New Zealand, who coded qualifications as no education, school education, and post-school education.

3.2.2 General sleep variables

Questions from the national OSA survey were used to document the drivers general sleep habits, and their daytime sleepiness.

Self-reported quantity of sleep (Question 5)

Question 5 asked 'how many hours sleep do you usually get in 24-hours?'

Self-perceived quality of sleep (Questions 6-7)

Question 5 and question 6 asked participants to rate how often they got *'enough sleep'* and how often they woke *'feeling refreshed'* on a scale from 0 to 3 (0=never, 1=rarely, 2=often, 3=always).

3.2.3 OSAS symptoms

Excessive Daytime sleepiness (EDS) (Question 10)

Poor sleep quality and inadequate sleep from any cause generally results in excessive daytime sleepiness (EDS). Subjectively, EDS is commonly reported by people with OSAS (Furuta et al., 1999; Punjabi et al., 2002).

The Epworth Sleepiness Scale (ESS) is a validated and internationally accepted subjective scale to measure EDS in adults (Johns, 1991; Johns, 1992, , 1994; Johns & Chervin, 2000; Johns & Hocking, 1997). It requires the participant to rate from 0 to 3 the likelihood of dozing in eight common situations that have different propensity to induce sleep. It is supposed to distinguish feelings of sleepiness from fatigue (Johns & Hocking, 1997). The summation of the scores for each question provides the Epworth Sleepiness score, ranging from 0 to 24. Having an ESS score above 10 is indicative of EDS (Johns & Hocking, 1997), although this is a validated method of measurement, there are limitations in using a subjective scale, which is the subject of ongoing debate.

Observed apnoeas (Question 11)

Apnoeas are generally not known to the person with OSAS, and are usually reported by the bed-partner as a complaint or worrisome matter. Question 11 derived from an Australian population-based study by Bearpark et al. (1995). It asks the participant whether they have ever been told that they *'sometimes stop breathing'* during sleep.

Snoring (Question 8)

Snoring may be caused by several malfunctions in the hyper-pharyngeal area. However, it is the 'trademark' pathophysiologic symptom of OSAS, reflecting the narrowing of the upper airway (American Sleep Disorders Association, 1997; Flemons & Whitelaw, 2002; Malhotra & White, 2002; Qureshi & Ballard, 2003). Snoring is not necessarily indicative of OSAS, although it is certainly a call for concern should it be accompanied by somnolence and other comorbidities (Bearpark et al., 1995). In this study, habitual snoring was defined as reporting snoring as 'often' or 'always'. The other choices were 'never' or 'rarely'.

3.2.4 OSAS risk factors

Neck circumference (Question 9)

As a proxy measure of upper body obesity, participants were sent a paper-tape measure to provide an estimate of their neck circumference (Schwab et al., 2003). This paper tape measure was initiated at the Sleep/Wake Research Centre because experience with workforces not in white collar jobs revealed that many people did not know their shirt collar size (Gander, 2006b). Moreover, this method was used instead of BMI measurements, because studies have shown neck size to be highly correlated with BMI (Katz et al. 1990, and Davies et al. 1992, Hoffstein and Mateika 1992). Neck circumference has also been found to be an independent predictor of apnoea and snoring in non-obese patients as well as obese patients (Hoffstein and Mateika, 1992). Neck size was also used because of the nature of the study (i.e., postal questionnaire), and it was feasible and cost-effective. Finally, it was in line with the methods used in the national survey, and self-measurement was subsequently validated in an objective prevalence study by Mihaere (2004).

Alcohol and Smoking

Alcohol and smoking are also recognised risk factors for OSAS (American Academy of Sleep Medicine, 2005). Questions on smoking and alcohol from the national OSA survey were omitted from the current study in favour of including additional questions specific to the thesis aims, and to maintain the length of the questionnaire to two A4 sides. Experience from previous surveys suggests that this is a key factor in obtaining a good response rate from a mail-out questionnaire (Harris, 2003).

Co-morbid conditions (Question 15)

Co-existing conditions such as hypertension, endocrine disorders, and cardiovascular problems have been identified as either potential consequences or causes of OSAS (Flemons & Whitelaw, 2002; Mohsenin, 2004; Nieto et al., 2000; Parish & Somers, 2004; Young, Skatrud, & Peppard, 2004). Question 15 asked the participant whether they received current treatment for various medical conditions.

Accessing health services for a sleep problem (Question 16)

Participants were asked to state whether or not they had sought help for a *'perceived'* sleeping problem, and if yes, to describe the problem. This question was not in the national OSA survey. However, it serves an important purpose in the current study because it addresses the central theme of this project, and was used as one of the inclusion criteria for participant recruitment into the focus groups.

Driving and motor vehicle accidents (Questions 12 – 14)

It has been postulated that the risk of MVAs among untreated OSAS sufferers is a direct result of EDS secondary to fragmented nocturnal sleep (Cassel et al., 1996; Howard et al., 2004; Marshall, Gander, & Neill, 2003). This study was particularly interested in the relationship between EDS, the likelihood of OSA, and MVA accident risk. Question 12 asked participants to estimate the total length of time (in years, months and weeks) they had been driving professionally.

In question 13, participants noted the number of times they had been the driver in MVAs over the last three years (Maycock, 1996).

Question 14 enquired about the average number of hours spent driving per week, as a measure of exposure to accident risk. Questions 13 and 14 were also used in the national OSA survey.

Nightshift work (Question 17)

Question 17 was not in the original questionnaire. The present study hypothesised that night-shift drivers would be more somnolent than those working day shifts, due to the lack of sleep opportunity for recovery and physical restoration (Redline & Strohl, 1999).

The question asks whether participants were night-shift workers according to the International Labour Organisation (ILO) definition (Article 2, Definitions 2 and 4). Thus, night-shift was defined as; *"any period of at least 3 hours of continuous work between midnight and 5am"*. This question was also used in a postal survey investigating insomnia among New Zealanders (Paine et al., 2004). It is flexible enough to include drivers who start or finish work outside the 'normal' work hours, and who are working during the part of the circadian cycle that is optimal for sleep.

Other work (Question 18)

The taxi industry includes a diversity of working time arrangements. Drivers may work night-shift, day-shift, have a set shift, or they may work in a freelance capacity (i.e., work according to need). Some drivers are self-employed, some are employed by a taxi license holder, and some drivers work additional jobs. In the pilot study, we found that a proportion of drivers were involved in 'other' types of work, both paid and unpaid. Question 18 asks the participant to state whether they are involved in any other type of 'paid' work during the week, in addition to taxi driving. Such information can help to identify where sleepiness may be associated with other work demands, rather than OSAS.

Incentive (Question 19)

To encourage participation in the study, and to minimise the possible response bias of having sleepy people more likely to respond, an incentive prize was offered (Harris, 2003). The incentive prize was an Air New Zealand mystery weekend trip away for one driver. It was approved by the Massey Wellington University Ethics Committee, and by the managers of the participating taxi companies. The incentive prize was sponsored by Fisher and Paykel Healthcare Ltd, New Zealand.

3.3 Calculation of OSA Probability

This study utilised a non-validated multivariate predictive model developed by Mihaere (2004) using a combined sample of clinic and community-based participants. It was designed to screen for OSA in a primary care setting. The model is currently being evaluated prospectively using patients referred to the respiratory clinic at Wellington Hospital, New Zealand.

The model estimates the likelihood that a driver has OSA, defined as having at least 15 respiratory disturbance events (apnoeas) per hour of sleep (RDI≥ 15). The variables included in the model are outlined in Table 0.1

Table 0.1 Probability of RDI≥ 15 Model

Variables	*Description*
Age	Yearly increase
Neck circumference	Centimetre increase
Excessive Daytime Sleepiness (EDS)	ESS>10 versus ESS≤10
Observed Apnoea	Yes / No
Snore	Always versus Never/Rarely/Often

The model was used in the present study to identify drivers at risk of OSA, because resource constraints (funding and availability of clinical beds) made it impossible to undertake polysomnographic evaluations of drivers.

Where the model indicated a high risk of OSA, participants were informed by letter. They were also given the opportunity to telephone the researcher for further details and request a comprehensive letter to be sent to their general practitioner (Appendix 9).

3.4 Ethical and Cultural Considerations

Ethical approval for the study was received from the Massey Wellington University Ethics Committee (MUHEC: WGTN Protocol – 03/124) (Appendix 10).

Cultural considerations were central in this study, since the study aims included estimating the risk of OSAS among Māori and Pacific drivers, and identifying barriers to care experienced by these groups.

With regard to Pacific cultural issues, the author is of Samoan ethnicity and cultural issues were discussed with a Pacific mentor throughout the study.

With regard to Māori cultural issues, the study was designed to respect the principles[18] of the Treaty of Waitāngi as required by the Ministry of Health[19] (Ministry of Health, 1997). Guidance was sought from Māori health researchers at Te Rōpū Rangahau Hauora a Eru Pōmare[20], with whom the Sleep/Wake Research Centre has a long established research partnership.

The opportunity to ask questions and provide feedback regarding the questionnaire was offered to participants, which is consistent with the partnership and participation aspects of the Treaty. The active protection aspect was integral to the study design, which sought to; (1) identify the risk of OSAS symptoms among Māori, and (2) subsequently identify the barriers to care for Māori taxi drivers. The information obtained will be used to improve recognition of OSAS, and to improve access to sleep services for Māori taxi drivers.

3.5 Data Collection

Data collection involved an initial mail out of the questionnaire, followed by two subsequent mail outs. This follow-up process was seen as important to increase driver participation, as well as providing information on possible response biases (Harris, 2003).

---

[18] **Principles of the Treaty of Waitāngi:** ***Partnership:*** This principle declares the agreement between the Crown and Māori to work together to establish strategies for improving Māori health to gain access to appropriate health services. ***Participation***: This principle endorses Māori to be involved at all levels of health development, planning and delivery of services. ***Protection***: This principle safeguards the rights Māori have to protect their culture, values, and practices.

[19] The Director-General of Health stated that any research or discussion involving Māori requires referencc to the Treaty of Waitāngi.

[20] Te Rōpū Rangahau Hauora a Eru Pōmare is the Māori heath research centre based at the Wellington School of Medicine and Health Sciences.

A toll-free telephone number was available to drivers as an alternative method of responding to the questionnaire. It also provided a means for drivers to ask any questions, or to clarify any issues they may have had. This method was also used successfully in the national OSA survey.

3.5.1 Data collection timeframe

The first mail out of the study package was sent to the drivers at the participating taxi companies in May 2004. The study package contained a cover letter, an information sheet outlining the study, a paper tape to measure neck size, a free-post return envelope, and a consent form for the focus group study (Appendix 6). The second mail out was a reminder post-card (Appendix 7) sent to non-respondents 19 days after the initial mail out. The third mail out consisted of a new full study package, which was sent to the remaining non-responders in June 2004 (20 days after the second mail out).

In the national OSA survey (Harris, 2003), telephone follow-up was used as the fourth wave for increasing the response rate, with telephone numbers traced using participants' names and addresses from the electoral roll. In the present study, telephone follow-up was not undertaken because the researcher did not have access to personal information about the participants.

Return to sender (RTS)

Where mail was returned to the Sleep/Wake Research Centre unopened ('Return to Sender'), the participating companies were contacted to determine accuracy of the address, or whether the participant had ceased driving. If the company sent back new or corrected addresses, the questionnaires were re-sent.

3.6 Data Management

To manage the mail outs, a response database was set up for each taxi company for monitoring response rates and updating the lists of non-respondents. One company provided personal details (names and addresses), while the other company provided a list of de-identified numbers for their drivers. The research assistant was the only person who had access to the database to match participant identification numbers to personal information. Questionnaires were given a unique four digit identification number which was used as the participant's identification number. The research assistant managed the mail-outs and up-dated the databases. The two databases were then merged and converted to a SAS™ (version 8.02) file for statistical analysis.

Questionnaire data entry

Questionnaire data were double entered by the research assistant and the researcher, and independently checked in separate Epi-Info databases (version 6.04a, World Health Organisation). To ensure consistency, a set of data entry rules was developed to cover anomalous or ambiguous responses, for example where participants did not respond as intended to the categories provided in the questionnaire (ticking between categories, or ticking more than one category) (see Appendix 8).

3.7 Data Analysis

3.7.1 Univariate analysis

In the following sections, the data were broken down by ethnicity (Māori, Pacific people and "others") and sex. Due to the limited number of women participants, subsequent analyses were broken down by ethnicity only. The analyses were performed in SAS™ (version 8.02) statistical package.

Because this study is based on a cluster sample, data would not generally be expected to be normally distributed. All data were graphically screened for normality according to the specific groupings required for each analysis. Normality was checked using Shapiro-Wilk and Kolmogorov-Smirnov tests.

For non-normal data, non-parametric tests were used. For continuous data, the Wilcoxon Rank Sum test was used to test for differences in medians between two groups. The Kruskal-Wallis test was used to examine differences between three groups. Where odds ratios are presented, 95% confidence intervals are reported. Chi-squared tests were used to examine differences between grouped proportions, and the level of statistical significance was accepted at the conventional level of $p \leq 0.05$.

3.7.2 Logistic regression

The main statistical method used was logistic regression, using the statistical package SAS™ (version 8.02). Logistic regression was preferred over other analytical model types (e.g., Mantel-Haenszel Estimate), because it examines relationships between a dichotomous dependent variable and independent variables that can be categorical or continuous, and do not need to be normally distributed. It also establishes the relative predictive importance of the independent variables (Clayton & Hills, 1993). Models were used to identify independent relationships, or risk factors associated with the following OSAS symptoms: snoring always, observed apnoeas, and EDS (defined as ESS>10). Results are presented as odds ratios, 95% confidence intervals and p-values.

Two logistic models were run for each OSAS symptom. Model one considered ethnicity, sex and age. Model two included variables from model one and potential risk factors. For each potential risk factor, an initial model was run to examine the effect of interactions between known confounding factors (ethnicity, sex and age). If the interaction variable was not significant, thus it was not included in the respective multivariate model. Relevant variables that attained $p=0.10$ at the univariate level were included in the respective multivariate model (Travier, 2005). Co-linearity was checked as appropriate. Missing data or 'don't know' responses were excluded from analyses.

CHAPTER 4
RESULTS

4.1 Introduction

This chapter is divided into four main sections. The first section presents a demographic profile of participants. In the second section, the distributions of variables will be described first by ethnicity and sex, followed by univariate analyses of OSAS symptoms and risk factors categorised by ethnicity. The study did not have sufficient statistical power to detect any differences by ethnicity among women. The third section examines independent predictors of OSAS symptoms. In the final section, calculation of the probable risk of OSA is presented.

4.2 Response Rates

A total of 241 questionnaires were received. Table 4.1 summarises the response rates obtained at each phase of the data collection. There are a number of ways of calculating response rates as shown in Table 4.2. It is evident that the additional mail-outs were useful in increasing the response rate.

Table 4.1 Responses from total sample at each data collection phase

	Number	*Percent (%)*
Mailout 1	140	21.50
Mailout 2	33	5.07
Mailout 3	68	10.44
Total	**241**	**37.01**

Table 4.2 Response rate (RR) equations and calculations for total sample

	Equation	RR calculation	RR(%)
$RR_1 =$	$\frac{\text{number of responders}}{\text{number in original sample}}$	241 / 651	37.02
$RR_2 =$	$\frac{\text{number of responders}}{\text{651-participants no longer driving}}$	241 / 598	40.30
$RR_3 =$	$\frac{\text{number of responders}}{598 - \text{RTS}}$	241 / 583	41.33

The original sample started with 651 potential participants. However, as a result of locating a number of participants that were 'non-drivers' or 'no longer driving' (n=53), the total sample reduced to 598. At the third stage, among the 598 mail-outs sent to potential participants who fulfilled the inclusion criteria, 15 came back as 'return to sender' (RTS). These 15 people were also excluded from the total sample, which resulted in a final denominator of 583 potential participants, giving an overall response rate of 41.3%.

4.3 Demographic Profile

Sex

As expected, the majority of respondents (90%) were male.

Ethnicity

Māori made up 11% of the study sample, while Pacific people accounted for 9%, all of whom identified as Samoan. People of "other" ethnicities were: New Zealand European (45%), Indian (9%), Chinese (2%), other European (8%), and other ethnic groups not specified (16%).

Age

Figure 4.1, shows the distribution of 238 respondents (3 data missing) by 10-year age groups. Most of the drivers (64%) who responded to this study were aged between 45 and 65 years old (mean=52.36, SD=10.59). For subsequent analyses, this variable was categorised in the following approximate quartiles: 25-45 years (26.0%); 46-53 years (22.7%); 54-60 years (26.9%); and 61-76 years (24.4%).

Figure 4.1 Age distribution of responders

Educational status

Education was used as a proxy measure for socio-economic position among drivers. Five people did not complete this question and were omitted from the analysis. About half the participants (49.2%) had not obtained any qualification, 29.2% achieved a school level qualification, which was mainly school certificate[21], and 21.6% reported having post-school qualifications such as diplomas and university level degrees.

Years worked as a taxi driver

Figure 4.2 shows the distribution of participants' years of driving taxis, categorised in five year brackets. Twelve participants did not answer this question. The data strongly skews to the left indicating that the majority of respondents were less experienced drivers, or that people stopped driving after five-to-ten years. Sixty-six percent of drivers had been driving for less than 15 years, and only 34% had been driving longer than 15 years.

[21] School Certificate: A previous secondary school qualification taken in form 5 (year 11). School Certificate was awarded for single subjects, and students could take a mix of internally and externally assessed subjects (Ministry of Education, 2006).

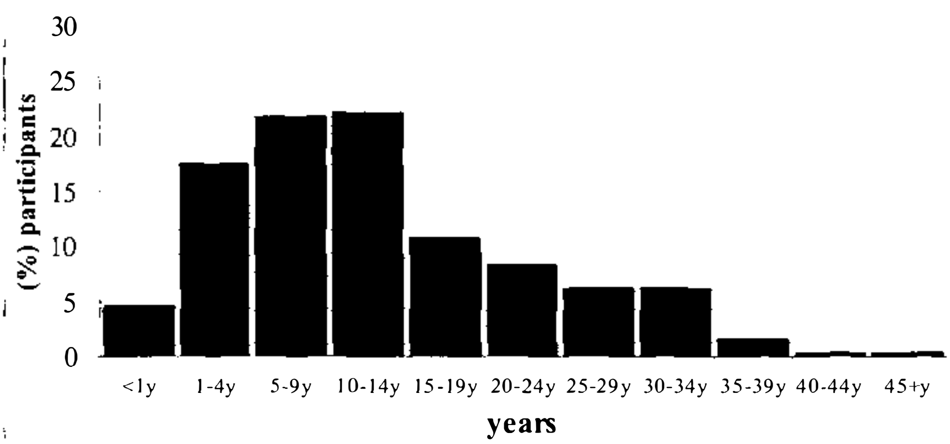

Figure 4.2 Duration of taxi driving

History of Accidents

Participants were asked, '*how many times during the last three years have you been involved in a motor vehicle accident (MVA) while driving?*' Eleven participants did not answer the question. Figure 4.3 shows the distribution of responses. About a third of the participants (32.2%) reported having been the driver in at least one MVA in the previous three years.

Figure 4.3 Number of accidents during the last 3 years

Co-morbidities

Participants were asked to report whether or not they were currently receiving treatment for the following medical conditions: asthma, high blood pressure, heart trouble, diabetes, stroke, thyroid problem, psychological problem and sleeping problem. A total of 236 participants completed these questions. Due to small numbers reporting each condition, all medical conditions were combined, and the responses were grouped as 'yes' or 'no' in receiving any treatment (Table 4.3). A chi-square test indicated a significant difference across the three ethnic groups (p<0.025). However, due to the lack of statistical power, this difference could not be explored further.

Table 4.3 Current treatment for co-morbidities, by ethnicity

variable	*Māori n (%)*	*Other n (%)*	*Pacific n (%)*	*All n (%)*
No	11 (45.8)	129 (67.9)	11 (50)	151 (64.0)
Yes	12 (50)	55 (28.9)	11 (50)	78 (33.1)
Missing	1 (4.2)	6 (3.2)	0 (0)	7 (3.0)

4.4 Sleep Habits

Previous studies have shown ethnic disparities in OSAS symptoms and risk factors between Māori and non-Māori (Harris, 2003; Mihaere, 2004). The risk of OSAS in men is also approximately two to three times higher than for women (American Academy of Sleep Medicine, 2005; Kapsimalis & Kryger, 2002a, , 2002b; Redline, Schluchter, Larkin, & Tishler, 2003; Redline & Strohl, 1999). Thus, questionnaire responses are broken down by ethnicity and gender in the first instance. Subsequent analyses were limited to comparisons by ethnicity, because of the small number of women participants.

4.4.1 Usual hours of sleep in 24 hours

The participants were asked how much sleep they would 'usually' get in 24 hours. Nine participants did not complete this question. Table 4.4 summarises the responses. From the national OSA survey, Harris (2003) estimated the population average was 7.41

hours per 24-hours (SD=1.42 hours). Taxi drivers were no different from the general population in terms of usual sleep duration.

Table 4.4 Usual sleep in 24 hours, data distributed by ethnicity and sex

variable	*n*	*Mean (hrs)*	*Standard deviation (hrs)*	*Median (hrs)*	*Interquartile range (hrs)*
Māori Men	17	7.03	1.45	7.00	6.0-8.0
Māori Women	7	7.36	0.56	7.50	7.0-8.0
Pacific Island Men	19	8.21	1.25	8.00	7.0-9.0
Pacific Island Women	2	8.00	0.00	8.00	8.0
Other Men	172	7.30	1.08	7.00	6.5-8.0
Other Women	15	7.23	1.15	7.50	6.5-8.0
Total	**232**	**7.36**	**1.14**	**7.5**	**6.5-8.0**

The following graphs (Figure 4.4) illustrate the distribution of usual hours sleep for each ethnic group. The Kruskal Wallis test was used to examine differences in the median between groups. It found no significant difference between the ethnic groups (χ^2=3.6311, df =2, and p=0.162). For subsequent analyses, this variable was categorised in the following approximate quartiles: 4.0-6.5 hours sleep per night (25.7%); 7.0-7.4 hours (22.8%); 7.5-8.0 hours (36.3%); and 8.3-10.0 hours (15.2%).

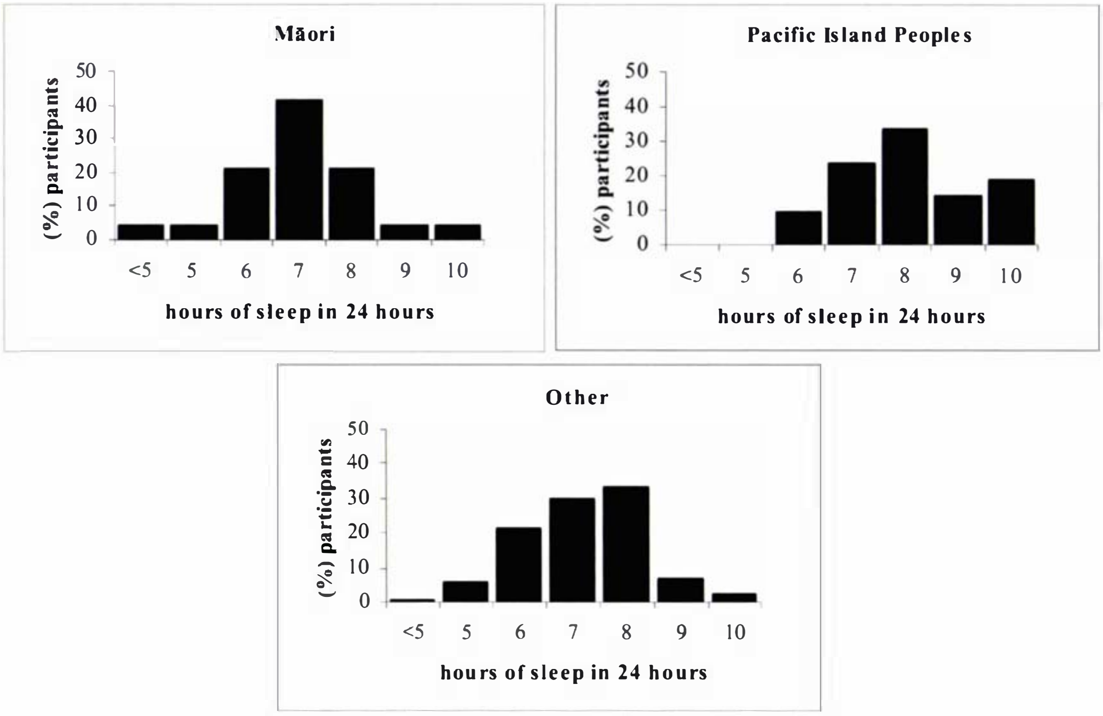

Figure 4.4 Distribution of hours of sleep, by ethnicity

4.4.2 How often participants got enough sleep

Question six in the survey questionnaire asked 'How often do you think that you get enough sleep?' The possible responses were 'never', 'rarely', 'often', and 'always'. Five participants did not answer this question. Overall, 26.7 % (95% CI 23%-33%) reported to have 'never' or 'rarely' got enough sleep. Figure 4.5 summarises the responses by ethnicity and sex.

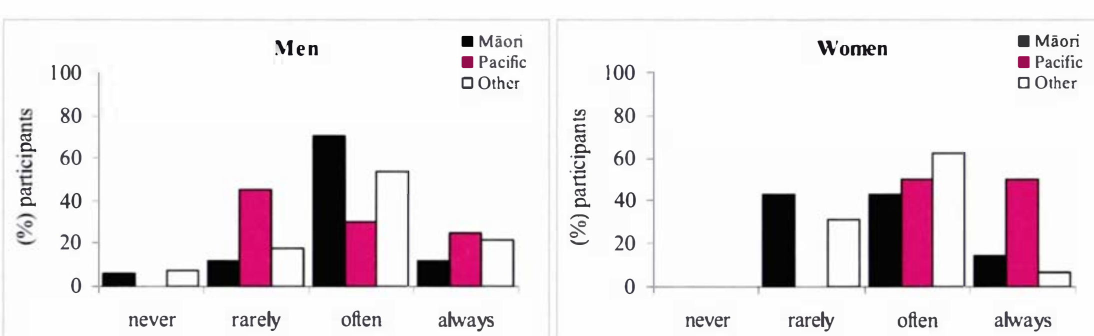

Figure 4.5 How often do you get enough sleep, by ethnicity and sex

Table 4.5 Risk of never/rarely getting enough sleep, by ethnicity

	never/rarely		*often/always*		χ^2 *p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	48	25.3	142	74.7		1.00		
Māori	6	25.0	18	75.0		0.99	0.37-2.63	0.978
Pacific	9	40.9	13	59.1	0.286	2.05	0.82-5.09	0.123

The chi-square test indicated that there was no relationship between ethnicity and reporting 'never/rarely' getting enough sleep versus 'often/always'.

4.4.3 How often participants woke refreshed

Participants were asked 'How often do you wake feeling refreshed?' The choice of responses were 'never', 'rarely', 'often', and 'always'. Six participants did not complete this question and were omitted from the analyses. Overall, 31.1% (95% CI 25%-37%) reported to 'never' or 'rarely' wake feeling refreshed. Figure 4.6 summarises the responses by ethnicity and sex.

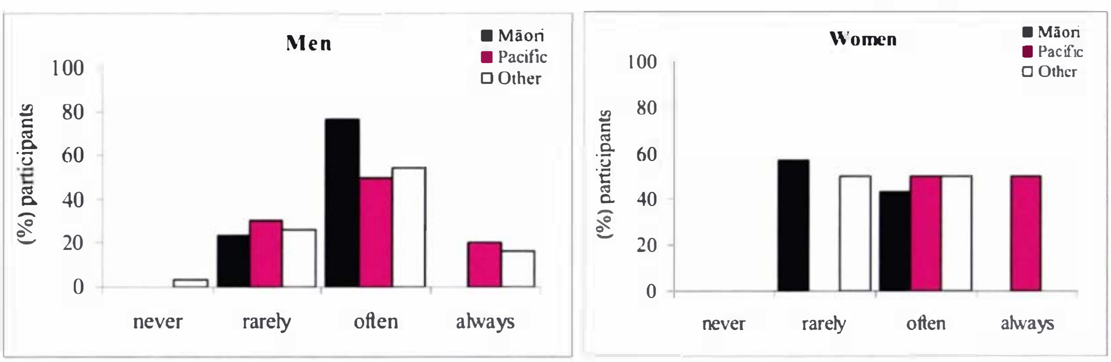

Figure 4.6 Wake feeling refreshed, by ethnicity and sex

Table 4.6 Risk of never/rarely waking feeling refreshed, by ethnicity

variable	*never/rarely*		*often/always*		χ^2 *p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	59	31.2	130	68.8		1.00		
Māori	8	33.3	16	66.7		1.10	0.45-2.72	0.834
Pacific	6	27.3	16	72.7	0.902	0.83	0.31-2.22	0.705

The chi-square test indicated that there was no significant difference among the ethnic groups in their likelihood of reporting 'never' or 'rarely' waking refreshed.

4.5 OSAS Symptoms

4.5.1 How often participants snored

Question eight asked; 'How often do you snore?' The options were, 'never', 'rarely', 'often', and 'always'. Twelve participants did not answer this question. Figure 4.7 summarises the responses by ethnicity and sex. Fifty-three percent of the participants who answered the question reported to 'often' and 'always' snore (95 % CI 47%-60%). The responses by ethnicity and sex are summarised in Figure 4.7.

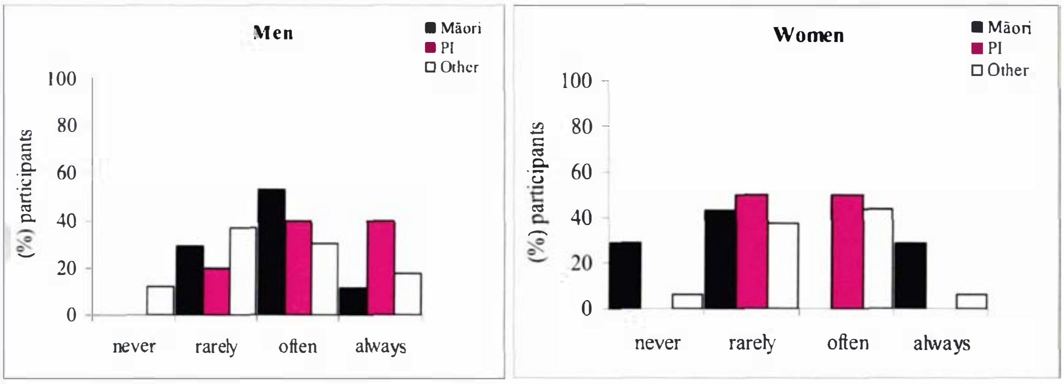

Figure 4.7 How often do you snore, by ethnicity and sex

Table 4.7 Risk of reporting snoring often/always, by ethnicity

variable	*never/rarely* n	%	*often/always* n	%	χ^2 *p-value*	*OR*	*95%CI*	*p-value*
Other	92	50	92	50		1.00		
Māori	10	43.5	13	56.5		1.30	0.54-3.11	0.556
Pacific	5	22.7	17	77.3	**0.050**	3.40	1.20-9.60	**0.021**

Table 4.8 Risk of reporting snoring always, by ethnicity

variable	*never/rarely/often* n	%	*always* n	%	χ^2 *p-value*	*OR*	*95%CI*	*p-value*
Other	152	82.6	32	17.4		1.00		
Māori	19	82.6	4	17.4		1.00	0.32-3.14	1.000
Pacific	14	63.6	8	36.4	0.099	2.71	1.05-7.01	**0.039**

In Table 4.7 the relationship between ethnicity and the likelihood of reporting snoring 'often' or 'always' was significant (p=0.050). People of Pacific ethnicity were significantly more likely than people of "other" ethnicities to report snoring 'often' or 'always' (p=0.021).

Similarly, in Table 4.8 the relationship between ethnicity and reporting snoring 'always' trended towards significance (p=0.099). Pacific peoples were significantly more likely than people of "other" ethnicities to report snoring 'always' (p=0.039).

4.5.2 Excessive Daytime Sleepiness

The Epworth Sleepiness Scale (ESS) was used to assess the degree of sleepiness among the participants. Excessive daytime sleepiness (EDS) was defined as having ESS>10. Eighteen participants did not complete the scale. The following figures present the distribution of Epworth scores by ethnicity.

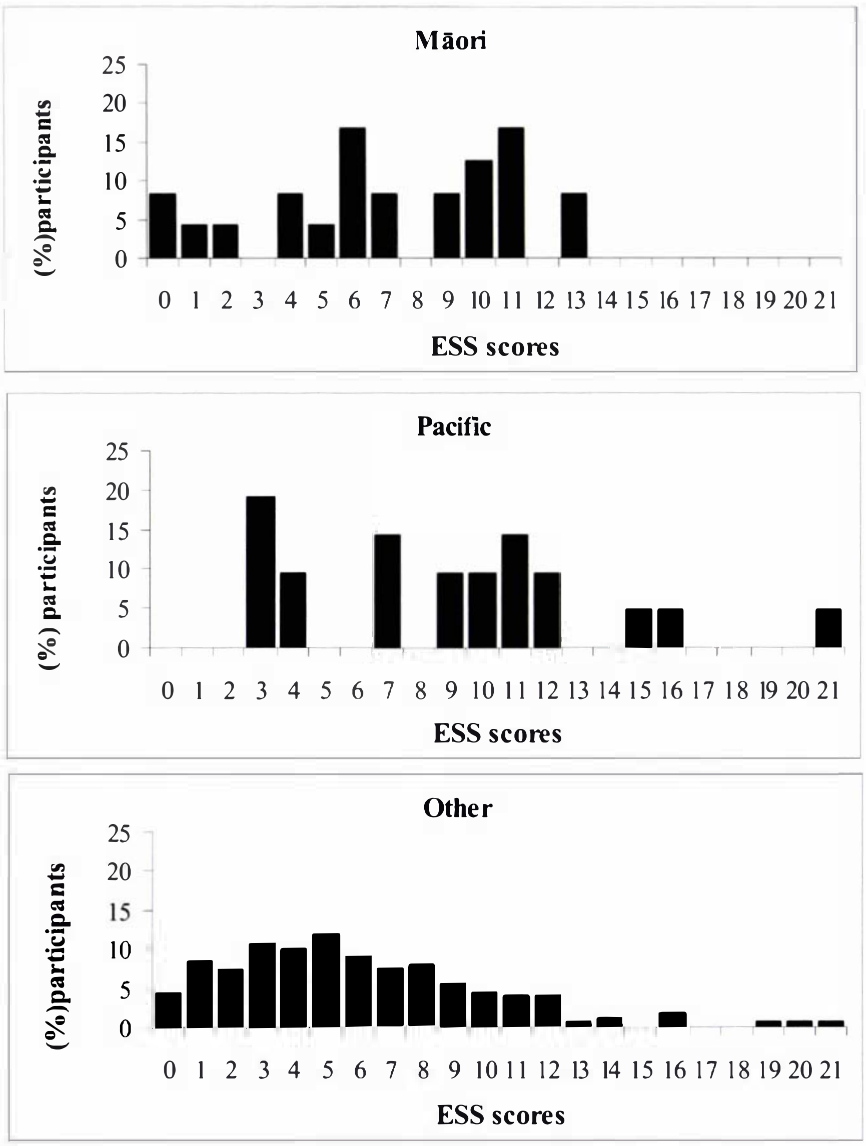

Figure 4.8 Distribution of ESS scores, by ethnicity

Table 4.9 shows there was a trend (p=0.065) for men to be more likely to report excessive sleepiness. There was a significant relationship between ethnicity and scoring ESS>10. People of Pacific ethnicity (p=0.005) were significantly more likely to report excessive sleepiness than people of "other" ethnicities.

Table 4.9 Excessive daytime sleepiness, by sex and ethnicity

variable	*ESS≤10*		*ESS>10*		χ^2	*OR*	*95%CI*	*p-value*
	n	*%*	*n*	*%*	*p-value*			
Sex:								
men	165	81.3	38	18.7		1.00		
women	24	96.0	1	4.0	0.065	0.18	0.02 – 1.38	0.099
Ethnicity:								
Other	155	87.1	23	12.9		1.00		
Māori	18	75.0	6	25.0		2.25	0.81 – 6.25	0.121
Pacific	13	61.9	8	38.1	**0.007**	4.15	1.55 – 11.09	**0.005**

4.5.3 Observed Apnoeas

Question 11 asked participants; 'Has anyone ever told you that you stop breathing sometimes during sleep?' The response was dichotomous; 'yes' or 'no'. Eight participants did not complete this question. Figure 4.9 shows the breakdown of responses by ethnicity and sex. In total, 15% (95% CI 11%-20%) of the respondents answered 'yes' to this question.

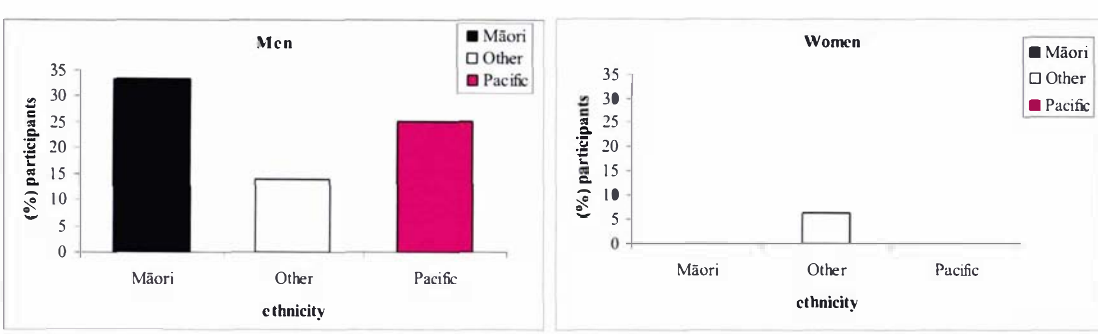

Figure 4.9 Reporting observed apnoeas, ethnicity and sex

Table 4.10 Risk of reporting observed apnoeas, by ethnicity

variable	*yes*		*no*		*χ^2p-value*	*OR*	*95%CI*	*p-value*
	n	%	n	%				
Other	25	13.2	165	86.8		1.00		
Māori	5	23.8	16	76.2		2.06	0.69-6.13	0.193
Pacific	5	22.7	17	77.3	0.245	1.94	0.66-5.73	0.229

There were no significant differences in the likelihood of reporting observed apnoeas, by ethnicity.

4.5.4 Neck size

Participants were asked to measure their neck circumference using a paper tape measure provided in the study package. The range of neck sizes considered reasonable was 27cm-54cm, which included all participants who answered the question (Harris, 2003). Fourteen participants did not provide neck measurements.

Table 4.11 shows the distribution of neck size by ethnicity. Pacific people had the largest median neck size (46cm) followed by Māori (43.5cm), and "other" ethnic groups (40cm). The Kruskal-Wallis Test found a significant difference of neck size between the ethnic groupings (χ^2 =26.676, df =2, p<0.0001).

Table 4.11 Neck size, data distribution by ethnicity

	n	*mean (cm)*	*SD (cm)*	*median (cm)*	*IQ range (cm)*
Māori	22	42.82	4.73	43.5	40-44.5
Pacific Island	21	45.36	3.54	46	43-47
Other	184	40.26	3.81	40	38-43
All	227	40.98	4.18	41	38.5-43.5

In Figure 4.10 the distributions of reported neck circumferences are presented for Māori men and women, Pacific men, and men and women from "other" ethnic groups. Only two Pacific women provided neck circumference measurements.

In subsequent analyses, neck size was categorised into the following approximate quartiles: (1) 27-38.5 cm (28.4%); (2) 39-40.5 cm (25.9%); (3) 41-43.0 cm (18.3%); and (4) 43.5-54 cm (27.4%).

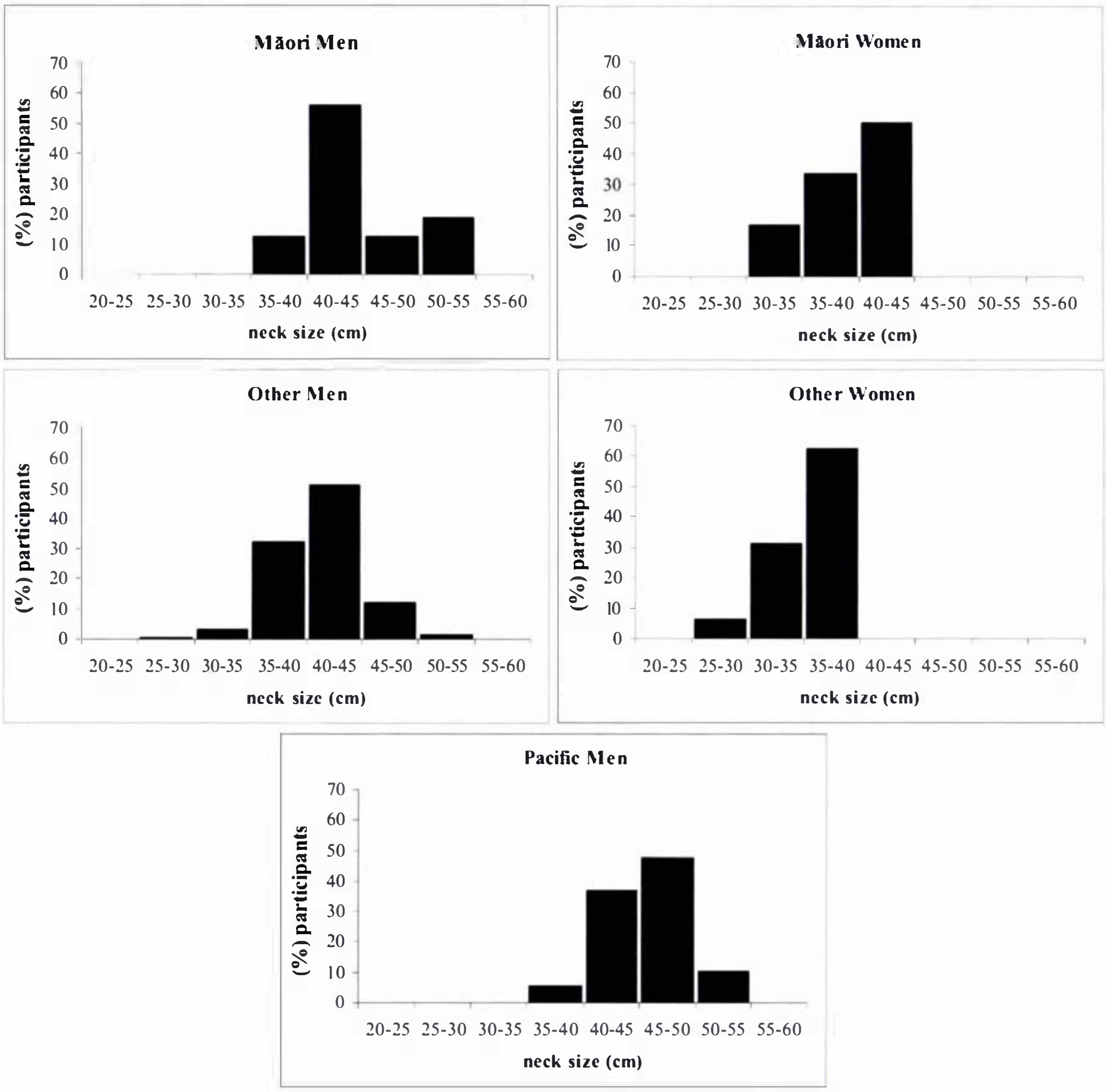

Figure 4.10 Distribution of neck size, by ethnicity and sex

4.6 Relationships between OSAS symptoms and Other Variables

Table 4.12 summarises the univariate relationships between the OSAS symptoms of excessive daytime sleepiness (ESS>10), observed apnoeas, and snoring always, and a range of other variables considered as possible risk factors. The relationships within ethnicity and sex have already been examined.

4.6.1 Relationships between sleepiness (ESS>10) and other variables

Neck size

For each centimetre increase in neck size, there was a 21% increased risk of scoring more than 10 on the Epworth Sleepiness Scale. Using approximate quartiles, participants with larger neck sizes (quartile 4) were significantly more likely to score ESS>10 compared to those in quartile 1.

Snoring

Participants who reported snoring 'often' or 'always' were three times more likely to score ESS>10. Participants who reported snoring 'always' were more than four times the likelihood of scoring ESS>10 ($p=0.0001$).

Observed apnoeas

Participants who reported observed apnoeas were 5.6 times more likely to score ESS>10 ($p<0.000$).

Wake refreshed

Participants who reported 'never' or 'rarely' waking feeling refreshed were 3.2 times more likely to score ESS>10, compared to those who reported 'often' or 'always' waking feeling refreshed ($p=0.001$).

Enough sleep

In the univariate analysis, participants who 'never' or 'rarely' got enough sleep were 3.4 times more likely to report excessive daytime sleepiness than participants who 'often' or 'always' got enough sleep ($p=0.001$).

Night work

Participants who reported to work at night time were approximately three times more likely to score ESS>10 compared to those who do not ($p=0.003$).

4.6.2 Relationships between snoring always and other variables

Neck size

For each centimetre increase in neck circumference, there was a 17% increase in the risk of reporting snoring 'always' (p=0.000).

Using approximate quartiles, participants with the largest neck size (quartile 4) compared to quartile 1 (27-38.5cm) were 5.8 times more likely to report always snore (p=0.001).

Observed apnoeas

Participants who reported observed apnoeas were 2.7 times more likely to report snoring always (p=0.013).

Sleeping problem

Participants who reported that they were receiving current treatment for a sleep problem were approximately four times more likely to report snoring always, compared to those who reported no treatment or don't know (p=0.031).

Night work

Working nights was significantly associated with reported snoring always (p=0.037)

4.6.3 Relationships between observed apnoeas and other variables

Age

For each year increase in age there was a 5% increase in the risk of reporting observed apnoeas (p=0.003).

Using approximate quartiles, people in quartile 2 and in quartile 4 were significantly more likely to report observed apnoeas, compared to people in quartile 1 (p=0.005).

Neck size

For each increase in centimetre there was a 19% increase in the risk of reporting observed apnoeas (p=0.000).

Using approximate quartiles, people with the largest neck sizes (quartile 4) were over three times more likely to report observed apnoeas compared to people with smaller neck sizes (quartile 1) (p=0.026).

Snore

Participants who snored 'often' or 'always' were 5.4 times more likely to report observed apnoeas than those who snored 'never' or 'rarely' (p=0.000). Snoring 'always' compared to reported 'often', 'always' or 'rarely' was also significantly more likely to be associated with observed apnoeas (p=0.013).

Enough sleep

Reporting 'never' or 'rarely' getting enough sleep in comparison to 'often' or 'always', significantly increased the risk of reporting observed apnoeas (p=0.025).

Usual hours of sleep in 24 hours

Using approximate quartiles, people who usually get 7.5-8 hours (quartile 3) were less likely to report observed apnoeas compared to those people who slept 4-6.5 hours (quartile 1), (p=0.030).

High blood pressure

Participants who were currently receiving treatment for high blood pressure were 2.7 times more likely to report observed apnoeas compared to those who were not currently receiving treatment or responded with 'don't know' (p=0.016).

Sleeping problem

Participants who were receiving current treatment for a sleeping problem were over eight times more likely to report observed apnoeas than those who were not receiving treatment or responded with 'don't know' (p=0.001).

Table 4.12 Univariate relationships between OSAS symptoms and other variables

variable	*ESS>10*			*Snoring Always*			*Observed Apnoeas*		
	OR	***95%CI***	***p-value***	***OR***	***95%CI***	***p-value***	***OR***	***95%CI***	***p-value***
Ethnicity1									
Other	1.00			1.00			1.00		
Māori	2.25	0.81-6.25	0.121	1.00	0.32-3.14	1.000	2.06	0.69-6.13	0.193
Ethnicity2									
Other	1.00			1.00			1.00		
Pacific	4.15	1.55-11.09	0.005	2.71	1.05-7.01	0.039	1.94	0.66-5.73	0.229
Sex									
Female	1.00			1.00			1.00		
Male	5.53	0.72-42.13	0.099	1.71	0.49-6.00	0.404	4.37	0.57-33.44	0.156
Age1 (yearly)	1.02	0.99-1.05	0.119	1.01	0.98-1.03	0.614	1.05	1.02-1.08	0.003
Age2									
Quartile 1 (25-45y)	1.00			1.00			1.00		
Quartile 2 (46-53y)	1.70	0.63-4.62	0.296	0.99	0.40-2.45	0.984	17.43	2.18-139.15	0.007
Quartile 3 (54-60y)	0.74	0.24-2.27	0.593	0.89	0.37-2.13	0.788	7.91	0.94-66.34	0.057
Quartile 4 (61-76y)	2.11	0.80-5.59	0.132	0.16	0.16-1.29	0.137	19.86	2.52-156.75	0.005
Neck1(cm increase)	1.21	1.10-1.33	<0.000	1.17	1.08-1.28	0.000	1.19	1.09-1.32	0.000
Neck2									
Quartile 1 (27-38.5cm)	1.00			1.00			1.00		
Quartile 2 (39-40.5cm)	1.52	0.45-5.13	0.498	2.37	0.75-7.47	0.140	0.92	0.26-3.21	0.896
Quartile 3 (41-43cm)	1.72	0.46-6.46	0.419	1.65	0.44-6.14	0.459	1.07	0.28-4.08	0.920
Quartile 4 (43.5-54cm)	4.21	1.42-12.51	0.009	5.83	2.00-16.99	0.001	3.23	1.15-9.06	0.026

Table 4.12 Univariate relationships between OSAS symptoms and other variables (cont…)

variable	*ESS>10*			*Snoring Always*			*Observed Apnoeas*		
	OR	*95%CI*	*p-value*	*OR*	*95%CI*	*p-value*	*OR*	*95%CI*	*p-value*
ESS (ESS>10 v ESS≤10)				4.20	1.96-9.01	0.000	5.69	2.55-12.72	<0.000
Snore1									
never/rarely	1.00						1.00		
often/always	3.33	1.49-7.43	0.003				5.41	2.15-13.62	0.000
Snore2									
often/never/rarely	1.00						1.00		
always	4.20	1.96-9.01	0.000				2.76	1.25-6.12	0.013
Observed Apnoeas									
no	1.00			1.00					
yes	5.69	2.55-12.72	<0.000	2.76	1.25-6.12	0.013			
Wake Refreshed1									
often/always	1.00			1.00			1.00		
never/rarely	3.25	1.59-6.61	0.001	1.28	0.64-2.58	0.484	1.61	0.77-3.37	0.211
Wake Refreshed2									
rarely/often/always	1.00			1.00			1.00		
never	5.03	0.69-36.83	0.112	0.85	0.09-7.47	0.884	2.99	0.53-16.96	0.217
Enough Sleep1									
often/always	1.00			1.00			1.00		
never/rarely	3.43	1.67-7.02	0.000	1.66	0.82-3.36	0.163	2.34	1.11-4.92	0.025
Enough Sleep2									
rarely/often/always	1.00			1.00			1.00		
never	3.59	0.96-13.39	0.057	0.79	0.52-1.19	0.262	1.79	0.47-6.86	0.395

Table 4.12 Univariate relationships between OSAS symptoms and other variables (Cont..)

variable	*ESS>10*			*Snoring Always*			*Observed Apnoeas*		
	OR	*95%CI*	*p-value*	*OR*	*95%CI*	*p-value*	*OR*	*95%CI*	*p-value*
Usual Hours of Sleep									
Quartile 1 (4-6.5 hours)	1.00			1.00			1.00		
Quartile 2 (7.0 hours)	0.55	0.22-1.38	0.202	0.71	0.27-1.91	0.499	0.55	0.21-1.41	0.211
Quartile 3 (7.5-8 hours)	0.32	0.13-0.80	0.014	0.92	0.40-2.13	0.848	0.37	0.15-0.91	0.030
Quartile 4 (8.3-10 hours)	0.47	0.15-1.43	0.182	1.21	0.44-3.33	0.718	0.29	0.08-1.08	0.064
Accident (in last 3 years)									
No	1.00			1.00			1.00		
Yes	0.78	0.36-1.70	0.531	1.29	0.64-2.60	0.471	0.75	0.33-1.68	0.481
Co-morbid Conditions									
Asthma									
No Treatment/DNK*	1.00			1.00			1.00		
Yes Treatment	1.97	0.72-5.39	0.189	2.19	0.84-5.76	0.110	2.41	0.87-6.65	0.091
High Blood Pressure									
No Treatment/DNK*	1.00			1.00			1.00		
Yes Treatment	2.00	0.90-4.44	0.088	1.39	0.63-3.09	0.429	2.73	1.21-6.17	0.016
Diabetes									
No Treatment/DNK*	1.00			1.00			1.00		
Yes Treatment	2.21	0.85-5.77	0.104	1.60	0.63-4.06	0.324	0.73	0.21-2.57	0.624
Sleeping Problem									
No Treatment/DNK*	1.00			1.00			1.00		
Yes Treatment	3.49	0.94-12.99	0.063	3.91	1.14-13.46	0.031	8.15	2.34-28.43	0.001
Night Work									
No	1.00			1.00			1.00		
Yes	2.93	1.44-5.93	0.003	2.06	1.04-4.05	0.037	1.96	0.94-4.09	0.075
Education Level									
Post-school Qualifications	1.00			1.00			1.00		
No Qualifications	1.69	0.64-4.49	0.294	1.00	0.42-2.38	0.994	1.71	0.60-4.89	0.320
School Qualifications	1.38	0.47-4.02	0.561	1.01	0.39-2.62	0.989	1.71	0.55-5.27	0.352

4.7 Multivariate Logistic Regression Models

Two models were examined for each OSAS symptom. In the first model, for each symptom the independent relationships with ethnicity, age and sex were examined because they have been identified as potential risk factors. The second model included variables based on the following justifications: (1) the variable is a known OSAS risk factor as evident from other studies (Harris, 2003; Mihaere, 2004); or (2) the variable showed a significant ($p<0.05$) relationship at the univariate level; or (3) an existing scientific hypothesis suggests a causal relationship (e.g., snoring disturbs sleep, leading to greater sleepiness).

Collinearity

Collinearity can occur when independent variables are highly correlated. This makes it difficult to infer their influence on the dependent variable (Last, 1995). In the current study, it was unlikely that potential predictors entered into the logistic regression models were collinear. The following criteria outlined by Dallal (2001) was used to screen for collinearity:

(1) By definition, there were no exact linear relationships among predictors.

(2) The study design did not allow for exact or nearly exact linear relationships to occur between variables. In fact, the majority of variables placed into the regression models were categorical, which makes it difficult for collinearity to occur or even be tested accurately.

4.7.1 Snore Always

Table 4.13 presents the results of the logistic regression model used to examine the independent relationships between reported snoring always and ethnicity, sex and age.

Table 4.13 Snoring always: logistic regression model 1

variable	*OR*	*95% CI*	*p-value*
Ethnicity (Māori v Other)	1.47	0.44-4.94	0.532
Ethnicity (Pacific v Other)	2.73	1.04-7.15	**0.041**
Sex (male v female)	1.72	0.47-6.41	0.414
Age (quartile 2 v quartile 1)	0.95	0.38-2.38	0.908
Age (quartile 3 v quartile 1)	0.87	0.36-2.14	0.767
Age (quartile 4 v quartile 1)	0.47	0.16-1.38	0.169

After controlling for age and sex, Pacific people were more likely to report snoring 'always' compared to people of "other" ethnicities.

Since snoring and apnoeas are considered to be on a continuum of severity of sleep disordered breathing (Redline & Strohl, 1999), observed apnoeas were not included as a dependent variable.

Table 4.14 Snoring always: logistic regression model 2

variable	*OR*	*95% CI*	*p-value*
Ethnicity (Pacific v Others)	1.62	0.50-5.27	0.422
Neck (quartile 2 v quartile 1)	2.53	0.79-8.08	0.116
Neck (quartile 3 v quartile 1)	1.72	0.45-6.55	0.426
Neck (quartile 4 v quartile 1)	4.92	1.56-15.56	**0.007**
Asthma (treatment v no/don't know)	1.98	0.62-6.34	0.248
Night work	1.79	0.81-3.92	0.148

Table 4.14 included other possible predictive variables. Participants in neck size quartile 4 (43.5-54cm) were significantly more likely to report snoring 'always' (p=0.007) compared to participants in quartile 1 (27-38.5cm). After controlling for other factors, the difference between Pacific people and "others" became non-significant (p=0.422).

4.7.2 Observed Apnoeas

The following models examined the independent relationships between possible predictive variables and observed apnoeas.

Table 4.15 Observed apnoeas: logistic regression model 1

variable	*OR*	*95% CI*	*p-value*
Ethnicity (Māori v Other)	1.88	0.57-6.19	0.299
Ethnicity (Pacific v Other)	2.41	0.74-7.81	0.142
Sex (male v female)	4.90	0.62-38.88	0.132
Age (quartile 2 v quartile 1)	17.54	2.18-141.22	**0.007**
Age (quartile 3 v quartile 1)	8.23	0.97-69.55	0.053
Age (quartile 4 v quartile 1)	20.86	2.58-168.73	**0.004**

After controlling for ethnicity and sex, people in age quartile 2 (46-53 years) and in age quartile 4 (61-76 years) were significantly more likely to report observed apnoeas than people in age quartile 1 (25-45 years) (p=0.007 and p=0.004, respectively).

Table 4.16 Observed apnoeas: logistic regression model 2

variable	*OR*	*95% CI*	*p-value*
Age (quartile 2 v quartile 1)	15.05	1.79-126.36	**0.012**
Age (quartile 3 v quartile 1)	6.05	0.69-52.84	0.104
Age (quartile 4 v quartile 1)	15.64	1.86-131.73	**0.011**
Neck (cm increase)	1.14	1.03-1.27	**0.013**
Snore (always v never/rarely/often)	5.10	1.79-14.51	**0.002**
High blood pressure (treatment v no/don't know)	1.18	0.44-3.15	0.734

Due to a small number of participants that reported observed apnoeas, and given that neck size by approximate quartiles was not significant in a previously tested model, neck size was entered as a continuous variable. Table 4.16 shows that age (quartile 2 and quartile 4, versus quartile 1) remained significant after controlling for other factors (p=0.012 and p=0.011, respectively). Increasing neck size was also significantly associated with reporting observed apnoeas (p=0.013). People who reported snoring 'always' were more likely to report observed apnoeas (p=0.002) compared to those who 'never' or 'rarely' snored.

4.7.3 Excessive Daytime Sleepiness

Sleepiness can have multiple causes and there is evidence that suggests both OSAS and non-apnoeic snoring are important causes of daytime sleepiness (Young, Peppard, & Gottlieb, 2002). Therefore, both snoring 'always' and observed apnoeas were included as potential predictive variables. The following tables examined independent relationships between excessive sleepiness and possible predictive variables.

Table 4.17 Excessive daytime sleepiness: logistic regression model 1

variable	*odds ratio*	*95% CI*	*p-value*
Ethnicity (Māori v Other)	2.75	0.90-8.39	0.076
Ethnicity (Pacific v Other)	4.74	1.70-13.23	**0.003**
Age (quartile 2 v quartile 1)	1.65	0.58-4.65	0.346
Age (quartile 3 v quartile 1)	0.73	0.23-2.34	0.596
Age (quartile 4 v quartile 1)	1.79	0.61-5.22	0.289
Sex (male v female)	6.05	0.76-48.46	0.090

After controlling for other variables, people of Pacific ethnicity were significantly more likely to score ESS>10.

Table 4.18 Excessive daytime sleepiness: logistic regression model 2

variable	*OR*	*95% CI*	*p-value*
Ethnicity (Pacific v Other)	3.60	0.86-14.98	0.078
Neck (cm increase)	1.07	0.94-1.22	0.285
Snore (always v never/rarely/often)	3.15	1.23-8.10	**0.017**
Observed Apnoea (yes v no)	2.65	0.97-7.30	0.059
Wake Refreshed (N/R v O/A)	3.38	1.16-9.83	**0.025**
Enough Sleep (N/R v O/A)	1.20	0.39-3.67	0.747
Hours sleep (quartile 2 v quartile 1)	0.67	0.19-2.34	0.532
Hours sleep (quartile 3 v quartile 1)	0.45	0.14-1.47	0.186
Hours sleep (quartile 4 v quartile 1)	0.45	0.09-2.25	0.337
Night work (yes v no)	1.74	0.69-4.37	0.239

Table 4.18 shows that, after controlling for other variables, the significant independent predictors of excessive sleepiness were: snoring 'always', and reporting 'never' or 'rarely' wake feeling refreshed. Reporting observed apnoeas did not quite reach significance at the 0.05 level, possibly due to limited numbers of participants reporting these.

4.8 Pre-test Risk of OSA

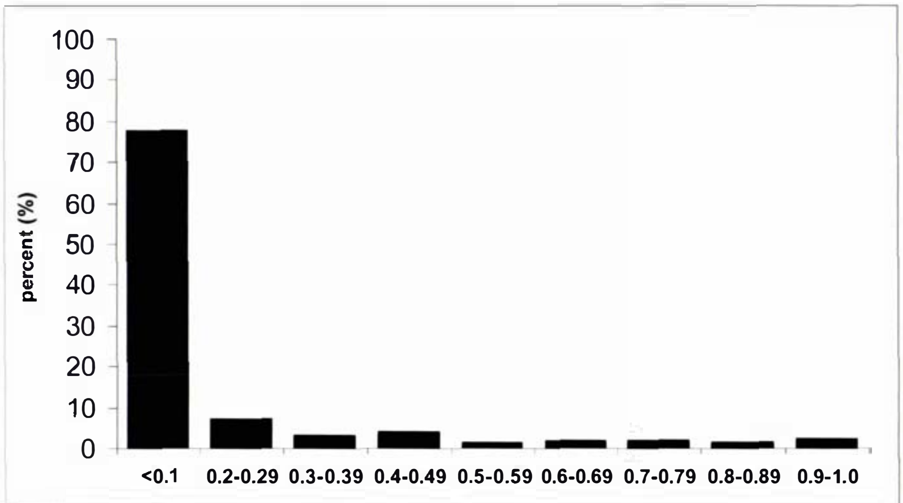

Figure 4.11 Distribution of pre-test risk of OSA

Figure 4.11 illustrates the distribution of pre-test risk of OSA (RDI≥ 15) using a threshold cut-off of 0.30 (Mihaere, 2004). The majority of participants did not have a high risk of OSA, with 77.6% of participants having scores less than or equal to 0.1. Seven percent of the participants obtained scores in the 0.2-0.29 range and 15.4% of the study sample had scores above the 0.30 threshold, which denoted a moderate-high probability of OSA.

Table 4.19 Pre-test risk of OSA, by ethnicity

variable	*yes*		*no*		*χ^2p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	22	13.1	146	86.9		1.00		
Māori	5	27.8	13	72.2		2.56	0.83-7.86	0.102
Pacific	10	50.0	10	50.0	**0.0001**	6.64	2.48-17.8	**0.0002**

Table 4.19 shows a significant association between ethnicity and probable risk of OSA (p=0.0001). Pacific peoples are significantly more likely to have a high pre-test risk of OSA, compared to people of "other" ethnicities. The small number of Māori drivers in

the sample resulted in a very wide confidence interval, but the suggestion is that the prevalence for Māori is intermediate.

Table 4.20 The risk of MVA and pre-test risk of OSA

variable	*odds ratio*	*95% CI*	*p-value*
Pre-test risk (≥0.30 vs <0.30)	0.76	0.34-1.71	0.506
Weekly driving (Q2 vs Q1)	1.32	0.57-3.07	0.523
Weekly driving (Q3 vs Q1)	1.44	0.54-3.86	0.467
Weekly driving (Q4 vs Q1)	2.15	0.93-4.99	0.075

After controlling for weekly driving hours (presented in approximate quartiles: Q1=6.0-40.0 hours (25.7%); Q2=42.5-50.0 hours (29.1%); Q3=52.0-58.0 hours (16.9%); Q4=60.0-76.0 hours (28.3%), there is no significant difference in the likelihood of reporting an MVA between drivers with a pre-test risk score ≥ 0.30 and drivers with a pre-test risk score ≤ 0.30. The small number of drivers with a pre-test risk score ≥ 0.30 (n=37) limited the power of this analysis to detect differences in MVA reporting.

Table 4.21 The risk of MVA and ESS>10

variable	*odds ratio*	*95% CI*	*p-value*
ESS>10 (vs ESS<10)	0.69	0.31-1.54	0.364
Weekly driving (Q2 vs Q1)	1.23	0.55-2.76	0.609
Weekly driving (Q3 vs Q1)	1.09	0.43-2.81	0.852
Weekly driving (Q4 vs Q1)	2.12	0.96-4.71	0.064

Similar to the above table, Table 4.21 illustrates that there is no significant difference between drivers that scored ESS>10 and drivers that scored ESS≤10 in their risk of reporting MVAs, after controlling for weekly driving hours. This is consistent with a previous study using the same measures for a random sample of New Zealand adults aged 30-60 years (Gander, Marshall, Harris, & Papaarangi, 2005).

CHAPTER 5
DISCUSSION

5.1 Introduction

This chapter discusses the results and implications of the survey questionnaire. It is divided into three main sections. The first section examines the potential biases and limitations of the study, providing a context for the discussion of the results. The second section examines the key findings of the study which are related back to the objectives and hypotheses. Finally, directions for future research are presented that are designed to contribute positively to the health and safety of taxi drivers, the taxi industry, and provision of health services to this industry sector.

5.2 Potential Errors and Limitations of the Study

This section identifies the potential sources of errors in this study, discussing how they were minimised, and how they affected the interpretation of the results. Other general limitations of the study are also discussed.

5.2.1 Bias

Bias is defined as any systematic error in a study that results in an incorrect estimate of the association between symptoms, and the risk of having the disease (Henneken & Buring, 1987). This study will refer to three general systematic errors, namely; selection bias, information bias and confounding.

Selection bias

Selection bias is a systematic error that originates from the procedures and methods used to select participants, and from factors that may influence study participation (Rothman, 2002).

The sampling frame used to recruit participants was obtained from two local taxi companies. It was defined as a cluster sample because the two companies were representative units of a larger area (i.e., Wellington region). That is, one company represented Wellington city-based taxi drivers, while the other company represented Hutt city-based taxi drivers. From here on, they will be referred to as the study companies.

All drivers were members of the New Zealand Taxi Federation (NZTF), and therefore members of the target population. However, this is a limitation because it cannot be assumed that the sample is representative of the general professional group at a regional or national level. There are several reasons that explain this limitation: (1) the sampling frame did not allow for participants to be randomly selected, and therefore the results were biased by the fact that participants were volunteers; (2) non-participating taxi companies may also be inherently different to the study companies; and (3) at the individual level, information about social and health status was not captured, and there is no reliable denominator data for taxi drivers as a group, so it was not possible to compare non-responders and responders.

Theoretically, the use of the electoral roll would have provided a better sampling frame. However, experience from the pilot study indicated that the electoral roll was not suitable because it did not contain updated information about drivers, which is particularly important given the nature of the taxi industry where there is unlimited entry and exit. Moreover, taxi drivers were not easily distinguishable from non-drivers. For example, a person with a taxi license is not necessarily a driver, they could also be self-employed as a taxi manager. Also, some people may not have listed their main occupation as taxi driving, given the fact that taxi drivers were protective of their identity, and of their job security. In terms of study feasibility, it was important to obtain endorsement from study companies in order to obtain the most accurate denominator of drivers. For the above reasons, the electoral roll was not pursued as the sampling frame.

Selection bias may also occur as a result of the study procedures. In the current study, information about the questionnaire was controlled by the taxi company administrators. They advertised the study through their newsletters. The larger company also administered the mail-out of the study packages, which required ongoing communication between the research team and the company to ensure accuracy (i.e., drivers versus only license-holders). The smaller study company provided personal details of taxi drivers to the research assistant, as their administrators felt over-burdened with the mail-out procedures. On the one hand, the administrators were not diligent in either providing accurate information to drivers, or mailing the study packages to eligible participants. On other hand, it is possible that drivers may have been less trusting of company administrators maintaining confidentiality, thus this could have inhibited participation in the study. As a result, sampling took a long time and the limited training given to the administrators about the study may have introduced selection bias.

Considering the identified potential for selection bias, and the low response rate (41.3%), it is also necessary to consider response bias (Last, 1995). There were a total of 342 non-respondents who were not in the sample analysed for the following reasons: failing to respond, incomplete questionnaires (e.g., missing variables such as age, sex and ethnicity), and questionnaires being sent to the wrong addresses (return to sender). Given the competitive nature of the taxi industry, it is possible that non-respondents may have felt threatened by the type of information sought and therefore chose not to respond. This point has been raised in other studies involving commercial drivers (Charlton, Baas, & Alley, 2003; Howard et al., 2004).

It was not possible to compare respondents and non-respondents on demographic variables such as sex and age. Only one study company supplied this information, which was incomplete, and therefore likely to be inaccurate. It was therefore impossible to correct for potential confounders in the analyses, and it was difficult to assess the likely size effect of selection bias and response bias. Sex is unlikely to be a systematic source of bias because 90% of the sample was male, reflecting the gender distribution in the taxi profession.

In this study, two study procedures were designed to minimise response bias. The first was the 'follow-up' of non-respondents (reminder post-cards and re-sending the full study package). The second procedure was the option to enter a draw for a prize as an incentive to participate. Edwards et al. (2002), in their systematic review of studies using postal questionnaires, reported that these two procedures significantly increased response rates by almost two-fold. In the current study, subsequent reminders produced an increase of approximately five percent per mail-out, which is indicative of the response rate improving. However, this was less than in previous studies of the general adult population (Harris, 2003; Paine, Gander, Harris, & Reid, 2004).

The healthy workers effect is a common problem in study designs similar to the current study, and this could have contributed to the low response rate. Drivers who perceived poor health may have been less likely to respond, for fear of jeopardising their job security. If this was the case, the study would tend to under-estimate the prevalence of sleep problems and sleepiness. Conversely, if the respondents were more aware of their sleepiness and other sleep complaints, the study would tend to over-estimate these problems. The lack of information and the small sample size made it impossible to estimate this bias. Another way to assess the healthy worker effect would be to have a comparison group with similar hazards and risks. Bus drivers and truck drivers would fit these criteria because of the similar driving exposure and shift-work.

Another factor that could explain a low response rate, and possibly introduce response bias could be attributed to limited literacy and receptive language skills among drivers, particularly those for whom English is not the first language. Many informal comments from the respondents alluded to this point. Future studies would benefit from translating the questionnaire into common ethnic languages.

A number of respondents were excluded from the sample analyses, because they did not: complete the question, missing ethnicity or sex data, or their specified age was outside the age range (e.g., 104 years). The exclusion of participants for analyses has the potential to introduce further selection bias, however this is unlikely as the number of participants excluded was relatively small.

Information Bias

Information bias is defined as the systematic difference in the way data on exposure or outcome was obtained from the study sample (Henneken & Buring, 1987). There are several types of information bias, however the most relevant bias to discuss in the current study is recall bias. Recall bias is the most common form of information bias in questionnaire-based studies, therefore, the potential for bias is higher compared to other designs (Henneken & Buring, 1987).

The reliability of the results rests upon the respondents' ability to recall accurately information pertaining to their sleep habits, such as snoring and observed apnoeas that occur during sleep. This issue is of importance because it affects the interpretation of the information regarding key OSAS symptoms that are central to this study. Other studies have indicated high correlation between self-reports and partner reports of snoring and apnoea behaviours (Bliwise et al., 1991; Kump et al., 1994; Bliwise et al., 1999). Some drivers wrote 'don't know', which was not offered as a response option to the questions pertaining to snoring and observed apnoeas. These responses were subsequently omitted from the analyses. They could have been responses from non-married persons, or people who lived alone, or who customarily slept on their own. Given this assumption, the proportion of taxi drivers who experienced snoring and apnoeas may have been under-estimated. In general however, the study design utilised closed questions with a choice of answers, and adopted a standard procedure to manage outlying responses. This was considered sufficient to minimise recall bias.

Another potential source of bias was the possibility that participants may have deliberately mis-represented their responses relating to excessive sleepiness, driving exposure and accident rate, and consequently introduced bias. There is no direct evidence to support this, however there are a number of reasons to expect that this is likely. Firstly, drivers may be protecting their job security by under-reporting hours of driving per week and MVAs. Secondly, drivers were aware that their health status determines their ability to continue working professionally, thus inaccurate responses may have been given for fear of being reported to the taxi company or finding out health problems. This could contribute to the study under-estimating the risks of OSAS symptoms and risk factors.

The 1996 Census question on ethnicity was used, as in previous studies by Harris (2003) and Mihaere (2004). This question allowed participants to self-identify their ethnicity rather than asking cultural or tribal affiliation, which is based on descent (biological). In the current study, the aim of the ethnicity question was to define Māori, Pacific peoples and people of "other" ethnicities, so that the data analyses could reflect their social realities (Harris, 2003). The 1996 ethnicity census question allowed participants to self-identify with several ethnicities and therefore their responses could be more aligned to ancestry rather than ethnicity. Therefore, using this ethnicity classification system could introduce bias that may under-estimate or over-estimate OSAS symptoms and risk factors for Māori and Pacific peoples.

5.2.2 Confounding

Confounding is thought of as a mixing or confusion of effects. It is a systematic error that researchers can prevent or remove from the study (Rothman, 2002).

In the current study, men dominated the analysed sample although this reflected the reality of the taxi profession, so this variable is not likely to be a confounder in the current study.

Various methods were used to control confounding (Henneken & Buring, 1987). In this study, one of the ways to control confounding was the use of stratification. The descriptive statistics were stratified by ethnicity and sex, with further comparative analyses given by ethnicity only because of the small number of women in the sample. Age stratification and further analysis by sex allowed specific examination of differences between OSAS symptoms and other risk factors.

As a rule of thumb, Peduzzi et al. (1996) recommended that there should be at least ten cases per dependent variable in a multivariate model. Thus, in the logistic regression analyses for each OSAS symptom, the first model examined the associations with ethnicity, sex, and age. Variables with significant associations were then entered into a second logistic regression model along with other potential predictors of OSAS. However, it is possible that residual confounding may exist when other important variables were not included in the model. For example, due to the limited statistical power of the study, important variables were non-significant at the univariate level. Hence, they were omitted from the logistic models, although they have shown to be significant independent variables (age, sex, ethnicity) in previous studies (Harris, 2003; Mihaere, 2004). Confounding in the logistic regression models is discussed in more detail in section 5.3.

5.2.3 Random error

Random error is defined as the residual error that remains after systematic error has been eliminated. It is nothing more than a deviation from the true population value that cannot be readily explained (Rothman, 2002).

It is possible that the current study is subject to random error because of its small sample size, and therefore the results may be due to chance or hidden biases. Double entering of the data was used to minimise random error from data entry.

In the logistic regression analyses, the small sample size limited the number of potential confounding variables that could be included in the models. Point estimates (odds ratios) and the 95% confidence intervals although significant produced extreme values, thus indicating less precision. The consistency of the findings with respect to other studies is considered in section 5.3.

5.2.4 Other limitations

Accessing the study population posed some inherent problems, and this may be a realistic reflection of the taxi industry in New Zealand. Better access to taxi drivers, along with better information to potential participants may have improved the response rate and therefore the explanatory power of the study.

The most important limitation is likely to be the ability to formulate generalisations from the findings. The current study's results cannot with unreserved confidence be generalised to taxi drivers at the wider local and national level due to a low response rate (41.3%). The lack of information about taxi drivers in general, makes it impossible to evaluate whether the present sample is representative on key measures. Thus, the prevalence estimates of OSAS symptoms and risk factors are limited to the analysed sample.

Furthermore, the sample contained a significant proportion (35%) of people of "other" ethnicities other than New Zealand European, while Pacific peoples represented only Samoan ethnic drivers. Demographically, because there is no routinely collected data on taxi drivers, there is no database to compare ethnic or age representation. Thus, it is impossible to comment on the ethnic 'representation' of the current sample. Moreover, wording and written language may have been a barrier for potential participants. Previous research has highlighted this issue, attempting to minimise language barriers by using appropriate print materials (rigorously designed and pre-tested) for various Pacific Island languages (Delaibatiki, 2003; Ministry of Health, 2002b).

Another limitation was that, not all questions used in the questionnaire were validated and this limits comparisons with other studies, making it difficult to assess possible bias for these questions. A small proportion of respondents did not respond using the question-response options offered (e.g., some offered written responses, others ticked between options). To enable accuracy, consistency, and to minimise any possible bias, a set of data entry rules developed by Harris (2003) was used (see Appendix 8). For example, where the respondent ticked both boxes 'never' or 'rarely' snoring, a conservative approach was taken, in which case the response was coded as 'rarely'.

The education variable was another limitation of the study, which was collected as a proxy measure of socio-economic and health status. A more comprehensive measure of individual socio-economic status may have revealed more interesting relationships with OSAS symptoms and risk factors.

Finally, the current study did not report all findings from the questionnaire. These include relationships between sleep variables with MVA and co morbidities, because some participants interpreted the questions of interest ambiguously, or there were too few respondents.

5.3 Summary and Explanation of Key Results

5.3.1 Univariate analyses

The results are discussed in the order they were presented: OSAS symptoms, OSAS risk factors and other variables. Due to the limitations of the study sample previously outlined, the comparisons of interest are limited to a description of the variables by ethnicity and sex. Subsequent univariate analyses permitted comparisons between Māori, Pacific peoples and peoples of "other" ethnicities. The study results are compared with findings from three local studies (Delaibatiki, 2003; Harris, 2003; Mihaere, 2004), as well as relevant national and international studies (Charlton, Baas, & Alley, 2003; Howard et al., 2004; Hui et al., 2002; Young et al., 2002).

General Sleep Habits

The average usual duration of sleep reported by drivers was 7.3 hours per 24 hours (sd=1.14 hours). As the data was not normally distributed, between group medians were observed and tested. There were no significant differences found between men and women of Māori, Pacific peoples and people of "other" ethnicities (χ^2=3.6311, df=2, p=0.162). The current study's average duration of sleep per day was slightly more than that reported by Mihaere's (2004) community sample 7.25 hours. In comparison to the national OSA survey, the average duration of sleep was comparable (7.41 hours, sd=1.42 hours). In general, an average of 7.3 hours of sleep per day is consistent with epidemiological studies where the average length of sleep varied between seven and eight hours (Partinen & Hublin, 2005).

The quality of sleep was examined by the question: '*How often do you think that you get enough sleep?*' Approximately 26% of the sample reported 'never' or 'rarely' get enough sleep. There were no differences between ethnic groups of reporting inadequate sleep. In comparison to the national OSA survey, reporting 'never' or 'rarely' getting enough sleep was less common than in the general population (37%) (Harris, 2003).

Sleep quality was also examined by the question: '*How often do you wake feeling refreshed?*' Overall, 31% reported 'never' or 'rarely' wake feeling refreshed, which was less than in the general population (46%) (Harris, 2003). Furthermore, there were no significant differences found between Māori, Pacific peoples and people of "other" ethnicities. This was consistent with the comparative analyses found in the national OSA survey (Harris, 2003), and in the community sample (Mihaere, 2004).

OSAS symptoms

Snoring

Pacific peoples were significantly more likely to report snoring 'often' or 'always' compared to people of "other" ethnicities (77.3% vs 50%, ratio=3.40, p=0.021). Māori were intermediary.

Pacific peoples remained significantly more likely to report snoring 'always' compared to people of "other" ethnicities (36.4% vs 17.4%, ratio=2.71, p=0.039). This was in line with results from Delaibatiki's (2003) adjusted population prevalence rates of Pacific data. Pacific men were significantly more likely to report snoring 'always' than men of Other ethnicities (23.2% vs 9.7%, ratio=2.40, p=0.015). Likewise, Pacific women were significantly more likely to report snoring 'always' than non-Pacific women (12.3% vs 3.8%, ratio=2.63, p<0.002). Overall, reporting snoring 'often/always' or just 'always' was not significantly associated with 'ethnicity', although it was closely trending towards significance, p=0.050 and p=0.099, respectively. This was consistent with results from the community sample from Mihaere's (2004) study.

Excessive daytime sleepiness

Using the Epworth Sleepiness Scale (ESS), achieving a total score of, or greater than 10 (ESS>10) was used to define EDS. Overall, the proportion of male drivers with EDS was 18.7% (95% CI 0.02-1.38). This indicates male taxi drivers are sleepier than men in the general population, 15.6% (Harris, 2003). Using the ESS, a study by Baldwin et al. (2004) found men and women answered questions of sleepiness differently. They reported that the ESS may be more sensitive in detecting sleepiness among men than in women. Thus, this could introduce the likelihood of information bias, particularly as 90% of the current sample is male, and they may have chronic sleepiness due to the nature of their occupation. Between ethnic groups, Pacific peoples were more likely than Māori and people from "other" ethnicities to score ESS>10.

In general, ethnicity was significantly associated with scoring ESS>10 (p=0.007). This finding was also found in the study using Pacific data (24.0% Pacific vs 13.76% Other, ratio=2.04, p<0.0001) (Delaibatiki, 2003).

Observed apnoeas

Reporting observed apnoeas was common in the current study (15.0%). This was similar to the national OSA survey (13.1%) (Harris, 2003), and more than the community sample (10.3%) (Mihaere, 2004).

While Māori (OR 2.06, p=0.193) followed by Pacific peoples (OR 1.94, p=0.229) were more likely to report observed apnoeas, there was no significant differences between these ethnic groups compared to drivers of "other" ethnicities. Moreover, the lack of statistical significance between ethnicity and observed apnoeas (p=0.245), contrasts with other studies (Delaibatiki, 2003; Harris, 2003; Mihaere, 2004). It is likely that, the small number of ethnic participants (Māori n=5, Pacific n=5) reporting observed apnoeas explains the limited ability of the study to detect differences by ethnicity.

5.3.2 OSAS risk factors

Neck size

Descriptively there were significant differences in median values for neck size between ethnic groups. Pacific peoples had the largest neck sizes (46 cm, sd=3.54 cm), followed by Māori (43.5 cm, sd=4.73 cm), and then people of "other" ethnicities (40 cm, sd=3.81 cm). Of particular note, in the current sample Pacific peoples had larger neck circumferences compared to the average neck size of the clinic (42 cm) and community (37.5 cm) samples in Mihaere's (2004) study. Likewise, Pacific peoples neck size were larger than the average neck size reported by the national OSA survey, and the Pacific data analyses (37.4 cm and 39.9 cm, respectively) (Delaibatiki, 2003; Harris, 2003). This is consistent with results from the 2002/2003 New Zealand Health Survey where the prevalence of obesity was higher among Pacific peoples (Ministry of Health, 2004c).

Observing neck size by approximate quartiles, for participants with larger neck sizes (quartile 4), there were consistent significant associations with the following OSAS symptoms: ESS>10 (OR 4.21, p=0.009), snoring always (OR 5.83, p=0.001), and reported apnoeas (OR 3.23, p=0.026), compared to participants with smaller neck sizes (quartile 1). This finding was expected, as increased neck size has been shown to be a strong severity predictor for OSAS (American Academy of Sleep Medicine, 2005; Ancoli-Israel et al., 2001; Baldwin et al., 1998; Young, Peppard, & Gottlieb, 2002).

Neck size was also examined as a continuous variable in the univariate analyses. There was a significant relationship between neck size (for each centimetre increase) and ESS>10 (OR 1.21 p<0.000), snoring always (OR1.17, p=0.000), and observed apnoeas (OR 1.19, p=0.000).

Age

Age was significantly associated with observed apnoeas. Using the approximated quartiles, a strong association with observed apnoeas was shown for age quartile 2 (OR 17.43, 95%CI 2.18-139.1) and quartile 4 (OR 19.86, 95%CI 2.5-156.7), compared to age quartile 1 (reference). Of note, the 95% confidence intervals were extreme, indicating small numbers of participants per quartile group.

Examining age as a continuous variable (OR 1.05, 95% CI 1.02-1.08) is misleading, because it assumes a linear relationship between age and OSAS. This contradicts previous research that indicates the prevalence of OSAS levels off after 65 years (Young, Peppard, & Gottlieb, 2002). As a result, subsequent discussions will be based on approximate age quartiles.

5.3.3 Relationships between OSAS Symptoms and Other Variables

Excessive daytime sleepiness

Having a large neck size (43.5-54cm), reporting observed apnoeas, and reporting snoring 'always' or 'often/always', was significantly associated with EDS. As symptoms and risk factors of OSAS this was expected (Young, Peppard, & Gottlieb, 2002).

Participants that reported getting 7.5-8.0 hours (quartile 3) sleep per 24 hours were less likely to report EDS (ESS>10), compared to drivers getting 4-6.5 hours sleep per 24-hours (quartile 1). This finding is in line with Howard et al.'s (2004) study. They used the ESS and MAP scores to determine chronic sleepiness of 2,342 Australian commercial drivers. They found drivers who averaged less than seven hours of sleep per night were more likely to report excessive sleepiness.

Reporting 'never/rarely' getting enough sleep and working nights were also significantly associated with EDS. As a plausible cause-effect relationship, this was expected at the univariate level.

There was no association between reported accidents over a 3-year period with EDS, and this was consistent across all OSAS symptoms. This finding is puzzling given the plausibility of its interaction. The likely explanations are: (1) sleepiness was not reported by the participants at the time of the accident; or (2) participants failed to accurately recall accident events over the last 3 years; or (3) participants chose not to answer the question accurately for fear of being identified and losing their employment status. Young et al. (1997) reported a similar finding from their review of MVA and polysomnography records over a 5-year period of 913 participants. They found that people with SDB and self-reported sleepiness were unlikely to provide a history of accidents.

Snoring always

Snoring 'always' is commonly used as a proxy indicator of habitual snoring in people with OSAS (Partinen & Hublin, 2005). However, the lack of objective tools to measure snoring severity makes it difficult to comment on its variability, particularly as Bearpark et al. (1995) found that not all people who snore heavily present with OSAS.

The results showed a significant association between reporting snoring 'always' with increasing neck size, reporting observed apnoeas, working nights, and receiving treatment for a current sleeping problem. Presumably, the association was attributed by a constellation of various OSAS symptoms and risk factors including night work and the preponderance of men, which may account for the strong association. This has also been demonstrated in previous studies (Bearpark et al., 1995; Howard et al., 2004).

Observed apnoeas

As expected, there was a significant association between observed apnoeas and a combination of OSAS symptoms ('never/rarely' getting enough sleep, 'often/always' and 'always' snoring), and risk factors (yearly increase in age), along with receiving treatment for a sleeping problem and high blood pressure. The latter association is in line with recent research that has linked OSAS to hypertension (Young, Peppard, & Gottlieb, 2002). Furthermore, participants who reported usual hours of sleep per 24-hours as being 7.5-8 hours (quartile 3), were significantly less likely to report observed apnoeas. Therefore, it is expected that short habitual sleepers with observed apnoeas would be at high risk of sleepiness because their sleep quantity and quality has been compromised.

5.3.4 Summary of key findings of univariate analyses

With respect to sex and OSAS symptoms, men were significantly more likely to score ESS>10. Furthermore, they were also sleepier than men in the general population (18% vs 15%, respectively) (Harris, 2003). Although, given recent evidence by Baldwin et al. (2004) the results may be artefact of how male drivers perceive sleepiness differently compared to their female counterparts. However, the limited nature of the questions may not have captured the real reasons that could have explained sleepiness.

In examining the general sleep habits, there were no significant differences by ethnicity. The main finding has shown that the OSAS risk profile for Pacific peoples is higher than for Māori and people of "other" ethnicities. This was demonstrated by Pacific peoples having larger neck sizes, they were more likely to report snoring 'always', observed apnoeas, get inadequate sleep, and score ESS>10. Thus, this is in line with clinical reports that Pacific peoples disproportionately present with severe OSAS symptoms and risk factors by the time they access sleep services (Baldwin et al., 1998).

Despite the higher prevalence of OSAS symptoms and risk factors among Pacific peoples compared to Māori and "others", Pacific peoples composed of only Samoan drivers. In comparison to the national OSA survey, Pacific peoples (n=121) included categories of Samoan, Cook Island, Niuean, Tokelauan, and other Pacific Island groups such as, Hawaiian and Tahitian. Thus, for the current study, the Pacific people estimates are not representative of all Pacific ethnic groups. However, the trends observed herein are consistent with the previous studies in regard to the prevalence of OSAS symptoms and risk factors.

5.3.5 Multiple logistic regression analyses

The purpose of these analyses was to identify independent relationships of potential risk factors of OSAS symptoms after controlling for other variables. Two models were run for each OSAS symptom. The first model included known confounding factors such as ethnicity, age and sex. In the second model any variables that attained statistical significance, or displayed a potential scientific relationship from the univariate analyses were added to the model.

Snoring Always

Model one included the demographic factors of ethnicity, sex and age. After controlling for age and sex, Pacific peoples had 2.7 times the odds of reporting snoring 'always' (95% CI 1.04-7.15) compared to people of "other" ethnicities. This finding is in line with the results found by Delaibatiki (2003).

Men were more likely to report snoring 'always' although this was not statistically significant. This contrasts with findings from Enright et al. (1996). They found a high prevalence of snoring complaints among men (33%, $p<0.0001$), however they reported snoring was associated with younger age, marital status, alcohol use among men. They further reported that snoring decreased with age.

In the current study, age did not attain significance after controlling for ethnicity and sex, and this contrasts with findings from a 10-year follow-up Swedish cohort of 3,201 randomly selected males (30-69 years). The study found the prevalence of snoring increased with age up to and between 50 and 60 years, and then decreased. They further reported that the independent risk factors for the development of habitual snoring were weight gain, BMI for all age groups and young smokers (30-49 years) (Lindberg et al., 1998).

In model two, after controlling for increasing neck size, treatment for asthma and sleeping problems, and night work, the ethnicity difference between Pacific people and people of "other" ethnicities disappeared. This can be explained by the larger neck size among Pacific peoples, which is in line with previous research findings on ethnicity, suggesting the risk of OSAS is due to other factors rather than ethnicity per se (Baldwin et al., 1998; Delaibatiki, 2003; Harris, 2003; Mihaere, 2004; Young, Peppard, & Gottlieb, 2002). In comparison, other studies have highlighted race as a risk factor for OSAS. Ancoli-Israel et al. (1995) found after controlling for age, sex, and BMI, that African-American race (compared to Caucasians) was independently associated with having an RDI≥30 (p=0.043). Additionally, a familial case-control study by Redline et al. (1997) identified ethnicity as a significant indicator of OSAS among young African-Americans compared with Caucasians (OR 1.88, 95% CI 1.03-3.52) after controlling for sex, obesity, proband sampling and familial clustering. However, these studies were limited by their disproportionate numbers of African-American participants and the lack of other available information regarding health status (e.g., hypertension) that may influence the severity of OSAS. Therefore their results do not provide the basis to adequately infer ethnic differences.

There was a strong relationship between snoring 'always' and participants in the largest neck size group compared to those in the smallest neck size group after controlling for other variables (OR 4.92, 95% CI 1.56-15.56). This is consistent with findings from a number of studies where neck size is a strong independent risk factor for OSAS (Baldwin et al., 1998; Bearpark et al., 1995; Partinen & Hublin, 2005; Young, 2004; Young, Peppard, & Gottlieb, 2002; Young et al., 2002; Young, Skatrud, & Peppard, 2004).

This study did not identify an association between reported snoring 'always' and receiving current treatment for asthma after controlling for other variables (p=0.248). However, there is evidence that supports a relationship between asthma and snoring. Franklin et al. (2004) found in their large sample (n=15,555), that habitual snoring is more prevalent (4.1%) in people with respiratory problems than in people without it (p<0.001). They also found chronic bronchitis and smoking are independent and additive risk factors for snoring. This finding has been supported by other studies (Ekici et al., 2005; James et al., 2005; ten Brinke et al., 2005).

The relationship between night work and snoring 'always' became non-significant after controlling for other variables (p=0.148). However, limited information about night work and the limited numbers of participant responses make it impossible to draw accurate inferences.

Overall, the difficulties with interpreting the results of the current study are as follows. (1) Data was based on subjective reports, and there were no supplementary objective measures. (2) The sampling frame was restrictive. (3) The study's low statistical power to detect any significant differences due to the limited number of respondents.

Observed apnoeas

In model one after controlling for ethnicity and sex, age remained significantly associated to reported observed apnoeas, particularly between quartile 2 (46-53 years, p=0.007) and quartile 4 (61-76 years, p=0.004) when compared to the youngest group (reference). Despite the middle-age group (quartile 3) trending towards significance (p=0.053), it supports the association that reporting apnoeas increases with age. This is consistent with what is already known about the relationship of age to OSAS symptoms (Partinen & Hublin, 2005; Young, Peppard, & Gottlieb, 2002).

Although ethnicity was not significantly associated with reported observed apnoeas, Pacific peoples followed by Māori showed higher odds of reporting observed apnoeas after controlling for age and gender. This follows similar findings from the national OSA survey. Harris (2003) found Māori were significantly more likely to report observed apnoeas than non-Māori (OR 1.97, 95% CI 1.73-2.25, p<0.0001) after controlling for gender and age. Delaibatiki (2003) also found Pacific people compared to people of Other ethnicities had a significant likelihood of reporting observed apnoeas (OR 2.02, 95% CI 1.26-3.22, p=0.0033).

In model two, as expected increasing age and neck size, and reporting snoring 'always' were significantly associated with observed apnoeas. This is consistent with that found by previous studies (Delaibatiki, 2003; Harris, 2003; Mihaere, 2004; Young et al., 2002). The significant relationship between the older age group and observed apnoeas was interesting, particularly as OSAS does not usually progress past 65 years of age. Therefore, the results suggest characteristics of SDB in this sample may be different from OSAS among younger to middle-aged people (Young et al., 2002). However, the limited number of participants and the likelihood of information bias hamper clarity in the interpretation of these findings.

Excessive daytime sleepiness

In model one, after controlling for age and sex, only Pacific peoples (followed by Māori) were significantly more likely to score ESS>10 than people of "other" ethnicities (OR 4.74, 95% CI 1.70-13.23, p=0.003). This was consistent with findings from Delaibatiki (2003). Harris (2003) also reported Māori were significantly more likely to report EDS than non-Māori.

There are many causes of sleepiness, ranging from societal influences to pathological aetiologies, hence it is not considered symptom-specific to OSAS. Therefore, if sleepiness was considered on its own, the ethnicity difference was expected due to a number of explanatory factors not previously considered in the model. These being, differences in the prevalence of other sleep disorders, poor health status, poor tolerance of shift-work, or other risk factors such as smoking and alcohol consumption (Harris, 2003), and other morbidities (Tukuitonga & Finau, 1997).

Age and sex was not independently associated with excessive daytime sleepiness, and this was in contrast to findings from other studies that found sleepiness increased with age (Bixler, Vgontzas, Ten Have, Tyson, & Kales, 1998; Delaibatiki, 2003; Harris, 2003; Young et al., 2002). In the current study, the lack of statistical significance could be explained by the healthy workers effect, particularly if the participants have good health status, thus they were more aware of their health issues. Alternatively participants may have concealed their true age or sex out of fear of being identified.

In model two, after other potential predictive variables were added and adjusted, the significant difference for Pacific peoples disappeared (p=0.078), this was similar to that found by Mihaere (2004) and Baldwin et al. (1998). In contrast, Delaibatiki (2003) found Pacific ethnicity remained significant even after controlling for other confounds. Likewise, Harris (2003) also reported scoring ESS>10 was significantly associated with being Māori, increasing age, increasing deprivation and neck size.

The general sleep variables, *wake feeling refreshed* and *getting enough sleep,* have little predictive value in identifying OSAS. However, participants who reported 'never' or 'rarely' wake feeling refreshed were three times more likely to score ESS>10 (p=0.025). This was not surprising, as it suggests that sleepiness was perceived as a general symptom with a variety of causes rather than OSAS per se. Furthermore, the presence of other disorders such as insomnia or depression could not be ruled out. Conversely, reporting 'never' or 'rarely' getting enough sleep was not significantly associated with ESS>10, after adjusting for various confounders. This was consistent with findings from other studies (Mihaere, 2004 #79;Harris, 2003 #46;Stradling and Crosby 1991, Hoffstein and Mateika 1992, Hoffstein and Szalai 1993, Flemons et al. 1994).

Of particular note, it was unusual to find that, increasing neck size did not attain a significant relationship with ESS>10, especially as it is a known independent predictor of EDS, and for objective measures of OSA using RDI and AHI (Bixler et al., 2001; Ferini-Strambi et al., 1999; Harris, 2003; Mihaere, 2004; Young et al., 2002). Thus, this supports the notion that scoring ESS>10 was likely to be due to causes other than known predictors of OSAS.

Observed apnoeas is a common symptom of OSAS, again it is unusual to not have found a significant relationship with scoring ESS>10 (p=0.059). In contrast, Young et al.'s (2002) progressive logistic modelling found breathing pauses were strongly associated with an AHI$\geq$ 15 (OR 2.5, 95% CI 1.72-3.53). In the current study, the lack of a significant association could be explained by the limited number of participants (n=35) who reported stopping breathing. A possible reason for under-reporting could be that people experience, interpret and report symptoms of SDB differently. Redline and Strohl (1999) stated questionnaires fail to use specific questions particularly in regards to distinguishing between symptoms. They suggested the deficiency in the specificity of a question can result in the 'no' or 'don't know' responses. In addition, if participants interpreted these questions in relation to fatigue rather than sleepiness, they could be under-stating their abilities. An example of this can be seen by a study of 102 taxi New Zealand taxi drivers by Charlton et al. (2003). They found taxi drivers in comparison to truck drivers were less forthcoming in their answers lending credence to the suggestion that taxi drivers' under-estimated their fatigue levels.

There was no significant relationship between scoring ESS>10 and hours of sleep after adjusting for other variables. A likely explanation could be due to drivers over-reporting the hours of sleep, particularly given the competitive nature of the taxi industry, and for fear of losing their job. This was evident by known loop-holes in the log-book system, meaning drivers mis-inform their hours of rest compared to hours of work, thus introducing information bias (Gaunt, 1996; Reddish, 2003; Soon, 1999b). In contrast, a study of Australian commercial drivers, found drivers significantly increased their odds of reporting excessive sleepiness by 50% if they slept less than seven hours a night during the working week. Furthermore, drivers who reported sleeping more than eight and nine hours per night were five times more likely to report sleepiness (95% CI 1.93-16.34). However, the sample contained a large number of night-shift drivers suffering from chronic sleep restriction, which in part is due to the complexity of shift-work patterns (Howard et al., 2004).

Finally, after controlling for other variables, working nights became non-significant (p=0.239). This was consistent with findings from Charlton et al.'s (2003) study, where working either day-shift or night-shift was not statistically significant with ESS ratings. Instead, they found the duration of shift-work and the number of days working per week were significant indicators of scoring ESS>10. The average shift-work length of 11 hours or more was associated with higher ESS scores compared to short-shift-workers. In general, it is expected that sleeping difficulties associated with varying shift-work patterns (e.g., rotating shifts) disrupts the biological process that programs daytime wakefulness and nocturnal sleep (Partinen & Hublin, 2005; Richardson, Miner, & Czeisler, 1989-90). In the current study, it was difficult to gauge definitive boundaries for shift-work patterns among taxi drivers. Thus, the 'night work' variable should be interpreted cautiously in this study as drivers may not have been forthcoming with their hours of work.

5.3.6 Pre-test risk of OSA

As previously described, the current study utilised a multivariate predictive model developed by Mihaere (2004) to estimate an overall pre-test risk of OSA among taxi drivers. In this study, the predictive model used considered the following variables: being male, increasing age, increasing neck size, excessive daytime sleepiness (ESS>10), snoring 'always', and reported observed apnoeas. These variables have been shown to be consistent predictors of OSA (Mihaere, 2004; Redline, Schluchter, Larkin, & Tishler, 2003; Young et al., 2002). The predictive model estimates the probability of OSA, defined as having at least 15 respiratory disturbance events (apnoeas) per hour of sleep (RDI$\geq$ 15). This model was developed for use by general practitioners in New Zealand as a screening tool. It is considered to provide reliable estimates of *a priori* probability of OSA with 71%-80% sensitivity and 81%-86% specificity. Such ratings are indicative of a potentially pragmatic clinical screening test, however this test is still in the process of being validated. For the present study, results estimated a high proportion (15%) of drivers at moderate-to-high risk of OSA. Pacific drivers in particular, demonstrated a significantly increased pre-test risk of OSA compared to drivers of "other" ethnicities. The increased risk is likely to be explained by Pacific drivers having larger neck sizes and reporting a higher OSAS profile. Nevertheless, this finding is consistent with Baldwin et al. (1998).

Table 5.1 summarises predictive models from relevant studies indicating the prevalence of OSAS among commercial drivers.

Table 5.1 **Summary of studies predicting the prevalence of OSA among commercial drivers**

First author and date	Sites	Demography	OSA diagnostic criterion	Sample size	Prevalence of OSA
Howard et al. (2004)	Australia	Commercial drivers (16-71 years)	(1) MAP* + ESS>10 (2) PSG (RDI≥5)	(1) 2,342 (2) 161	(1) 54% (mild OSA) (2) 16%
Gurubhagavatula et al. (2004)	United States of America	Commercial drivers (ave age 44.4 years ±11.2)	(1) MAP* (2) PSG (those with high MAP scores)	(1) 1,329 (2) 406	(1) 28.1% (AHI≥5) (2) 4.7% (AHI≥30)
Hui et al. (2002)	Hong Kong	Bus drivers	SHQ[±], ESS>10, MESAM4	216	(1) RDI≥5= 20% (2) RDI≥10 = 9.8%

* = MAP: Multivariable Apnea Prediction questionnaire

± = SHQ: Sleep & Health Questionnaire used to assess daytime sleepiness

In Table 5.1, depending on the diagnostic criteria and sample population targeted, a wide range of prevalence rates of commercial drivers is evident. For instance, for an RDI≥ 5 / AHI≥ 5 denoting mild OSA the range is between 20%-68%. The extensive range of results is likely to be an artefact of: the different methods used (e.g., questionnaire-based versus objective measures like the MESAM4); different thresholds used to diagnose OSA; the different predictive models used; and the different ethnic groups and the anthropometric characteristics of the sample studied.

Howard et al.'s (2004) questionnaire sample is the most relevant for comparing with the current study. With a large sample size of randomly selected drivers and a high response rate (72%), the questionnaire-based prevalence of mild OSA (54%) was high, especially compared to that reported from the PSG-based prevalence (16%). The latter proportion was representative of the general population. Although, the questionnaire-based prevalence was higher than the current study's crude pre-test risk of 15%, the difference can be explained by differences in the questionnaire tool used, and the smaller sample size of the current study. Despite this, both results are high enough to highlight serious concerns about the possibility of undiagnosed OSAS among professional drivers, warranting further research.

For the present study, the pre-test risk (15%) is not a defined prevalence per se, because the participants in the present study did not have a confirmed diagnosis of OSA. Therefore, it provides a crude estimated proportion of risk. It could be argued that the proportion of OSA is under-estimated but this could be due to the low response rate. Also previous research has shown that commercial drivers are more likely to under-report correct information regarding their symptoms of OSAS for concerns of job security (Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997a; Howard et al., 2004). On the other hand, the pre-test risk of OSA may be over-estimated, especially if participants with known sleeping complaints were more aware, or that drivers were overly sensitive about their health. They may have biased the results incurring the healthy-workers effect. Nevertheless, this proportion remains a crude representation of the study sample, and cannot be generalised to other professional drivers.

5.3.7 Summary of key findings of logistic regression

Key findings from the logistic regression models for OSAS symptoms demonstrated that demographic and anthropometric variables: age, neck size, snoring and observed apnoeas were the main predictors of OSAS among taxi drivers. Increasing neck size, EDS, snoring and observed apnoeas were significantly prevalent among middle-aged and older aged taxi drivers, which in turn, suggest OSAS may be common among taxi drivers. This is also consistent with findings from previous research (Baldwin et al., 1998; Delaibatiki, 2003; Harris, 2003; Mihaere, 2004; Pack, 2006; Young, Peppard, & Gottlieb, 2002; Young, Skatrud, & Peppard, 2004).

As an interesting finding, Pacific peoples demonstrated greater risks compared to people of "other" ethnicities for most OSAS symptoms, however after controlling for potential confounding factors, statistical significance disappeared. This was in line with previous research that has not found ethnicity to be an independent predictor for OSAS (Baldwin et al., 1998; Mihaere, 2004). The limited number of Pacific participants and Pacific Island ethnic diversity hamper the accuracy and the ability to generalise this finding.

The study also depicted a high unadjusted pre-test risk of OSA (15%) for taxi drivers. Despite previous research showing a wide range of prevalence (20-68%) estimates of OSAS, the current study follows the trend suggestion that OSAS is a public health concern for professional drivers.

5.4 Strengths of the Questionnaire Study

Hopefully this study will be a catalyst to improve the health and safety of professional taxi drivers, by informing the taxi industry of the risk factors of OSAS which places drivers at an increased risk of MVA. The results of the study can also guide policy-makers to improve the provision of appropriate and effective screening, to enhance access to effective assessment and treatment for drivers at risk of OSAS.

This study was unique in the way that it examined ethnic differences in the risk factors and symptoms of OSAS. The qualitative part of this thesis builds on this characteristic by exploring and identifying barriers to accessing health care services for sleepiness and other sleep complaints.

This study provides additional information provided by two companion studies carried out under the partnership of Te Ropu Rangahau Hauora a Eru Pomare and the Sleep/Wake Research Centre (Harris, 2003; Mihaere, 2004).

In comparison to the Pilot study, using taxi companies as the sample frame proved to be more effective than the electoral roll. This was evident by a better response rate, better accessibility to drivers, and a realistic representation of the denominator.

5.5 Implications on Health and Services

The results of this study have indicated a number of major health and service implications in relation to identifying OSAS as a public health concern for professional taxi drivers, and more specifically among Pacific and Māori drivers.

In New Zealand, the rate of obesity is predicted to increase and this will have a considerable impact on the prevalence of OSAS (Ministry of Health, 2004c), particularly as the presence of OSAS increases the risk of cardiovascular disease (CVD) and morbidity (Ministry of Health, 2003a, , 2003b; Newman et al., 2001). Therefore, effective public health strategies are necessary in the management of OSAS. An example of a population-based strategy is given by the Oranga Kai-Oranga Pumau Strategy (Ministry of Health, 2003b), aimed at increasing physical activity, improved nutrition and knowledge to reduce obesity. Although this approach alone is not sufficient in what is required to educate, and treat people with OSAS, other measures are needed. The research and information obtained from this study provides insight about the risk of OSAS among Māori, Pacific people and people of "other" ethnicities, hence informing various components of the New Zealand public health infrastructure of where the needs should be addressed.

According to the document, *Strengthening Public Health Action*, three of the goals are: (1) to improve, promote and protect Māori health status so in the future Māori will have the opportunity to enjoy at least the same level of health as non-Māori; (2) to improve, promote and protect the health of Pacific people; (3) to improve, promote and protect the health of adults (Ministry of Health, 1997a). As a public health priority, four areas have been specifically identified where the public health infrastructure could consider improving services for OSAS among professional taxi drivers:

Specialist sleep services

Access to technical advice and expertise in the area of sleep medicine is limited in New Zealand. See Appendix 11 for a list of current sleep service providers (Gander, 2003). General practitioners play a pivotal role in identifying potential OSAS among professional drivers, as they provide adequate information and health advice. The issues of resourcing for this are two-fold: (1) education and training given to medical doctors on sleep disorders is limited (Gander, 2003), and (2) increasing the human resources of medical physicians specialising in sleep medicine, although this is a peripheral issue (Neill, Taylor, & Whyte, 2002). The present study could be a catalyst to improve the medical training and education of sleep disorders among GPs so the symptoms and risk factors of OSAS are effectively screened for and managed appropriately.

Health providers

As previously mentioned, the current health system in general would struggle to meet population needs in the diagnosis and treatment of OSAS (Harris, 2003). Currently, there are no specific services that could meet the needs of professional drivers. Guidelines established by LTNZ for medical doctors when dealing with drivers exhibiting EDS and OSAS symptoms is less than sufficient. There is no information on how GPs manage professional drivers exhibiting OSAS symptoms, and in particular, the use and compliance of the LTNZ guidelines is not monitored or reported elsewhere. This makes it impossible to comment on resourcing needs. Screening for OSAS by occupational physicians employed by the transport industry may be an avenue to eliminate drivers slipping through the net in the general health system. Further research is needed in this area, particularly at identifying how GPs recognise and manage patients exhibiting OSAS impairments.

Māori and Pacific drivers reported higher symptoms of OSAS and risk factors. Under the two aforementioned goals of strengthening public health, appropriately designed and supplied resources for reducing the health risks of these ethnic groups should be provided. Further research could examine whether the need for screening programs of specific high-risk groups such as taxi drivers would be more cost-effective for companies and drivers alike. This fits well with the public health notion of developing new service providers (e.g., occupational physicians) by considering a range of services to meet the needs of this group.

Workforce

This term refers to developing the knowledge and skills of the workforce. Studies have found OSAS to be highly prevalent among commercial drivers (Howard et al., 2004; Hui et al., 2002). Therefore, workplace educational programs integrating sleep hygiene and sleep medicine would be of benefit in improving the health and safety of drivers and passengers, and the industry as a whole (Pierre, 2005).

Information and research

This refers to providing evidence-based research. The current study provides a crude representation of the pre-test risk (15%) of OSAS among taxi drivers, however further systematic surveys are necessary to inform policy-makers and regulators about the need of prioritising OSAS as a public health and safety concern. The study's low response rate may be indicative of the lack of ethnic and taxi cultural sensitivity, therefore research should incorporate translated and occupational-relevant questionnaires in order to obtain an accurate estimate of risk.

5.6 Directions for Future Research

This study provides the first estimates of OSAS symptoms and risk factors, accompanied by a pre-test risk of OSAS for professional taxi drivers in New Zealand. Further study with accurate estimates that are more representative would better inform transport regulators and drivers of the actual risk. The current study is an important starting point that can inform health service planners and the transport industry of the potential size of OSAS as a health and a safety problem for drivers and passengers.

Various other practical issues that need to be considered for future research in this area include:

1. A taxi driver's database be established and used as a systematic sampling frame for research. This way an accurate dominator can be used to provide representative prevalence estimates.

2. A prospective study involving both a screening tool and objective diagnostic tools such as polysomnography or the MESAM IV to accurately define the prevalence of OSAS among taxi drivers.

3. The impact of OSAS on drivers and their families' lives should be examined, because this can inform candidacy compliance for treatment, and provide other information such as the impact on quality of life. This is important from a Māori and Pacific perspective, as family and cultural factors are integral to their health and well-being.

CHAPTER 6
THE FOCUS GROUPS STUDY

PREFACE

It is important that in this chapter that I begin with a preface to explain my position in this study, which is twofold.

In the first instance I was the primary researcher, and in this role I have tried to maintain independence in my research practice. In the second instance, I also have personal concerns regarding the health of taxi drivers. My parents have been taxi drivers for over twenty years, and I have observed the combined effect of shift-work hours and poor sleep hygiene taking its toll on them and on the fanau (my siblings and myself). For example, there was a change in their lifestyle focus from maintaining the well-being of fanau to the desire to earn a lot of money. I can remember in my high school years eating fast-food and takeaways every night for almost two years. This created the perception that my parents no longer had the time or effort to properly look after our health and well-being.

From my personal experience of the taxi culture and observing its effects on health and well-being, I was able to establish rapport with the drivers in each focus group. This approach worked well, as it appeared to influence drivers to be more open and honest about their personal experiences.

6.1 Background

This was the first time that qualitative methods have been used in sleep and in the New Zealand transport industry. Initially, the current study was rejected by a group of Wellington-based taxi company managers, because it was perceived as placing the taxi profession at risk of public and political scrutiny. Or the managers may have been concerned about outside scrutiny of their own activities. This rejection may have been a protective reaction of managers wanting to shield their drivers from losing their livelihood. Eventually, professional rapport was established through ongoing communication and by an educational workshop on fatigue management. Thus, the study was able to proceed.

Since in-depth background information on taxi drivers (qualitative and quantitative) was not available, hypotheses were developed based on the available literature (Banno & Kryger, 2004; Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997a, , 1997b; Machin & De Souza, 2004; Reuveni et al., 2004). They are:

1. Drivers' perceptions about health and safety are largely influenced by the need to make a living.
2. Drivers do not perceive sleepiness and sleep complaints as a *real* health problem.
3. Drivers do not seek medical assistance because identifying a health condition could jeopardise their employment.

These hypotheses suggest that barriers in accessing health care services may exist for taxi drivers, therefore identifying these barriers was considered a priority. In New Zealand, there are explicit public health strategies that aim to reduce inequalities in health between Māori and non-Māori (Ministry of Health, 1997b). A qualitative approach utilising ethnicity-based focus groups was deemed necessary and appropriate. Identifying the main issues, and gaining insights about drivers' perceptions was seen as a way to provide knowledge to improve the cultural appropriateness, effectiveness, and efficiency of health services for the diagnosis and treatment of sleep complaints among taxi drivers (Fitzpatrick & Boulton, 1994).

6.1.1 Methodology

The development of qualitative methodological approaches in sleep science can be described as emergent, but scant. A number of epidemiological studies have investigated the patterns and determinants of sleep-related health problems among professional drivers with or without OSAS. McKinlay et al. (1999) described epidemiological approaches and methods, such as questionnaires, as 'a good servant' that will do whatever it is asked, but seldom asks the questions why. Qualitative methods are an advantage when the more traditional scientific methods are incapable of addressing the questions of interest. Quantitative methods can be seen superficially as a focus on 'validity' as opposed to the 'reliability' of the research (Greenhalgh & Taylor, 1997). Although, qualitative research is concerned with limited cases, it should still be reasonably replicable for future comparative studies.

In public health, qualitative research is used to discover a population's subjective experience, rather than investigating what the 'real' issues or events might be (Dew, 2001). Additionally, it is important to understand 'why' people hold such beliefs (i.e., gain insight) (Ryan, 1996). For instance, public health is not just interested in the number of infants immunised in a population, but also how immunisation is viewed by that population (e.g., parents, other care-givers), thereby establishing possible effective ways to overcome any problem issues.

Focus groups

Focus groups are a particular form of qualitative research, and were employed in the current study. There are some notable features of focus groups that were important for this study. First, focus groups are able to draw out interactions between participants. This was seen as one of the most positive aspects, as this interaction provides insight into the participants' opinions, and the decision making process that led to these opinions. Second, focus groups are considered more reliable than other forms of qualitative methods. The group setting moderates extreme positions, and involves more opinions because of the semi-structured nature of the process. Thirdly, focus groups are useful in situations of power differentials. Setting up a group of peers allowed for a relatively natural discourse. Finally, focus groups are also well-suited for gathering information among minority groups, especially in the area of public health, as there are differences in health sector use and health seeking behaviours (McKinlay, Plumridge, & Daley, 1999).

The underlying purpose of the focus groups was primarily exploratory. This area has not been researched before using this method in the sleep research community, however its input has been strongly encouraged in previous transport research (Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997a, , 1997b). Focus groups were selected to provide insights that could not be found using any other research method. Intrinsic in the practice of focus groups is that they are a model of social interaction, and this could lead to problems such as intimidation, censoring, or embarrassment. Moreover, the interaction within the group was limited to verbal and non-verbal behaviours. Therefore, the information presented will be affected by social factors and this must be incorporated into the analysis.

Furthermore, an exploratory approach was deemed appropriate, because information about New Zealand taxi drivers was not freely available in the public arena. In addition, information on their sleep and work patterns, and the general health status of drivers was unknown. Therefore, findings from the current study would identify key issues and methods for future research.

The intention of this project was not only to make an important contribution to the knowledge-base of sleep research, but also to provide guidance for further industry-based research from a comparative viewpoint. In addition, it aimed to inform the debate among the taxi industry and policy-makers with regards to improving driver and passenger safety. The latter point is in line with the suggestion of Fitzpatrick and Boulton (1994) that "qualitative research methods in health care should be intended to convey to policy-makers the experiences of individuals, groups and organisations who may be affected by current policies" (p.107). Thus, the specific goals of the present study were as follows:

To identify factors that might prevent taxi drivers from seeking health care services for perceived sleepiness and sleep problems.

1. To identify whether there are different barriers to care for different ethnic groups (Māori, Pacific peoples and people of "other" ethnicities).

2. To provide insights that may explain how these barriers to care affect the behaviour of taxi drivers.

3. To establish an appropriate research approach for future research in the transport industry.

6.2 Theoretical Underpinnings

Research can be concerned with a number of different types of outcomes, whether it is predicting an outcome, understanding an issue, clarifying, or deconstructing the issue. Different goals lend themselves more naturally to certain theoretical traditions than others. Theoretical and methodological positions can become overly prescribed when used indiscriminately as a recipe for doing research (Southwick, 2004). Therefore theory choice is integral to the research process, because it clarifies and justifies the internal validity of the project (Southwick, 2004).

Two general and overlapping groups of theories were considered. Interpretive theories are described as how humans might interpret the world and information (McKinlay, Plumridge, & Daley, 1999). Methodological theories on the other hand, pay more attention to the research process or methods used to investigate the world (Jones, 1994). A brief summary of the selected theories for the current study is given, followed by an outline of how they were used in the current study.

6.2.1 Interpretative theories

Positivism

Positivism is the dominant paradigm in social research (Rice & Ezzy, 1999b). It focuses only on that which is observable. Observations that fit with predicted outcomes are said to 'verify' the underlying hypothesis. This theory employs a *'deductive'* method to test a hypothesis. If a hypothesis is applied to an experimental set-up, a prediction can be generated and tested. This means that research under a positivist paradigm is hypothesis based, and interested primarily in falsifying or verifying the hypothesis.

Deductive and Inductive Logic

Deductive and inductive logic are methods of reasoning used to reach a conclusion. The difference between the two is that, in deductive reasoning analyses occurs from a 'top-down' approach, and the data analysis confirms or rejects the hypothesis of interest. Inductive reasoning on the other hand can be seen as a 'bottom-up' approach, whereby data analyses can detect patterns to formulate a tentative hypothesis (William, 2002). Deductive logic is a more narrow approach and concerned only with testing the hypothesis, whereas inductive logic is more open-ended and exploratory.

Phenomenology

Phenomenology is based on the assumption that everything experienced by any person is always directed towards something. Thus, what we experience is based on our own intentions and interests (Rice & Ezzy, 1999a). Phenomenology is concerned with the study of lived experience, how the world is viewed and experienced. (van Manen, 1990). Phenomenology attempts to reveal and describe the structures of a lived experience, by asking questions like, *'what was the nature of the experience?'* Moreover, phenomenology illustrates meanings by describing peoples' experiences (van Manen, 1990). The goal of phenomenology is essentially to 'enlarge and deepen the understanding of the immediate experiences' (Goulding, 2002).

Hermeneutics

Hermeneutics is the attempt to understand and interpret texts (Rundell, 1995 in Rice & Ezzy, 1999; Jones, 1994). In the current study, 'text' has been generalised to mean any kind of human communication exchange, for example, conversation and gestures. Phenomenology has shown that people have intentional states, but hermeneutics points out that they have an historical aspect as well. Using hermeneutics, portions of the text must be recognised as part of the whole, and the whole text must be situated in its relevant context. As the researcher, there is a degree of effort required to achieve an *empathetic* understanding by positioning oneself as one of the participants in the focus group discussions. This allows the participants' perspectives to be better understood and appreciated. An obvious problem with this approach is that the researcher is second guessing the text, and indeed the researcher can never really know the background of the text as well as the focus group participants (van Manen, 1990).

6.2.2 Methodological Theories

Grounded Theory

Grounded theory is based on the notion that theory or theories (i.e., hypotheses or conclusions) arise from the observed data based on the participants' experiences, accounts and the context. Therefore, it is a methodology aimed at the *emergence* of a theory. This is in direct contrast to a positivist approach which focuses on the deductive testing of a hypothesis, which neglects the process of how hypotheses are founded. Researchers who immerse themselves in the analysis of qualitative data can generate a theory by creating definitions and making repetitive comparisons. Grounded theory can be applied to any form of non-structured material (e.g., field-notes, interview transcripts) (Henwood & Pidgeon, 1995). Moreover, grounded theory utilises the inductive, emergent methods. It acknowledges that sometimes there is no pre-existing 'grand theory', however it assumes that there is some kind of explanation hidden somewhere in the data (Henwood & Pidgeon, 1995).

6.2.3 Theoretical framework of the study

The principle theoretical framework used for the focus groups was *phenomenology*, recognising that true insight into a group is not achieved through a response-based study such as a questionnaire. The current study, however, used a specific technique. Focus groups were a means by which drivers could share their thoughts as a result of their experiences. Focus groups were used on the premise that it is important to observe how the drivers interpreted sleep-related health and their actions. The group environment produces a snapshot of their belief system, and it also reveals cultural structures and evolving thought processes. Additionally, rather than trying to identify the 'true' issues, the researcher was interested in how taxi drivers actually perceived the issues. The outcome of interest was to generate ideas for recommendations for use by public health planners, transport policy-makers, taxi companies and drivers, and for health promotion strategies.

Methods

The focus groups were semi-structured, in that written questions were used, but the researcher allowed exploration of these questions to range freely. This produced hypotheses as the text was analysed. As subsequent groups were conducted, this caused questioning to become more specific in later groups to further probe the issues. Therefore, an *emergent process* was followed. This process limited the issues considered by the groups to those of interest to the study outcomes. Furthermore, as the group conducted its own discussion the emergent process was dynamic and fluid, thus adapted to the needs of the study. The researcher played a role in this process by steering the discussion in various directions in order to cover some common themes found in previous groups. Therefore, the involvement of the researcher took on a *positivist* stance, because she directed the focus group discussion to fit the outcomes of the study, thus ensuring sufficient evidence was obtained.

Findings (Analyses)

Grounded theory is useful in the current study, particularly where the data are disparate, and not easily pigeon-holed into preconceived themes or ideas. The focus is to invent the categories that will fit the data. In this way, a more accurate representation is achieved (Charmaz, 1994). Of particular relevance is the idea of focussed conceptual development, which involves the exploration of a few relevant issues to considerable depth (Henwood & Pidgeon, 1995).

The principle starting point for analysing the focus groups in this study was *hermeneutic-phenomenology*. Hermeneutic-phenomenology disciplines can help inform the analysis of the texts, recognising that analysis must be contextualised appropriately, rather than seen as an atomistic process. This contextualisation is not a transparent process, but one steeped in meanings mediated by the cultural norms presented in the groups. It should be noted that how far these notions were taken was the researcher's decision. The more the analysis involves the deconstruction of what is actually said, the deeper the analysis will be, however, this appears to be at the cost of a progressively more subjective and therefore less reliable picture. With this in mind, the level of analysis depended on the objectives of the current study.

Interpretation

The current study's interest in hermeneutics is that it utilises the life-cycle approach to explain actions and experiences of the participants. That is, interpretations of both past, present and cultural factors continually influence each other in every day life. This contextualised approach fits in well with obtaining the objectives of the present study.

The discussion of the findings will be from a positivist perspective, utilising both inductive and deductive methods to give some answers and ideas predicting possible outcomes and goals. This will also be flavoured by the fact that research will be presented from the insider's perspective. Nevertheless, the information obtained from this project was intended to be used in an effective manner, and therefore needs to be presented in a comprehensive and reliable way for use by public health planners and policy-makers for example. This was not simply an exercise in understanding the mind of a taxi driver as an end in itself.

CHAPTER 7
THE FOCUS GROUPS STUDY: METHODS

7.1 Ethics and Cultural Issues

The focus group study was approved by the Wellington Massey University Ethics Committee for the period June 2004 to September 2004 WGTN Protocol 03/124. All participants were sent an Information Sheet and a Consent Form outlining the focus group procedures (Appendix 5 & 6 respectively).

Dr Margaret Southwick was invited to provide advice and comment on the cultural appropriateness of the research protocol to ensure cultural sensitivity, particularly as the plan was to separate focus groups by ethnicity. Dr Southwick advised that such an approach would allow for a more 'comfortable' and 'open forum' for participants of the same ethnic group to voice their perceptions.

All data will be kept securely for ten years at the Sleep-Wake Research Centre in CD-ROM format as required by Massey University Human Ethics Committee policy.

7.2 Focus Group Planning

7.2.1 Location of focus group sessions

The focus groups took place at the Research School of Public Health, Massey University, Wellington campus. In the original proposal, the focus groups were to be held at the New Zealand Taxi Federation rooms. However, the decision to host the groups on campus ensured participants could maintain a degree of confidentiality. All focus groups took place at the beginning of the working week, in the late morning (1000hrs) or early afternoon (1330hrs). This schedule was suggested by the participants, as during these time intervals they had fewer customers, making it easier for them to attend.

7.2.2 Constitution of the focus groups

Initially, five focus groups were planned according to ethnicity (New Zealand European, Māori, Pacific peoples, Asian, Other ethnic groups). However, due to the limited number of consenting drivers in these specified ethnic groups, the number of groups was reduced to three. The final groupings were: (1) New Zealand European, (2) Māori and Pacific peoples, and (3) people of "other" ethnic groups. The Māori/Pacific peoples groups were combined because a number of Pacific drivers who had indicated their willingness to participate did not confirm their attendance for a focus group session. The final numbers of taxi drivers per focus group were:

1. New Zealand European: 10
2. Māori/Pacific Island People: 7
3. People of "other" ethnicities: 8

Homogeneity was addressed by the common factor that all participants were of the same occupational group, with each driver having at least one year driving experience in the taxi industry. Homogeneity allowed for a free-flowing conversation about personal experiences and feelings that would be expected in a good focus group (Rice & Ezzy, 1999b). Although some effort was made to recruit more women, the preponderance of men in the focus groups reflects the demographics of the taxi industry.

7.2.3 The Role of the Researcher

Each focus group involved two researchers: the main researcher (the author), and an assistant researcher (note-taker, assistant). Both researchers had no previous experience in social research methods, however they were guided and advised by two mentors who were skilled in qualitative research methods (Gillings, 2004; Southwick, 2004). The role of the researchers in the focus groups was to observe the 'perceived' world of the participants intimately, and at the same time to remain objective and analytical. In addition, the researchers accumulated and analysed the data in a coherent manner that would describe and explain participant behaviours. It could be argued that the researchers themselves were research tools, as they guided the discussion as appropriate, and noted behaviours and comments that were considered worthy of further exploration.

7.3 Recruitment

Participants for the focus groups were recruited via the Questionnaire Study. Only those drivers who responded to the questionnaire, and returned a consent form were eligible to participate in the focus group study. A total of 125 participants from the pilot study and the current study consented to participate in the focus group study.

7.3.1 Selection criteria

All consenting participants were prioritised on the basis of the following criteria:

1. **Sex:** Females were prioritised as they represented only 10% of the study sample. All female volunteers were invited to participate in a focus group, according to their ethnic group.

2. **Ethnicity:** All volunteers who correctly specified their ethnic grouping from the survey questionnaire.

3. **Pre-test risk of OSA:** Volunteers were ranked from highest to lowest based on their pre-test risk of OSA (RDI$\geq$ 15)[22]. This score was derived from a multivariate predictive model created by Mihaere (2004) based on the survey questionnaire study. Recruitment began with those drivers with highest pre-test scores until 10 people per ethnic group were successfully recruited.

4. **Diagnosis of OSA:** All volunteers who answered Question 15 of the survey questionnaire as having a previous diagnosis of OSA were also invited to take part in the study.

[22] OSA was defined as having at least 15 respiratory disturbance events (apnoeas) per hour of sleep (RDI$\geq$ 15) (Mihaere, 2004).

5. **Attempted access to health service:** All volunteers who answered Question 16 of the survey questionnaire as having a perceived sleep problem and having tried to access help for it were invited to participate in the study.

Participants who consented and fitted the above criteria were contacted by telephone and personally invited to join a focus group, according to their self-identified ethnic grouping. Letters of confirmation were sent to participants outlining the focus group procedures, their rights as participants, and session dates and times. Participants were then reminded one week before the session date by letter, and then one day preceding the focus group by telephone. This procedure was carried out in order to ensure participant retention (see Appendix 12).

7.3.2 Focus Group Incentives

All participants were given a $50 petrol voucher. This token was deemed an appropriate, yet modest compensation for drivers who could have worked during the time that the focus groups took place (Rice & Ezzy, 1999b).

7.4 Research Tools

7.4.1 Digital Voice Recorder

An Olympus DM-20 digital voice recorder was used to record the focus group discussion. The device has two stand-alone microphones and a 128 MB memory, making it suitable for recording long group discussions lasting up to four hours. The DM-20 model also has an event marker that the assistant researcher pressed to identify pre-specified issues or events. Examples of such events included important issues discussed, or non-verbal behaviours that were noted down to provide contextual meaning. The participants were notified about the use of a voice recorder via the information sheet. The group discussions were downloaded onto the researcher's computer and transcribed using the Olympus DSS Player 2002 software.

7.4.2 Observation notes

Due to simplicity and low cost, observation notes were also used as a means of data collection. Both researchers took notes on verbal and non-verbal communications, and other communications that occurred outside the group discussion. In the transcription phase, the researcher referred to these notes to obtain added information for semantic purposes with regards to the social context.

7.4.3 Social Activities

In order to reduce any social barriers to interaction, social activities were set up for participants to promote an easy transition from introductions to the focus group session. As an example, name tags were provided and light refreshments were offered upon arrival.

Timetabling is important for a successful focus group. Greenbaum (1998) suggested that the best time to feed the participants is at the beginning, as this eliminates any clutter on the table. It also allows participants to interact with one another, and with the researchers. Morgan and Krueger (1993) supported having the refreshments before the start of the group discussion as it aids in creating a relaxed atmosphere and reduced social pressure for conformity, which can strongly influence information sharing during the group discussion. More importantly, because the participants were from competitive taxi companies, this social activity helped to create a safe atmosphere for drivers' self-disclosure without feeling intimidated.

Pipe-cleaners were provided as another social activity. This was merely an activity for participants to occupy themselves during the discussion, and to enable them to feel comfortable in a group setting and freely engage in the discussion as appropriate. Of note, this resource was utilised well by the participants.

7.4.4 Focus Group Interview Techniques

The focus groups were conducted using several semi-structured questions. However, exploration of these questions was allowed to range freely. Issues raised in earlier groups were added for further investigation in later groups. In this way, the emergent process was followed, although the initial questions were more heavily predicated on the literature than would usually be the case. The researchers' involvement in the groups was probably more active than expected.

The technique used to elicit information from the participants can be aligned to *'nominal group technique'*. This strategy encourages the participants to concur upon solutions as a group (Morgan & Krueger, 1993). Nominal group technique precludes the overriding conformity of ideas. The success of this technique is a direct result of a good facilitator who endorses a safe, open and tolerant atmosphere so participants can share a range of experiences and feelings. As previously mentioned, the researcher maintained a high degree of dominance over the participants. The reason for using this technique was to minimise the interaction between participants so that a wide spread of *'individual'* ideas and experiences were shared, and to minimize tangential discussion.

7.5 Focus Group Process

Each focus group lasted two hours. At the beginning of each group discussion, participants were briefed on relevant preliminary results from the survey questionnaire study. This provided them with some insight into the study to set the context for the direction of the discussion. They were also re-assured that they would not be personally identified as each person was given a 'pseudo-name', and that any information would be used in the most respectful and confidential manner.

The participants were then asked to individually write down their feelings and experiences. This process was important, as it assured participant authenticity, and it was the best way to minimise participants from being influenced by other's ideas or feelings (Greenbaum, 1998). Next, each individual read out their answer to each question, which was transcribed onto a whiteboard. In doing this, common and differing experiences and ideas were easily identified, which were then used to prioritise and initiate the group discussion.

The researcher set the discussion context by making the following statement:

"Think of a time when you were working [as a taxi driver], and you felt really tired, fatigued, not refreshed, and sleepy on the job, now consider these following questions" (refer to Table 7.1).

Table 7.1 Questions and Prompts for Focus Groups

Questions	*Prompts*
Question 1: How did you feel working in this situation?	(a) Think about 'what is good' working in this situation as a taxi driver, or 'what is bad'? (b) Can you give some examples of daytime sleepiness/tiredness, and how it affected your work? (c) Described what happened to you? (d) If you haven't had this experience, what would be your attitude / opinion?
Question 2: Were you worried about how you could perform as a taxi driver?	(a) If you haven't had this experience, what would be your attitude / opinion? (b) You have to make critical decisions whilst driving, and think about public safety as well as your own. Do you consider this point at all while driving tired or feeling sleep?
Question 3: If you were worried, what did you do about it? Were there any cultural clashes that stopped you from getting help?	(a) Did you go and get help? Where? Lead on from discussions. (b) How did you get help? Lead on from discussions. (c) Why did you go there? Lead on from discussions. (d) Why did you not get help? Lead on from discussions. (e) If you were working for someone else, is your employer sympathetic to your problems? Needs?

Table 7.1 shows the prompts employed to aid the participants to elicit past or recent events observed or personally experienced. These questions were not piloted among taxi drivers due to restricted funding and resource availability.

7.5.1 Transcription and Analysis

The data collected from the focus groups were independently transcribed by the researcher and the research assistant. The transcripts also contained emotive language and non-verbal communication that occurred during the session. Transcripts were then sent to participants for authentication, that is, participants corroborated that their transcript was a true and accurate record of the group discussion. It should be noted that participants could only modify or verify their *own* comments and non-verbal behaviours, and not those of others. All participants returned their transcripts with no amendments or comments.

In the analysis, the researcher read over each group transcript thoroughly whilst listening to the digital voice player several times. This allowed for complete immersion in the group discussion. Emergent themes were identified using a general inductive approach because the study was exploratory, as well as a deductive approach but to a lesser degree because hypotheses were previously outlined. Thus, grounded theory was the primary approach of analysis.

The themes were developed from the questions outlined in Table 7.1. Based on the grounded theory approach of constant textual comparisons (Glaser, 1995), themes that arose from Question 1 came from the texts addressing drivers' feelings, emotions, knowledge and awareness of sleepiness and its effects on driving or work performance. Themes from Question 2 came from texts addressing concerns about their own functioning (or that of other drivers) when they felt sleepy or fatigued. Finally, themes from Question 3 were related to perceptions that prevented drivers from accessing health care services and advice. The initial analysis identified eight dominant themes, which were subsequently merged into four main themes. Thereafter, the researcher further compared the texts within each main theme and subordinate themes were then coded and filed as appropriate. Coding and filing ended when no new subordinate themes could be identified (i.e., saturation). Overall, these themes were developed into rationales explaining the existence of barriers to care for taxi drivers. The research assistant also read through the texts independently and identified themes similar to those identified by the primary researcher. The actual names of the themes were agreed upon by both the researcher and researcher assistant.

The main themes were common across all focus groups. The themes were re-analysed by both the researcher and research assistant independently to maximise consistency of the themes. However, each ethnic group revealed nuances to the main thematic issues, which were related to personal experiences. Therefore, the findings for each group will be presented separately in the next chapter. The themes form the main topics under which the research findings will be presented, along with transcript excerpts to illustrate the points of discussion.

CHAPTER 8
NZE FOCUS GROUP: FINDINGS

8.1 Demographics

Ten participants were recruited for the New Zealand European group (NZE group), based on the selection criteria described in the previous chapter.

Table 8.1 describes the basic demographic information about each participant. To minimise the chances of participants being identified, other socio-demographic information were not collected. It also summarises the variables considered in the multivariate model used to estimate a pre-test risk of OSA. Some of participants were at significant pre-test risk of OSA (cut off=0.30). However, they were not informed prior to the focus group session of their pre-test risk scores. The drivers were informed subsequently and encouraged to seek help from their GPs, including being offered a letter of support explaining the results.

Table 8.1 Demographic Information, New Zealand European Group

	Sex	*Age*	*Years Driving*	*Snore Always*	*Neck Size*	*Observed Apnoeas*	*ESS>10*	*Pre-test risk*
Martin	male	66	30	yes	43cm	yes	yes	**0.770**
Josie	female	36	8	no	37cm	no	no	0.012
William	male	53	5	yes	46.5cm	yes	yes	**0.842**
Georgia	female	62	20	no	38cm	no	yes	0.069
Nigel	male	57	3	no	44cm	no	yes	0.251
Annabel	female	56	28	no	35.5cm	no	no	0.017
George	male	54	6	no	44cm	yes	no	**0.421**
Philip	male	59	7	yes	45cm	no	no	0.291
Gary	male	47	8	no	46cm	yes	yes	**0.614**
Michael	male	62	11	no	46cm	no	no	**0.306**

As can be seen from the above table, three females participated in the focus group from a total of 16 invited drivers (6 of the 16 were women). As expected, the pre-test risk scores showed the majority of males in the group had a high probability of OSA. From the number of years driving, it is clear that these participants were 'experienced' taxi drivers. There were four main themes, they are: (1) sleepiness as a perceived safety risk, (2) personal demands, (3) industry demands, and (4) driver avoidance.

8.2 Theme 1: Sleepiness as a Perceived Safety Risk

This theme describes how the drivers see sleepiness as a possible risk to their health and passenger safety. It is made up of three categories: (1) drivers' experiences of sleepiness and their underlying concerns, (2) the role of shift-work in inducing sleepiness which affects driving ability, and (3) drivers' views about the possible causes of sleepiness.

Personal experiences

Everyone in the group had encountered sleepiness whilst driving or while at work. The discussion indicated that drivers who reported *sleepiness* were aware of its impact on their work behaviour. However, they did not know or understand whether sleepiness was a health problem that required further assessment, whether it could be treated, or what caused it.

Martin stated:

"...I'm interested in ... whether there is a cure for it ... coz I do know that I've felt it myself ... that in the middle afternoon I can feel my body shutting down ... you actually feel it ... your body just wants to shut down ...I don't know if anyone has that feeling, but I know I've had it ..."

George said:

"...I'm not sure whether that's a sleep disorder or normal ... I'm here to see if there are danger signs that I ought to be aware of ... I'm on the wrong side of 50 [years], I've only got 50 years left and I want to make the most of it ..."

Michael added:

"...I would just like to see if I can get a better sleeping pattern. I have experienced what you do Martin, all of a sudden ya just want to go to sleep, so ya best to ah go home or get out of the car and go for a walk..."

Martin, George and Michael expressed genuine concerns about sleepiness. They indicated uncertainty as to whether sleepiness was within normal limits given their age, or whether it was symptomatic of a medical condition.

Other drivers concurred by voicing their own experiences of the effects of sleepiness on their driving.

William said:

"...when ya get tired, really tired and ya near the end of ya shift, ya start to see things... flashes of light, like say a light flashes at you or something that makes you feel that something's coming at you like it's going to hit you ...just momentarily".

Other drivers added:

"Black dogs"

"Yeah flashes of light"

"...missed turns"

"running a red light"

"sliding off the side of the road"

"having to ask passengers where they were going again!"

These examples showed that driving behaviour worsened with increasing sleepiness. However, it is not just the personal experience of sleepiness that was identified by the group. Two women in the study spoke of their husbands' (also taxi drivers) sleeping habits that had an impact on their own quality of sleep.

Josie stated:

"...yeah like Martin I want to get [something] out of this group ... but something that's really interesting coz my husband has exactly the same problem that he (Martin) does, sort've like 2 or 3 go into shut down mode. He's a night boy ... so I'd really like to talk more about him."

Later Josie explained her personal situation:

"...he snores like a gorilla (everybody laughs), well I have to kick him in the back 90 times and I just have to go in the other room just to get some sleep..."

Georgia added:

"...similar to (points to Josie) see if I can help my husband to go and get tested for sleep apnoea, coz I reckon he snores from the time he hits the pillow to the time he wakes up. I have to wear ear-plugs ... I don't know what he's like out in the taxi but I do believe he goes to sleep on the airport rank ... I growl him to get out and walk. But he's been a lot better since he's been going to the gym, but he still snores...that won't stop, so I don't know what else, whether it's worth looking at [sleep apnoea as a possible cause].

Even though these women were primarily interested in getting help for their partners, their statements showed how their partner's sleeping habits affected *their* sleep quality, because they had to modify their own sleep habits (e.g., wear ear plugs).

Along similar lines, Gary spoke of his personal experience with OSAS when he used to snore, and reported family members' concerns.

Gary said:

"I don't snore anymore, I used to snore quite loudly ... they [referring to family] used to close doors on me at home. I've had an operation on my throat and nose so I don't snore anymore. But I still get that afternoon between 1 and 3, I have to sit down and blob, then 3 o'clock comes I'm out on the road."

Shift work and sleepiness

As the majority of drivers in this focus group were experienced drivers, they were able to provide accurate insights on work patterns in taxi driving, and how it impacted on their health and safety. In William's experience:

"... I actually slid on the road about a hundred k and took the bloody hub cap off and pulled over ... sort've survived it. I had no passengers, I was going to work and then suddenly realised this is ridiculous and cut my hours in half ... I just wasn't used to the industry and I didn't realise the consequences of what I was doing ..."

William's experience illustrated how the long work hours in his early taxi career almost resulted in an accident. The near miss incident was referred to his lack of tolerance of the long work hours in the taxi industry. He could perceive the risk that sleepiness had on passenger safety. From this incident, William realised that the financial benefit was less important, and for the sake of his health and safety he reduced his hours. He later told the group that his partner also played a significant role in his decision to reduce his work hours.

Drivers with previous experience from other industries that involved shift-work shared their views about sleepiness.

George said:

"...before I got into taxi driving I was in pubs for ... about 18 years working shifts all the time...but as a taxi driver you can drive down the road and end up 3 miles down the road ..."

Josie finishes George's statement:

"...Yeah you sort've et into automatic pilot and this is when you're already half way there and suddenly you come to and think where the heck are we going? (laughs)

Nigel added:

"I've driven a stage coach (bus company) – it's actually easier than driving a cab coz you're on the go all the time."

Drivers referred to the point that other types of shift-work occupations (bar-work, bus driver) differed to taxi driving. Their comments implied that taxi driving was less labour intensive but dangerous, because the amount of time waiting for jobs takes it toll on vigilance and alertness.

Driver perceptions of what causes sleepiness

Drivers rationalised possible causes of sleepiness. Some examples follow.

William says:

"...if ya sitting down, ya wouldn't be getting enough oxygen to the brain anyway, coz you're not breathing, you're not pumping you're only breathing passively ... I think that's one of our big problems."

Gary says:

"Yeah it's lack of exercise"

Annabel adds:

"when I get tired ...I actually feel quite scared ... I've never had an accident ... but I put it down to just having late nights..."

The comments above link back to the nature of their job. That is, taxi work is sedentary and there is little opportunity for physical activity at work. Embedded in these comments were the tension between health and safety and the nature of taxi driving.

Due to the experience of drivers in the group, they all agreed that taxi driving was no longer considered a 'job' independent of other daily activities. William's statement was a good example:

"I think some people think because of their circumstances have to work pretty hard. In my situation I don't have to these days...but I'm lucky...ah my wife tends to control me and that, I wanna do more hours and she says no only do these [hours]. It makes more sense into a lifestyle, I think I'm started to go that way where I've turned my job into a lifestyle."

Group: All agree.

The drivers acknowledged that there was a need for balance between driving enough to gain a reasonable living, and driving too much, which could threaten driver health and passenger safety.

Drivers compiled a list of coping strategies they thought would be conducive to reducing sleepiness, thus reducing the risk of accidents:

Annabel suggested:

"sort've jump up and down, walk around and take some deep breaths if its too early in the day you just got a do it"

Nigel added:

"If the weather's fine I always take an hours lunch break and I always get at least a half walk more if I can ... but that still doesn't affect the way I feel ... makes no difference to how I feel in the day."

Josie stated:

"Maybe I will try 'P' next time [Group laughs]

Philip suggested:

"...have a good night's sleep the night beforehand ... before or straight after your shift".

Despite this list, when asked by the researcher, no drivers had thought about seeking help from a medical practitioner to rule out the presence of a medical condition that might underlie their fatigue. However, access to medical care prompted the following reaction:

Gary said:

"If you're saving for a goal, or you're not working for somebody and you feel you're obliged to work ... you tend to put in the hours that maybe you can walk away from if you weren't under so much pressure"

Gary's statement implies that health concerns are not a priority due to the need to meet financial targets. Other drivers agreed with him.

8.3 Theme 2: Personal Demands Inhibit Accessing Care

This theme considers personal demands that drivers perceived cause tension between their work and lifestyle. It is closely linked to the first theme, in that the effects of sleepiness influenced drivers' ability to meet their own personal needs. Financial security was the key category under this theme, with a sub-category called the 'taxi driver culture' that appeared to mediate the drivers' ability to obtain financial security.

Financial security

In the current study, financial security was arbitrarily defined as the achievement of the financial targets set by taxi drivers.

Financial security is motivated by an established taxi driver culture, which is defined as an attitude driven by factors such as family, material expectations, mortgages or personal motivation, not by the demands of society in requiring a service. An example of this taxi driver culture is given below:

Gary said:

"I know how much I need to make per week ... got that right down to a fine line so I worked out how much I have to make per day ...and um if I don't get to that level, then yeah I stay out until I try and get to that level."

It is evident from Gary's statement that the taxi driver culture is to 'work to live and live to work'. But it is clear that meeting financial goals can be an onerous task for taxi drivers. A different example is given by Josie.

Josie said:

"...I don't like feeling sleepy when I'm at work coz I'm at work to work and not to sleep ... but as the other guys said, if I'm financially desperate, I'll drink a can of V and push myself".

Josie made reference to 'pushing' herself to her physical limits in order to achieve financial security. Although, Gary does not blatantly state it, he too indicated this notion through his comment, but Josie's statement insinuates sleepiness as a perceived risk is easily overcome by taking legal stimulants such as an energy drink. This demonstrated that Josie was forced to weigh up the risks of sleepiness versus the financial benefits of continuing to drive.

Part of the taxi driver culture is to manipulate the system so that the work schedule fits in with drivers' personal 'need' such as obtaining income to pay for bills and the running costs of a taxi business. The conversation below is an example:

Gary said:

"...yeah um ... if I need to work and sometimes you ah haven't had a good night, just stay out longer and ah yeah I stay out..."

William added:

"...certain times of the month and everyone will agree with me here, that certain times there are certain bills that you have like ya GST comes, your insurance on ya car,

ya levies ...all that sort've comes right at a particular week ... you really have to go hard out."

George said:

"...oh goal setting..." [the whole group laughs in agreement]

This suggests the culture among drivers endorses the behaviour to continue working in order to achieve financial targets, even when this means working longer than the regulated driving hours. On the other hand, personal 'wants' in this context was defined as the desire to continue working when it was not legal or necessary.

William said:

"You don't make any more ... oh sometimes you do ...but it seems to be around about the same for the same amount of hours ... but its hard it's bloody hard to keep to that ... you know the greed and that..."

Gary added:

"Yeah the taxi driver greed yeah ... [you think] oh I wonder if he's going to the airport?

Other drivers: agreed by nodding heads and shaking heads in disapproval.

This conversation indicates a tension between drivers' needs and wants, both of which can lead to very long work hours.

8.4 Theme 3: Industry Demands Inhibit Personal Self-Care

This theme is the most important explanatory theme. It demonstrates that drivers believe they have lost the ability to look after themselves because of the growing pressures of the industry, such as not taking breaks, or keeping to log book times. Industry demands were defined as the political and social context that prevented drivers maintaining good health, and promoted poor driving habits. Because the industry is competitive, drivers felt obliged to work longer hours, sometimes outside regulatory limits, in order to earn a living. This theme is embedded in a political context, namely, deregulation of the taxi industry in 1989, which resulted in a significant change in the working conditions of taxi drivers. This change saw a new regime of unlimited drivers entering the taxi industry. There are two main categories under this theme: (1) the impact of deregulation: drivers explain why they exceed the regulatory limits due to the nature of the current state of the taxi industry, and (2) working conditions: drivers discussed the limitations the industry places on them.

The impact of deregulation

It is clear from the above themes that drivers do perceive sleepiness as a safety risk, yet the incentive to continue working is the need to meet financial targets. Presumably this theme goes deeper than just attaining the financial targets. It goes back to the historical context of this industry and the consequences of regulatory changes over time.

George said:

"...because of the intermittent nature of our job ya can't sit for a long time – ya tethered to the car with respect to getting work. We're on a computer dispatcher and if you don't respond within 7 seconds the job will find somebody else."

All the drivers agreed with George's statement. Previous to computer dispatchers, most drivers would receive jobs via a radio dispatcher, and jobs were easier to come by. Now it seems that with computer dispatchers, jobs are given to those on the ranks on a 'first-on-first serve' basis. This is the 'intermittent' nature of the work that George is referring to. Thus, one reason that drivers feel they have to continue working is that the communication network system that regulates passenger services reduces drivers' flexibility in getting work and meeting financial targets.

Working conditions

Drivers outlined the working conditions that they perceived to result in sleepiness, which in turn lead to unsafe driving practices.

Nigel said:

"...I mean it seems to me there are 3 issues ... the legal log-books requirements allow, allow you to work when its unsafe to work. Um that's um the fact of the change

in the regulation means there's more cabs hire than the main income so therefore your more compelled to stay out because you need the money ... and the fact that there is a lot of computer control means you can't leave the cab, whereas before you know you can get out exercise, talk to your mates and you call over somebody else' radio... so there are a series of things ... although I've only been in it for 3 years, when I look back historically and when I talk to other drivers, the industry's worse now than its ever been as far as I'm concerned."

Michael adds:

"... it's bloody ridiculous [if] you get out of ya cab ... ya get a ticket"

George agrees"

"Yeah by law you're not spose to be more than 3 metres away from your car or you get a ticket"

Nigel and others provided a summary of what the rest of the drivers think about the current state of working conditions in the taxi industry. He further commented that industry and government regulations place restrictions on drivers.

Nigel said:

"...when it comes to our industry, many of us have to stay out. The fact that we're tied to computers means we can't leave the car, take a break and come back. It will show that you've logged off so that means you go to the bottom of the line... just to come back on again coz it's a quiet period – you could lose another hour on top of the hour you've taken off..."

Group: Showed agreement by verbal interjections and head nodding.

Nigel went on to say:

"So you're absolutely compelled to being with ya car. The by-laws and other laws around Wellington and New Zealand also mean people have got other restrictions like putting ya car somewhere else, so all the time you're locked into a system that's actually detrimental ... it's happening because the whole industry is badly organised, and it's the controls in the industry are one of the major factors causing these issues...sleep apnoea makes it worst!"

Drivers believed that poor driving practices and sleepiness were the result of a poorly managed taxi industry. Nigel's comments infer that drivers in the current state of the taxi industry are at a disadvantage. Taxi driving is not like the average job where tea breaks are scheduled, or where people can have a break when they want. Taxi drivers feel tethered to their vehicles because they do not have a fixed income, and the computerised dispatcher system limits the freedom to log on and off, especially when financial targets are not met.

Log-book system

The log-book system was a method implemented to ensure driver compliance with regulatory work limits. However, drivers made a mockery of the log-book system because of obvious loop-holes. Drivers disagreed that the log-book system fostered safe driving practices.

George said:

"...I'm curious in finding out about other industries ... are they compelled to stick to a timetable ... you know bus drivers or truckies that have got to meet the ferries ... you know how they go and cope ... I think we're away from that and that's a bonus in this industry ... that is we are not compelled to a timetable or that type of thing ..."

Researcher: "Do you guys actually take breaks?"

George says:

"Well ... we make them up ... honestly speaking ... we make them up ... I haven't done anything since half past eleven so that can be the start of me break ..." (The rest of the group laughs and agrees).

This issue indicates a tension between the intent of the regulator and the behaviour of drivers. The introduction of log-books was intended to ensure compliance, fair, safe and responsible work habits, but the taxi drivers took advantage of the 'honesty policy' to meet their financial goals.

The flexibility of work demands can be seen by Philip's approach:

Philip said:

"um if it's busy I tend to be running on adrenaline sort of thing, so keep awake doing that ... and just take 10 minute naps when it's quiet."

The group laughed at Philip's comment and most muttered 'under their breath' in a pessimistic manner:

"Can ya do that?"

"Alright for some"

"What's that?"

"In the world of ... top commerce that's called a power nap and its approved of ... but that's illegal in the taxi industry"

"It's definitely discouraged"

"oh that's typical [taxi company name] for ya"

Philip's example of safe driving practice triggered a competitive reaction from other drivers. However, it appears that 'power-napping' is a controversial issue in the taxi industry. The confusion evident from other drivers' comments also suggested that drivers were limited in their knowledge and practice of efficient, safe napping. The topic of power-napping was not investigated in-depth because it did not fall within the study objectives.

The driving hours of taxi work also appeared to be a concern for drivers. One driver was also a Justice of thc Peace and he believed taxi work practices and the regulatory system prevented drivers from maintaining good health.

"Well, my partners a teacher and she works sort've similar hours and she'll come home at say round half past 5 or 6, she's up till 1am, and I'll gone to bed by then, and I get up about half an hour before she does ... we'll go and sit in front of the TV or gone to the pictures and we've gone to sleep ... at the end of the day the number of hours being worked in both cases are grossly excessive, and that s the case of a large number of groups in society now, the 8 hour day's gone out of the window. [Group agrees] "...the difference between her and myself is that for her to drive home is potentially unsafe. I'm in a car all the time, so it's potentially unsafe for me or my passengers for the large proportion of the time. For her, its unsafe for a short period of time, while she drives to or from work. So at the end of the day the process for both of us is almost the same."

8.5 Theme 4: Driver Avoidance Inhibits Accessing Care

This theme was defined as drivers ignoring their personal health and well-being out of fear of losing financial security. It also describes the issues underlying drivers' *attitudes* towards perceived health risks. Thus, it presents why drivers do not access health care services. This theme has three main categories: (1) embarrassment, (2) driver ignorance, and (3) ignorance of general practitioners

Embarrassment

The fear of going to the doctor was related to embarrassment about personal image and saving face.

Gary said:

"You know you don't want to hear it, you know, you're overweight and you look in the mirror everyday and you see this guy whose ah ... 'oh he doesn't look too bad' coz you've been looking at it for close to 50 odd years and all of a sudden someone turns around and says 'oh well you're quite overweight and you should do something about it' ... it's being told the truth"

Josie added:

"Its not that he's not satisfied with what the doctor's done, I think it's going and hearing the doctor's saying 'you're overweight'! So if [husband] could have something to stop his snoring he'll be more than satisfied, but he still doesn't want the doctors to say '[name] you're fat and ya overweight mate!' He doesn't want to hear that"

George and Josie's examples indicated that saving face and embarrassment prevented drivers from seeking medical help.

Male stoicism

The research assistant questioned the women in the group who had concerns about their husbands. Josie began with a similar description given earlier about her husband's snoring and how it disturbs the quality of her sleep. She further added that he had previously smoked cigarettes and that this was a habit that was hard to end.

Josie said:

"I don't think its so much as fear or scared to seeing the doctor...I think at the end of the day ... no offence to the male species here, it's just a little of the stubborn ole male pride there ... not so much I'm scared or that I don't want to – its just that"

Martin added:

"I don't think it's a fear, it's a feeling that you really can't do anything about it"

Josie's comments refer to her husband's habits and possibly to his personal attributes (i.e., stubborn). However she generalised this to the group by inferring that males do not seek help because it is in their nature to ignore the problem, to save face, and embarrassment. Martin's statement on the other hand suggests a lack of information for drivers about sleepiness and its potential causes. At the beginning of the group discussion, Martin complained of sleepiness and how it affected his ability to work. He also questioned whether help or a cure was available. From Martin's experience, it appears that he had little support or information available to him when he was initially concerned about sleepiness.

From a different perspective, Gary who has a mild form of OSA, spoke of his experience after the research assistant asked him: "So what was the thing that got you there in the first place?" Gary said:

"My wife, yeah she's a very forceful lady ... it [snoring] got so bad that ya know the kids used to complain as well so I just went to the doctor ... I can still remember as a kid coz I've always been fat. As a kid I had problems, I used to wake up you know ya couldn't breath and you had to force the air out before you could breath in"

Gary's sleeping problems stem back to his childhood, but eventually his wife and children's well-being was the motivating factor to seek medical help. His example supports Josie's previous statement about male stoicism and not seeking help, however Gary's family forced him into being proactive about his sleep concerns (e.g., *"wife- a very forceful lady..."*). Gary was not essentially concerned about his health, rather he gave in to his wife's nagging.

Driver ignorance

This category is defined by the impressions drivers gave regarding their perceptions of sleepiness and sleep complaints.

George gave an example of a driver who was known to the taxi community because he spoke openly about having OSAS, and his driving practices were often the topic of discussion among drivers.

George said:

"I met a guy with sleep apnoea and he's a bad case, I don't think I've ever met a guy like that ... because he'll be asleep as soon as he puts his key in, pulls up at the back of the rank, .. oh he's a big boy with a fat neck too!" [Group laughs]. "... but if a really bad case is still driving then the rest of us have got no worries at all!"

William added:

"Yeah, but how do you know that's causing a problem? Just coz he's gone to sleep?"

George responded:

"... he's aware of this problem, he speaks to us about it ... but to us he seems to drive alright, except that he's probably 30k in a 80k area...as soon as he's on the rank he's asleep before he turns his key ..."

Gary & Josie both say:

"I wouldn't want to get in the car with him then ... yeah he's dangerous"

George added:

"Well not car 12, coz he's either upset the passengers or the passengers have spotted him ..."

What is of interest here is the drivers' risk assessment. Although they would not drive with this individual, they take the attitude that if someone that badly affected by sleepiness can continue to drive, then they consider it to be normal to continue driving while sleepy.

Financial pressures versus health

Financial pressures appear to come ahead of health needs. George reinforces this point by responding to the researcher's question of why drivers should seek medical help.

George said:

"We can't do all these good things while we're at work, because we're tethered to our car. Um if I had spare time at home ...well I'd just jump in the car!"

Drivers are, however, aware of some health issues that they take seriously, but it seems the financial consequences demand higher priority rather than health consequences.

"The biggest things that worries taxi drivers are heart attacks while driving that to me is what I sort've gleaned out of everybody, you know you hear about the odd driver who's pranged his car and he's had a heart attack and he's ah off work for a minimum of 3 months and most of them don't come back ...

Josie adds:

"Yeah coz that would financially ruin you basically..."

The attitude that ignores the health and safety aspects of sleepiness was explored further.

Researcher:

"So you're not worried about being tired and making critical decisions while driving?"

Gary says:

"Nah because as a taxi driver you can drive down the road and ah end up 3 miles down the road and not realise how ya got there anyway."

Researcher:

"Oh sorry [interrupting] ... so does that give you a surprise ... you suddenly realised that oh it was just a sleep?"

Nigel adds:

"...I'm just becoming used to it ... so no it doesn't give me a surprise any longer..."

Ignorance of the medical profession

The researcher asked whether symptoms of OSAS such as daytime sleepiness or snoring were ever discussed at their medical check-ups, which are needed every five years when drivers renew their taxi license, requiring a medical certificate.

"Nah nah ...never!"

" ... can ya see that number on the back of the chart – yeah eye-sight"

"... quick check of the heart ... now and again you get a blood test for diabetes"

"... sometimes the doctor asks 'how do ya feel – oh yeah pretty good ... thanks very much."

Medical check-ups were carried out by the drivers' own general practitioners who evidently failed to recognise or even acknowledge sleep complaints as a potential indicator of serious health concerns. It appeared that doctors were more concerned with drivers' visual acuity, blood pressure levels, and tests for other medical conditions such as diabetes. But even these conditions did not appear to be routinely assessed as reported by drivers. The impression obtained from these drivers' experiences is that doctors are not well informed about sleepiness, other sleeping complaints, nor do they routinely assess symptoms of OSAS.

Martin added:

"Sleepiness, I've actually mentioned it to the doctor, but he just said well, you know, just part of the age group! ... yeah so he said, have you tried this and try that and nothing happened so you try first before you do anything about it ... so I tried snorex ... it tasted bloody revolting"

Researcher: "Did it make any changes?"

Martin responded:

"Yeah well my wife said it quietened me down a bit"

Researcher: "and did you do anything more about this?"

Martin said:

"Nah, I stopped taking the Snorex tastes revolting"

Martin's example was interesting, as it was a good example of the doctor not carrying out a thorough examination by probing further into Martin's complaint of sleepiness. Instead, the doctor reverted to 'aging' as an explanation for Martin's somnolence. From this scenario, it appears that the doctor-patient interaction is one of 'trial and error'. Martin continues to suffer from sleepiness because he did not like the Snorex treatment, and no other treatment options were made available to Martin at the time. Thus, it showed that doctors are ignorant about the causes of sleepiness, and the treatment options offered are limited. This represents a barrier to accessing adequate health care for concerned drivers.

8.6 Summary

There is clear evidence from the above analyses that these taxi drivers experienced barriers to care. Sleepiness was perceived as a safety risk, as drivers reported the effects of sleepiness on their performance and alertness. However, sleepiness was not a matter of health concern. The lack of knowledge about sleepiness being associated with an underlying medical pathology was demonstrated by their list of coping strategies, which did not include seeking medical help. Furthermore, the competitive nature of the industry pushed drivers to work beyond regulatory work limits. This was exacerbated by the oversupply of taxi drivers, and the taxi driver culture, which supported drivers' attitudes prioritising financial security over personal self-care. It seems that drivers avoided seeking medical care for the sake of saving face, and avoiding embarrassment. The fact that drivers reported sleepiness and OSAS symptoms were not investigated at medical examinations supports the notion that drivers potentially at risk of OSAS continue to pose a health and safety risk to the general public. Doctors play a pivotal role in identifying drivers at risk of OSAS, and this was also considered a potential barrier to accessing adequate health care.

CHAPTER 9
MĀORI/PACIFIC FINDINGS FOCUS GROUP: FINDINGS

9.1 Demographics

Seven participants were recruited into this focus group. Table 9.1 below presents the basic demographics of the participants. In comparison to the New Zealand European (NZE) group, this group was slightly older, with the average age being 59.6 years (NZE group, average age 55.2 years). The majority of drivers in this group were somewhat more experienced, although the NZE group had a wider spread of driving experience. Finally, 57% of participants in this group presented with high pre-test risk scores of OSA, compared to 50% of the NZE group.

Table 9.1 Demographic Information, Māori/Pacific Island Group

	Sex	*Age*	*Years Driving*	*Snore Always*	*Neck Size*	*Observed Apnoeas*	*ESS>10*	*Pre-test risk*
Lewis	male	59	9	no	44cm	no	no	0.181
Anita	female	46	12	no	48cm	no	no	0.289
Bradley	male	63	10	no	46cm	no	no	**0.315**
Warwick	male	70	14	no	42cm	yes	no	**0.441**
Wilson	male	63	1	no	40cm	no	yes	0.121
Bob	male	64	10	yes	49cm	yes	no	**0.912**
Paul	male	52	27	no	49cm	yes	no	**0.736**

Interestingly, two drivers who attended this group had originally declined to participate in the focus group. They made a last minute decision to participate only through the *motivation* of their wives who participated in the first focus group (New Zealand Europeans). Again, all participants were 'owner-drivers', and pseudo-names have been employed to maintain confidentiality.

There are three major themes that were of particular concern to this group. They are: (1) sleepiness as a perceived health and safety risk; (2) personal demands as a barrier to accessing healthcare, which is multi-faceted; and (3) driver avoidance and personal fears.

9.2 Theme 1: Sleepiness as a Perceived Health Risk

When asked the same questions about sleepiness and health, it was apparent that Māori/Pacific drivers perceived the situation very differently from the NZE drivers. Three categories describe this theme: (1) safety concerns, (2) health concerns, and (3) poor working conditions.

Safety concerns

Drivers clearly perceived sleepiness as a safety concern. The following discussion provides an example of this:

> *Warwick said:*
>
> *"... I don't understand why taxi drivers are really sleepy. You really can't be sleepy when you're driving a taxi, that's how I see it. You know, you've got to be aware, especially if you've got um, people in the car.*
>
> *Lewis added:*
>
> *"... I'd be absolutely mortified because of the safety issue of being tired while you're driving."*
>
> *Anita also added:*
>
> *"...I was getting tired too, but if I got tired while I was driving, I'd go home. I wouldn't stay in the car. ... But I've never had the problem of sleeping in the car ever, coz ah, wasn't my cup of tea. Like you see some, you know, you can drive around and see some drivers sleeping in their cars aye, and I think that they should go home 'coz they are a risk, that's what I believe."*

Warwick and Lewis point out that sleepiness diminishes passenger safety as well as the safety of the driver. This issue was also highlighted in the NZE group, but the drivers in that group offered pressing reasons (primarily financial) for working long hours. The Māori/Pacific group clearly recognised that it is unsafe for the driver. Anita's comment was an example of good driving practice as she described her immediate reaction to feeling tired was to log off and go home.

The following example shows the direct effects of sleepiness and tiredness on the ability to function whilst driving.

Anita said:

"If I was feeling tired, you know if I closed my eyes I could see the road markings of the road, and I would go home ... coz I thought that was the, you know, a danger. I could see it in my mind – every time you closed your eyes you could see those white lines. And then I know I'm tired, so I just go home."

Anita's comment was similar to that reported by members of the NZE group. She recognised herself as being at risk of having a MVA when she had the unusual experience of visions of road markings every time she closed her eyes. Anita took this as a sign that it was time to stop working.

Warwick and Lewis' experiences also emphasized their personal responsibility for safety when they were tired.

Warwick said:

"...how do we understand this: what are my feelings if I got tired in the cab? ... I'd be absolutely mortified because of the safety issue of being tired while you're driving, or myself and the client in the car. Well, passenger first really. Because anything can happen when you're tired. What would I have done? I would actually log off and go home if it got to that stage..."

Lewis added:

"Yeah I agree with Warwick there, I'd be mortified too and also from the safety aspect. Earlier on in my career I was driving home on the motorway and for a split second I went to sleep, just like that. And then I woke up and thought ...my god did that really happen? Um so mortification did set in there, when I realised what had happened and I was actually moving over to the left of the motorway, and that really um ... beat home to me that I needed to address that problem straight away. ..."

The emphasis on personal responsibility was different to that of the NZE group, for whom financial concerns took precedence over personal health, safety and well-being. The

Māori/Pacific drivers measured sleepiness as a health and safety indicator, and this was largely shaped by their own taxi driving experiences.

Health concerns

Other drivers referred to sleepiness in direct association with obesity and lack of exercise.

Paul said:

"...it's because they're overweight. um ... they probably eat about 4 or 5 times a day and no exercise."

Bob added:

"Most of them are overweight, you know that, um that's the reason, as soon as they stop the car, it's quiet and five minutes they're away."

Lewis also added:

"...when I first started driving I think I did what a lot of drivers did, pig out in the car with fish and chips, hamburgers and all the rubbish that you take into the system, and consequently I had a medical problem..."

Paul, Bob, and Lewis all indicated in their reasoning that sleepiness and tiredness was due to poor health as a result of being overweight. They think taxi driving created a risk of poor diet and subsequent poor health. Lewis shared his personal experience with the group to make his point clear.

Lewis said:

"...yeah I don't really agree with that [nodding off in the car], and I think that you know if you get to that stage, then you should get off the road... I became obese, and had to address that problem pretty smartly, because I became a diabetic, became obese, and also asthmatic – one of the areas that my doctor had great concern for. Um he gave me a program for me to follow and he said, you know, 'this is what you can do to remedy your problem, whether you choose to do so is entirely up to you'..."

To Lewis, being a taxi driver had led his health to deteriorate, and the program set up by the doctor was a crucial life changing event. This was evident by his achievements in reducing his weight, attaining better physical health, and a change of mindset.

Poor working conditions

Drivers reported that increased work demands driven by the competitive nature of the industry led to working long hours, which in turn resulted in sleepiness. Lewis provided an example.

> *Lewis said:*
>
> *"... being early in the career, you know, I was out there trying to get as many hours as possible, to get the big dollars, and um not really focussing on the real issue, which was safety first, and you know, you sustain yourself after. Um, the big dollars appealed to me, so instead of staying out there 12 hours you're staying out there 14 hours, 15 hours, and ah there are a lot of drivers doing that."*
>
> *He further added:*
>
> *"I go home now every day around 1030, 11 o'clock and ... I'm up there and I walk for an hour every day. I get home, have my main meal and I get back out on the road anytime after 2, 3 o'clock – totally recharged, and I work until about 7 o'clock and that's me, I'm home. And doing it in that manner, I've found that I'm rejuvenated. I think the healthier living has given me the opportunity to be able to ... help recharge the body and I think you need to, I mean look around here you know we're not getting any younger."*

There are several important points illustrated by Lewis's comments: (1) financial pressures tend to be higher at the beginning of a career when a driver is trying to pay off his vehicle loan; (2) greed can also be a factor; (3) that financial motivations can lead to drivers working long hours that exceed the regulatory limits; (4) working long hours can lead to health problems and safety issues; and (5) Lewis's experience parallels that of William in the NZE group. That is, he has made the transition from taxi driving as a job to taxi driving as a lifestyle. Bob and Wilson also gave long accounts of adapting their taxi job into a lifestyle, not because of near misses or accidents, but because they always felt tired and sleepy, and this impacted on their ability to function socially and emotionally.

9.3 Theme 2: Personal Demands Inhibit Access to Care

This theme had two aspects. Drivers learnt from their 'early-career' experiences of taxi driving, and the impact of financial demands on their driving behaviours. The second aspect was related to the demands of whānau, and the cultural expectation to consider the needs of whānau in all aspects of their (the drivers') life.

Financial security

This category describes the demands imposed upon the driver to make a living and to sustain their taxi business. As with the NZE group, making an income was important to these drivers, and attaining financial security was largely driven by the competitive nature of the industry.

> *Anita said:*
>
> *"...when I was paying off my car, I would work my butt off to um finish paying that car off quickly. ... yeah if I didn't get my target for that night, I'd stay out there until I did, and it didn't matter how long it took me, I'd still stay out and do it."*
>
> *Wilson asked:*
>
> *"What, over and above the legal time working, you'd still carry on?"*
>
> *Anita responded:*
>
> *"I'd still do it!"*
>
> *Lewis added:*
>
> *"...I did exactly the same thing. I paid my business off in, well it took me two and a half years, but I did it. ... I looked at the short-term goal, and that was the short term goal for me, to get my license paid off. Bang! I worked every minute of the day. Broke every rule in the book."*
>
> *The group members all agreed with Anita and Lewis verbally and non-verbally, except for Wilson.*

Similar to the NZE group, drivers set themselves daily financial targets. In addition, these drivers felt it was necessary to pay off their business rapidly, in order to establish a sense of financial security, and this was largely driven by competition within the industry.

The researcher then posed a question to the group regarding the 'impact' of working beyond regulatory hours and the effects this would have on their driving performance. Their responses were as follows.

Lewis said:

"...you make errors, you make mistakes. I mean that's the price you pay to do that."

Paul added:

"Yeah sometimes you're lucky not to have an accident." "... Some people they're unlucky. They end up in hospital, big accident. So yeah there are times in our life where we take risks, and hopefully we come out on top, instead of you know, going under..."

Lewis further added:

"I guess you know, all it boils down to is working smarter ... and I'm taking home exactly the same today as I was 10 years ago."

The group members all agree with Lewis's point of 'smart working'.

These drivers were aware of the risks (e.g., errors and near misses) that working long hours entailed. Moreover, they viewed their job in earlier days as risk-taking. Lewis made reference to 'smart-working', which is setting up the taxi business in a short time-frame to establish financial security. Thereafter, there was no need to work outside regulatory hours.

In contrast to the NZE group, these drivers did not blame anyone or any institution for their actions. Rather, they viewed the risks (earlier in their careers) as self-imposed. However, in both groups the main factor determining long work hours and the inherent safety risk was being financially secure in a short time frame.

Demands driven by the needs of whānau

Whānau is the Māori term used to denote 'family'. This category of comments was described by the drivers' motivation to enhance the health and well-being of their whānau.

The emphasis was on what the drivers' perceived to be *good practice* in addressing the needs of their whānau.

This point was illustrated by Bradley's story. Bradley's example is somewhat unique in nature, but it is a common scenario for a lot of Māori kaumatua (Durie et al., 1997). It demonstrated how he took on the greater burden of responsibility for his whānau.

Bradley said:

"I started a long time ago ... my wāhine, my partner she took sick. I'd just started a taxi business, I wasn't very old when she took sick ... and it was quite a serious illness. I had to look after her for a number of years, about ten years. So I had to look after her, come out and do the taxi work ... and over a period of time the old business became a problem ... at the time we were doing a permanent night shift ... and my kids were growing up, they were at college so we got a system going: during the day I would stay home with my wāhine. When they come back from school I cook the kai, and then they get ready for bed, when they settle down I go to work at night. But I had to stay out all night as it was permanent night shift – can't help but fall asleep ..."

Bradley's story was an interesting account of a constellation of work and personal demands. He took on multiple roles as the husband, father, carer and income earner for his household. Clearly, the long work hours and the burden of personal demands explained his sleepiness. Bradley considered it important to fulfil the needs of his whānau despite how hazardous it was to his health and well-being.

Another discussion between several participants' followed Bradley's story. It is the tail end of a conversation between drivers about when 'duty time' starts and how long a driver has been awake before they begin driving.

Lewis said:

"I disagree, I don't believe, you know, people are awake for 10 hours and then decide "hey I'm going to work now". Um, I'm not saying it doesn't happen, but I certainly don't wake up about five or six hours before I'm due to go to work. I make sure that I'm awake when I'm due to get up at the appropriate time, um, as opposed to waking up 10 hours earlier and then deciding to go to work. And as Bradley says, that puts another 10 hours onto the end of your day.

Wilson questioned:

"That would be a silly thing to do ... to be awake all day, and then start driving a taxi, wouldn't it?

Bradley responded:

"That's what I'd been doing with my wife..." ... "My wife ... she had heart trouble, I had to be at back home ... it was hard for me, I'll admit that ... because I had to get out and earn a living. It was bloody hard, there's no two ways about it.

Lewis and Wilson did not appear to understand Bradley's circumstances. Bradley's situation was unique because the responsibilities to his whānau were not similar to any other driver in the group. To Bradley, upholding whānau responsibilities and working to sustain the well-being of his whānau was how he viewed his role. This was how he perceived maintaining health, determined by a commitment to uphold his responsibilities to whānau to ensure their needs were met.

Culture as a barrier to accessing health care

The question regarding cultural and ethnic issues was posed to the group on several occasions to prompt drivers to discuss and to clarify their views. The responses were as follows.

Bob said:

"I don't, my doctor he has a history of what you know, what he's checked me out for and all that and he might say to me, 'oh this time of the month you haven't had a prostate for 12 months, we'll check you over', and things just like that. If I was sleepy, I'd soon tell him that's for sure. But that's a personal thing, I guess, between the two ... but I'll always go back to him every 6 months for a check-up and that."

Lewis added:

"You know, you want to be around for your mokopuna so that you open up, you respond more to your GP. I don't believe there's a cultural issue, I mean if there is people need to stand up and say ..."

Other drivers agreed with Lewis non-verbally by head nodding

Bradley says:

"You've done your research and you've found out that Māori and Islanders are worse off ... but for me, it doesn't worry me!"

Bob adds:

Well, I don't disagree with [Lewis], but I can't get around that culture bit you know? It's gotta be there somewhere – I might be lying to you, I just can't get round it!"

The drivers considered that cultural and ethnic issues did not hinder access to medical help because most drivers had established a good and trusting relationship with their own GP. Lewis and Bradley (being the only two drivers in the group who shared their major lifestyle events in relation to taxi driving) disagreed that there were any ethnic issues, despite what health research indicated. They both viewed responsibility to whānau as the main motivation for maintaining good health. Bob on the other hand disagreed with Lewis's comment. He believed that there may be cultural issues, but he was uncertain of this. Bob was not willing to pursue his statement further.

9.4 Theme 3: Personal Fear as a Barrier to Care

This theme describes the issues relating to 'why' health-seeking behaviours among this group of taxi drivers were not regarded as a high priority. The theme is characterised by three categories, (1) pressure from whānau, (2) driver ignorance and avoidance, and (3) ignorance of the medical profession.

Pressure from whānau

Drivers in this focus group commonly reported their immediate whānau were the motivation for them to seek medical care for any 'perceived' health problems. An example of a conversation follows.

Bob said:

"I snore a lot, it upsets mum, she tells me to let her sleep and all that sort of thing."
"... mum's been onto me for a few years now ... I'd better do something about it coz ah, she reckons that I stop breathing at times ..."

He continued:

"I didn't believe I snored ... I was sleeping one afternoon there and my daughter she took a recording on me snoring [group laughs] ... she put it on, all I heard was snoring noise. I said what the hell is that, who's that? She said, that's you!" [group laughs].

Bob's partner (Georgia) was concerned with his sleeping habits, such as snoring and witnessing apnoea events. This scenario is typically reported by other studies (Reuveni et al., 2004), where the bed-partner is the first person to complain about a partner's sleep habits, because it disturbed their own sleep. Bob's daughter was also concerned about his snoring. The audio recording of his snoring was evidently successful in increasing Bob's awareness of how his sleeping habits disturb others' quality of sleep. This shows that multiple complaints from whānau finally prompted Bob to seek medical help.

Paul's wife (Josie) was also concerned about his sleeping habits (namely snoring) and other poor health behaviours such as smoking.

Paul said:

"... I used to smoke until 3 years ago and my wife used to say 'you snore a lot you might as well you know try and stop smoking'. So three years ago I stopped but I'm still snoring [laughs with the group]. ... it's either your wife or somebody, your friend watching you while you're sleeping and ah then they tell you that there's something wrong with your sleeping. But you never believe them because you don't know what you're doing while you're sleeping."

Paul's reaction to reports of his sleeping habits demonstrated disbelief, because he does not believe he has a sleeping problem. Despite multiple people (friends and family) reporting Paul's sleeping problems, he continues to ignore their observations. Perhaps this is the 'stubborn' male pride that Josie was referring to previously. Paul later reported that he did not want to seek medical help about his sleeping problem, because he was afraid that other health concerns could be identified. Paul's comments are interesting, as they show his distrust of the health system, and of other peoples' perceptions of his health, especially if his health is perceived as being 'poor'. A common problem for all participants was not understanding the concern from someone else's perspective (e.g., sleep disturbances).

These examples demonstrated how family members expressed concerns about the sleeping behaviours of the participants. Despite these concerns being voiced, there still appeared to be some reservation by drivers about taking any action. The pressure from their family has instigated at least minimal level health-seeking behaviour. This was evident by Bob and Paul's attendance at this focus group discussion to find out more about OSAS, in order to determine whether they need to seek further help or not. More importantly, it gave them a degree of understanding as to why their family members continually complained about their sleeping habits.

Ignorance and avoidance by drivers

Driver avoidance was based on fear of consequences. That is, there is a conscious decision not to reveal any health concerns to their GP, as it could potentially worsen their current health status and/or affect their ability to attain financial security. An example of the discussion is given.

Paul said:

"You tell him [doctor], and then they'll probably give you another test or something else and that will delay your certificate of driving, and that's probably the worst thing…a delay of another week … it might delay you the last certificate for fitness, you know to go and get your licence you see what I mean?

Bob completed Paul's sentence:

"…might open a can of worms"

Paul continued:

"I mean if the doctor tells you 'excuse me sir, you're a little bit overweight, try and lose some weight,' and you don't want to say 'what about my sleeping disorder?' 'I feel a bit tired!' You don't want to open up, you know? And I suppose all the taxi drivers … feel like that too."

This attitude was also evident among the NZE group. Paul and Bob raised two issues that led others into a group consensus. The first issue is withholding information from the doctor for the sake of protecting their job security. It was clear from Paul's text that seeing the doctor was not the problem, it was 'informing' the doctor of other health issues that could reduce the chances of renewing his certificate to drive. Therefore, Paul and Bob would conceal any health problems that may preclude them from gaining a certificate of health in order to continue working as a taxi driver.

In New Zealand, there are currently no standardised methods of screening professional taxi drivers' health status. Medical certificates are provided by GPs who evidently vary in their medical screening practices. The second issue was related to withholding information from the doctor for personal reasons. Paul raised the point that drivers who are overweight, and know that they have a sleeping problem, would not go and seek help from the doctor because they would feel embarrassed. The line of treatment that Paul expects from the doctor is to 'lose weight'. Paul's text insinuates that drivers would not be open to this type of treatment, because it is embarrassing, and this could lead onto finding out about other medical problems, which can cause a lot of stress for whānau and for the drivers themselves. In short, drivers avoid seeking medical help because they do not want to know about their health problems.

Ignorance of the medical profession

This issue is concerned with the group's impression of their doctor's knowledge regarding sleepiness and sleeping complaints. Drivers identified that their GPs demonstrated little or no knowledge in examining sleep-related health issues, given the context of OSAS and its associated increased risk of MVAs. Refer to the following example.

Lewis said:

"I see my doctor 4 times a year minimum ... he's never asked me that question [sleep related] ..."

Paul added:

"Yeah the doctor never asks about sleep. Never!"

Bob said:

> *"...my doctor ... he's checked me out ... and all that and he might say to me, "oh this time of the month, you haven't had a prostate for 12 months, we'll check you over"...If I was sleepy, I'd soon tell him that's for sure. But that's a personal thing, I guess, between the two ... but I always go back to him every 6 months for a check up and that."*

These drivers expressed concerns about their GPs lack of screening sleep complaints as part of their routine medical check-up. Of note, this was more evident in their tone of voice. Furthermore, they queried why their GPs did not ask questions relating to sleepiness and sleep complaints, particularly since they reported good relationships with their physician as evident by their regular check-ups. Thus, it appears that GPs do not carry out health checks that would detect sleep-related symptoms. Conversely, drivers were afraid or did not think to mention 'sleepiness' as a health concern, because it was not a priority. A good example of this point is given by Bob. He said:

> *"You don't even think to tell the doctor when you get there, you don't even think about it ... you worry about your eyesight and what not, and so forth, not the sleeping business."*

Bob's statement illustrates an issue that is a common factor across all focus groups, which helps explain why sleepiness and sleep complaints remain an issue among shift-workers like taxi drivers.

9.5 Summary

The above findings illustrated clear barriers to care specifically outlined for this group of Māori/Pacific drivers. Three predominant themes uncovered various issues, they were: (1) sleepiness was a perceived health concern and the onus of responsibility remains with the driver, and not with the industry. Furthermore, health and safety were prioritised higher than the need for additional financial gain. (2) Working extended hours was primarily driven by the demands of whānau, which can compromise driver health, but this was seen by the Māori participants as a responsibility for sustaining the health and well-being of their whānau. Thus, providing for the whānau was perceived as being healthy. 3) Ignorance and avoidance are barriers to care as seen by drivers' not revealing health concerns related to sleepiness in order to protect their job and financial security. Along similar lines, there is uneasiness about the ignorance of GPs, who do not screen for sleepiness and sleep complaints. Finally, this group did not perceive any cultural or ethnic issues inhibited access to health care services, because drivers had good relationships with their GPs.

CHAPTER 10
OTHER ETHNICITIES FOCUS GROUP: FINDINGS

10.1 Demographics

Ten drivers were invited to participate in this focus group and eight agreed to participate. Similar to the focus groups described previously, Table 9.1 presents basic demographic information of this group. In comparison to the previous groups, the average age was slightly younger. There was a broad range of driver experience, from four to 34 years, and 12.5% of this group presented with high pre-test risk scores for OSA, which is less than the NZE and Māori/Pacific peoples groups. However, more drivers in this group self-reported excessive daytime sleepiness.

Table 10.1 Demographic Information, "Other" Group

	Sex	*Age*	*Years Driving*	*Snore Always*	*Neck Size*	*Observed Apnoeas*	*ESS>10*	*Pre-test risk*
Zack	male	52	8	no	40.5cm	yes	no	0.198
Mitchell	male	56	10	yes	39cm	yes	yes	0.339
Andrew	male	52	14	no	40cm	yes	yes	0.252
Chris	male	50	4	no	45cm	no	yes	0.250
Harry	male	49	5	no	41cm	yes	yes	0.293
Patrick	male	61	14	no	42cm	no	no	0.119
Nathan	male	64	34	no	40cm	yes	no	0.259
David	male	40	5	yes	34.5cm	no	no	0.015

The "other" ethnic group comprised mainly Fijian-Indian, Eastern European and European people who had migrated to New Zealand. For the majority of this group, the taxi driving profession was not a preferred option. It was reportedly the employment option that offered an easy transition to gain a livelihood. Some drivers stated they did not expect to drive taxis for a living in New Zealand, it only eventuated as a result of being unsuccessful in their preferred employment. Some examples are given.

Chris said:

*"Oh been here for almost 7 years now ... prior to that I used to work for the Fiji government in Fiji. Did not prefer to become a taxi driver, but I had no options when I got here – couldn't find work ... ended up driving taxis to earn a living, and that's given me a few problems like ah lower degeneration of the lower discs which Dr ***** is dealing with..."*

Andrew said:

"...prior to driving taxis I worked for the power board which is quite physically demanding ... taxi driving is quite relaxing and mentally very stressful – it seems to bore you out and you feel sleepy..."

It is important to note that not all drivers experienced this situation.

There are three main themes, but the main issues are primarily focused around the first two themes. They are: (1) health and safety issues; (2) driver avoidance; and (3) cultural issues.

10.2 Theme 1: Health and Safety Issues Inhibited Access to Care

Health and safety issues were described by the participants under two categories. (1) Safety concerns: drivers shared their personal experiences in relation to driving whilst sleepy, and their perspective on safety implications of such behaviours. (2) Onus of responsibility: drivers questioned where the 'onus' of responsibility rests with regards to personal health and safety issues.

Safety concerns

For this group of drivers 'sleepiness' was an issue that affected their ability to work in a safe manner. Some examples of drivers' experiences and perceptions about sleepiness are as follows:

Mitchell's experience:

"...I used to work long hours – when I working at nights coz it's not easy to sleep during the day. First 18months I worked the night, I did it two jobs actually all the

finance pressure – you know to get the money together to pay off the things – to meet my budgets really."

Andrew's experience:

"Oh very similar – when I first started off I was working long hours. Sometimes I did feel sleepy at the wheel – nowadays things have changed with a lot of outside activities and going to the gym improved my health. You don't feel tired anymore and I haven't had any problem since. When I was snoring I went on Snorex and went on the internet ... but still wasn't much help. Outside activities has improved quite a bit."

Chris's experience:

"I do feel tired. I fall asleep in the car, these days I head up to the airport and get out of the car rather than sitting in my car..."

Similar to the previous two focus groups, the drivers spoke of early taxi driving years being related to working long hours to meet financial targets, which resulted in sleepiness. Mitchell and Andrew's experiences have changed since they have achieved more financial security. They see taxi driving as less demanding and they no longer report sleepiness as a current risk to their health or passenger safety. In retrospect the group's discussion was largely based on ignorance. They were aware of feeling sleepy and drowsy but the drivers considered it to be normal. Two examples are given below.

Nathan added:

"Yeah I think that that will be the usual thing for everybody. We think it's almost natural. We don't think it's medical um disorder and um because we don't hear ourselves we thinks okay ... um I don't think anybody would go and seek help."

Andrew said:

"Well most of the time you think you are alright."

Both Nathan and Andrew demonstrate the point that they were 'unaware' of the issues surrounding sleepiness and the potential effects on their health and driving safety. Nathan perceived sleepiness as *within normal limits* and this attitude precludes the need to seek help. Andrew was less informative, however his statement supports Nathan's attitude that sleepiness was not considered a symptom of a potential medical condition.

Their views illustrated a common perspective held by most people in the general population on sleepiness, that is, sleepiness was not considered to be medically-related. In response to this reaction, the researcher alluded to the point that sleepiness can be symptomatic of medical conditions.

Patrick said:

"The more you make people aware of that, the best assurance coz then people will start doing something about it. If you say well ... if you're suffering from this disease unless you do something about it, I mean nobody's ... oh well none of us were aware of that."

Chris added:

"I didn't know you could seek medical help with regards to that"

Patrick and Chris stated that drivers can not be expected to have an understanding of the role of poor sleep habits and its impact on the body, cognitive processes and performance. This is important because it has major implications for the health and safety of taxi drivers and their passengers. Patrick refers to his own personal experience when he was driving:

Patrick recounted:

"I remember one day I was driving around the Basin Reserve, and there was this fella ... he was in our company and next minute the car went off the road into the cricket stand ... and I thought oh he's just driven in there. Next minute his passenger got out and he was shouting to me and I said 'oh I've got a passenger and he said no no the driver the driver'. So I went around the block and I came back. That fella died! He was overweight, the passenger was in his car and he crashed into the pohutukawa tree ... and I got out of the car and he was so fat this guy his stomach was out there (demonstrates). He was stuck behind his wheel, all his face was red and he had a massive heart attack, you know, he died. The passenger wrote to the company and said next time I get a driver I'll make sure he looks fit and healthy. A lot of drivers complained about this guy, and I mean where does he get his doctor's certificate from? I've got no idea ..."

The above example was a worst-case scenario. However, Patrick wanted to demonstrate that drivers who are overweight and have poor health not only place themselves at risk but also passenger safety. This example raises the question, 'who takes responsibility to ensure drivers are fit and healthy?' Moreover, Patrick refers to the function of the medical certificate and whether it can be deemed an accurate warranty of health. Other drivers in the group concurred with this concern. This example led to further discussion of where the onus of responsibility rests for drivers who are a risk to society and to themselves.

Onus of responsibility

In terms of overall responsibility for the health and safety of drivers and passengers, there is an ongoing tension between taxi drivers as individuals and the companies as their 'management structures.[23]' The discussion surrounding this issue stemmed from Patrick's example above, and his comment based on health and well-being.

Patrick said:

"...I think a lot of taxi drivers are overweight, and the apnoea comes from being overweight. I mean, I've got a driver who's not a driver cause he uses my license ... but he's overweight and I tell him he's overweight ... and I think a lot of the problem is like I won't drive in the night because my eyes aren't good ... coz I reckon I'd be a danger driving in the night so I keep off the road when it goes from day to night, because I think it's responsible. I think many drivers are very irresponsible because their too fat and their not fit enough and that's a lot of the problem and they won't face up to it. I mean they talk about their problem but they won't do anything about it as far as keeping fit."

The failure of drivers to take responsibility to resolve personal health issues was particularly noted in the NZE group. The Māori/Pacific group demonstrated more personal responsibility for maintaining safety.

Important to this study was the investigation of the tension of 'responsibility' between drivers and taxi company managers, especially in relation to ensuring driver fitness and passenger safety. Some drivers' views illustrate this issue further.

[23] Taxi companies are not employers in the traditional sense. In general, drivers are shareholders of the company and they pay a fee to the company for communication services and branding.

Nathan said:

"...It's impossible for taxi companies to ah um police anybody exercises, um doing the right things, eating the right food. It's individual things that company can never have any ah an input, even if they try their best ...we won't change."

Patrick added:

"...but I think if you're overweight that's half the problem I think, there's lots of taxi drivers ... people don't want to talk about it because they think they're above that. But I think that's most of the problem's of peoples health is being overweight and with taxi drivers even more so coz they're just sitting there all day, they don't get out and do anything!"

Nathan and Patrick agree that drivers are responsible for their own health and wellbeing. Nathan believes the company cannot police every health act (e.g., exercising, eating healthy food). His stance on responsibility is that it rests with the driver, and that the taxi company cannot impose their views, because only the driver can change his or her own behaviours. On the other hand, Patrick endorses the need for drivers to be aware of their health concerns, and to manage this appropriately, so passenger safety is not placed at risk. When he rationalises the drivers' behaviour by stating "they're above that", Patrick was referring to an 'attitude' that is present among taxi drivers, and this was evident across all three focus groups. This taxi driver attitude was driven by the need to attain financial security, and to some degree Patrick believes it is a barrier in itself, because it inhibited drivers from seeing the reality of their own health status, and its potential consequences.

Another discussion added to this tension, arguing that taxi companies and GPs should be more responsible.

Harry said:

"...see if you first [get your] medical, and the medical I've done now says I'm fine I can go and drive for the next 5 years, LTSA's going to buy that and let you drive for the next 5-years without a medical ..."

Mitchell added:

"... this guy works in ... on one of the stands ... and he's sleeping ... I think he's got a diabetics ... he's fairly big and I think the company's should do something about it as well as doctors eh? I mean why doctors give people like [that] certificates of fitness?"

The message from Harry's quote, points to the fact that the LTSA (currently the LTNZ) relies on one medical certificate as being sufficient to permit drivers to work over a five year period. Thus, the onus of responsibility is lost. Mitchell on the other hand, refers to GPs and taxi companies as playing integral roles in recognising drivers who may pose a safety risk, although this idea was not accepted by all drivers.

The role of the regulator was also discussed by the NZE group participants. Patrick further elaborated on this:

> *"I think it was a 'cop-up', because what happen if you have to have an ID every year it's alot've bureaucracy involved and it takes ages for the ID to be changed. And I think the ministry of transport or whatever they're called copped-out of it ... coz it was too much for them to do ... so really it's bad administration. ... I mean everyone should have a medical every year. I go for a cholesterol test every 3 months ... go down to the med lab and I get my blood test, I mean that's a pretty responsible thing to do, and I think everybody should do it and I think all drivers over 50 should have a cholesterol test coz that in part I should imagine the sleep apnoea thing."*
>
> *Nathan disagreed with the above notions, particularly in regards to the medical check-ups. He said:*
>
> *"I was fit ... and I would feel fine ... 12 months ago I had a heart attack ... so unpredictable and I don't think any medical can tell you that you're gonna die tomorrow when driving the taxi."*

Nathan's stance differs slightly. He concurs that drivers should take full responsibility, because GP visits and medical tests are not the same as keeping fit and healthy.

Another way of looking at individual responsibility was by observing the 'decisions' of drivers. Nathan alluded to this point:

> *"Actually taxi driver has plenty of time, all the time in the world, and it's not a shift issue, it's a choice issue. You can work anytime you like in the taxi industry. They don't force you to work certain days and or certain time. You choose yourself when to work, you got a lot of flexibility."*

Part of the problem of 'who takes responsibility' remains in the definitions of shift-work and management roles. For instance, Nathan's statement led Patrick and Harry into this discussion.

Patrick said:

"...there's a big distinction between day shift-workers and night shift workers."

Harry said:

"...you've got 30% to 40% of drivers that would drive a fixed time everyday, and then there's the evening people who start work at one in the afternoon or at ten in the night and finished at eight in the morning or ten in the morning ... and then there are drivers like me, who drive as their need arises. ..."

Patrick asked Harry:

"So you swap your shift around all the time?"

Harry answered:

"To suit me, I have my own car so I can do what I want. There's three kinds of drivers in the industry – ones who have fixed hours in the morning, fixed hours in the evening, and then you have freelancers like me who drive all the time."

Shift-work hours are not defined by the industry or policy-makers, rather they are determined by the drivers themselves, because most taxi drivers are self-employed. Harry arbitrarily defined drivers' work patterns according to three types: (1) fixed morning drivers, (2) fixed evening drivers, and (3) freelance drivers. This arbitrary definition was well accepted by the group. It is an indication of a grey area within the taxi industry that requires further clarification. The flexible nature of taxi driving differs from most other commercial drivers who generally work in a more scheduled shift-work capacity, such as truck drivers and bus drivers.

10.3 Theme 2: Driver Avoidance and Perceived Dissatisfaction with GP Services Inhibited Access to Care

The drivers in this group were candid with their reasons as to why they would not seek medical help. This theme is characterised by: (1) driver ignorance, (2) avoidance, and (3) personal fear.

Driver Ignorance

Like most drivers from the other groups, the drivers in this group also demonstrated 'ignorance' of their sleep habits and the consequences of daytime sleepiness on work and performance.

Andrew said:

"Well most of the time you think your are alright."

Nathan added:

"Yeah I think that will be the usual thing for everybody. We think it's almost natural. We don't think it's a medial disorder um because we don't hear ourselves we thinks okay. If it wasn't for the compliance for the um the family and the other stuff around you, um I don't think anybody would go and seek help."

Harry said:

"...um my problem was identified with snoring. My two daughters sleep about 30 meters away from where I sleep and they can hear me snoring ... my wife complained to my doctor."

Mitchell said:

"I think most of the people not aware that this is a problem. It's just one of the things that happen! ...I think it is that probably haven't got anything to do you know, it's just a lazy type of job you just sitting down – ya got nothing else to do [laughs.]"

The three drivers illustrated three points of ignorance which are worth noting here. Firstly, there is 'disbelief' in the notion that a symptom such as sleepiness could be an indicator of an underlying medical problem. This point was also conveyed by the NZE group. Nathan alluded to this point by referring to it as being natural, implying that such symptoms and poor sleep are just part of the aging process. Secondly, Mitchell's point focuses on the sedentary nature of the job, which was perceived as being a *'lazy'* occupation and therefore inducing daytime sleepiness. This shows ignorance about the physiological need for sleep. Thirdly, Harry's example was typical of those patients suspected of having OSAS. It brought to light the point of 'ignorance' when family members began complaining of Harry's sleep habits (snoring). Neither Harry nor his family knew he had an underlying medical condition. It turned out that Harry was diagnosed with mild OSAS after his wife complained to their family doctor. This event forced Harry to seek medical help. He was treated via a dental splint which proved to be successful. Harry stated that he would never have sought medical care if it was not for the persistence of his wife and children. This example was similar to that of Gary's situation from the NZE group. That is, family members are usually the first to identify underlying sleep problems. Several other drivers also agreed by making the following statements.

Zack said:

"...because I have a young family maybe that's the reason why I working during the day coz I have my life with my kids ... before, my business was terrible it was many hours. ... In the summer time I change - I work only a life to end ... I thinking that is too dangerous."

Nathan said:

"... my problem disappeared now. I went to the surgeon removed the tonsils, cut the soft palate ... make it rigid so it won't collapse ... I don't snore anymore at all and my daughter used to get a heart attack ... every time I go (makes choking noises) and then for um 2 or 3 minutes panting. It was quite terrible ..."

Along with Harry's example above, both Zack and Nathan referred to their families as playing an important role in overcoming health issues that could have worsen if left to deteriorate over time. The reluctance of drivers to seek medical care can be partially explained by the feeling of trepidation and uncertainty as described by another driver.

Chris said:

"... I fall asleep in the car ... and ah that's one thing I try and do well I haven't seek any medical help, but what I try and do these days is more often head up to the airport and get out of the car whilst I'm up there rather than sitting in my car. That's the way I'm dealing with it at the moment."

Researcher asked:

"Did it occur that it may be a medical thing...?"

Chris responded:

"It never occurred to me ... but yeah after today's discussion it may be worth my while in trying to seek medical help."

Chris was somewhat wary that his taxi job may become insecure because of his current and possibly new health problems.

Avoidance

Avoidance was defined in the previous section on findings from the Māori/Pacific People's focus group. In comparison to the other groups, the drivers in this group expressed and experienced more avoidance due to their immigrant status. Living in a new country with little or no family networks and limited financial support, lessened the likelihood of accessing medical help for any sleep-related problems.

Medical costs and information

Andrew said:

"We get more information on any subject from the internet than from the doctor, then going to see the doctor you have to have $58 dollars in your pocket (with the) going in the door, and the internet doesn't cost you anything, and you can get all the information you want from the internet without going to the doctor ... you have heaps of information on the internet which you can you try and control it instead of going to the doctor next time ..."

Andrew's reasons for not seeing the doctor can be considered in two parts. The first part is the cost of visiting the GP. He perceived it as being expensive with little worth, particularly when other methods are freely available, such as the internet. The second part relates to the limited amount of information that GPs provide, because their time spent with each patient is limited. Other sources such as the internet can provide a wealth of information about any medical problem.

Doctors appointments are restrictive

Nathan continues on from Andrew by stating another reason for not seeing the doctor was due to the level of information they provided. He said:

"Their time is so limited that they don't have the time to explain to you and they don't have the time to give you all the information you um desire. I usually used to if I have um a problem, I used to you know read books, and um re-educate all the problems, rather seek the help of the doctor to indicate that to me."

Nathan expresses a deeper concern that received its impetus from Andrew's second point above. He perceives that GP's restricted appointments do not allow for adequate information sharing and education. Thus, he resorts to finding other sources of information, such as reading books to address his personal health issues.

Fear of finding out about medical problems

Harry recounted a conversation back to the group that he had with a co-worker:

"... he cannot drive for long hours, he feels like going home for a sleep, and I said why don't you go and have a check-up with the doctor ... he also snores and ... he said yeah yeah I don't have to go to the doctor right now, coz what happens if they find out something wrong with me, they say I can't drive anymore. ... and I've got to get off for 2 or 3 months before I get back on the road. What will happen then coz I lose my house and my family, so no, I don't think I go down. ... so even if they are having problems in good faith and somebody's telling them that they're having problems, they don't want to go. They're quite comfortable for the next 4 years..."

Nathan added:

"I had that problem ... used to dread to go to the doctor just in case he told me I had cancer and die"

The fear of visiting the doctor was also about the apprehension of finding out about further health problems. This was a real concern for taxi drivers because having poor health status meant their license to drive could become either restricted or ceased until they were deemed fit to operate a vehicle again. This finding was also apparent from the Māori/Pacific group.

Another way of looking at this issue was given by Nathan in respect to having prior knowledge.

Nathan said:

"I think if I knew that um it was apnoea was a threat to my license, if I knew I had apnoea and I was scared to go to the doctor because I might lose my license I might get some information first. If apnoea was treated, treatable then I'll go and seek help and treat it. If not, I'd probably shut up [laughs]."

Nathan's comment endorsed the point that if he had prior knowledge of the availability of 'successful' treatment options for OSAS, then he would seek medical help. However, because he was not aware of the treatment options, his first choice would be to try and find information outside the health care system, or not at all. By doing this, Nathan avoids all associated medical costs (e.g., medication, specialists, and laboratory tests).

Personal Fears

Fear for job security differs from financial security in that it relates primarily to staying employed. Harry continues from the conversation above.

Harry said:

"Apart from the fear of going to the doctor and getting taken off the taxi ... if you told a real fat man that he's falling off to sleep and that it's a problem and he should go and see the doctor. He's not going to go."

Harry pointed out that drivers who knew they had a problem that affected their work were not likely to visit the doctor because it placed their employment at risk. Maintaining job security was an important concept for this group of drivers. In particular, owner-drivers work in 'isolation', and therefore there are less opportunities for employment and income if you get sick.

Financial security

This is about the fear of losing money. The time factor plays an important role in financial security as indicated below.

Andrew said:

"Yeah I mean not everyone is hard fetched for cash. Some people are just like that you know it's second thing, no it's the first thing. The first thing is to get another job ... maybe I'm wrong but that's how I look at it. A lot of people would do these things. They don't have any time for themselves. All they do is sit on the stand and work and work and work, and after a certain time and ah unless people decide no they have to make some times for themselves you know they have a problem and they got to go and see a doctor. They have to make the time you know.

Andrew's comments suggest that drivers see 'time' as a critical factor in maintaining job and financial security. Any opportunity to obtain a job must be taken, and therefore drivers do not have the time to spend on looking after themselves. That is, drivers would rather spend the time waiting for a job, than visiting a doctor. This can be explained by the competitive nature of this occupation, which was an issue previously articulated by the other groups. The NZE group referred to this attitude as the 'taxi driver greed'. However, this was not how Andrew perceived the situation, particularly as taxi driving was not his preferred occupation in this new country. For him and other drivers working long hours and avoiding other issues was simply needed for financial stability. Nevertheless, other drivers concurred with Andrew's statement by urging drivers to make the time to get health check-ups or help, by referring to the times of the day when it is easiest to get jobs.

Patrick said:

"The taxi job is a great job ... the time you've got is your own time ... you can pick your time to stop and start so you've got a great job. ... most drivers ... know that the more breaks they take the more money they make. If ya gonna sit in your car all day you're not gonna make more money because I find that the more breaks I take the more money I earn ... so if you sit in your car all day, the less you get out of your car for breaks.

Nathan disagreed:

"I don't know unless you put the hours in you don't get the money"

Patrick reacted:

"You know the peak times though, there's no use sitting in your car from 10 to 12 when you know you're only going to get $10."

Nathan responded:

"Yeah but it's $10 more..."

Patrick said:

"Yeah well, you can't sit in your car all day. I mean you've got to make the choice!"

Zack came into the discussion reinforcing the point that Patrick made by stating:

"... I like enjoying my life ... I always look after myself, if I feel something that is wrong with me I go to the doctor ... if you don't check their health after that it will be too late ... but I always to my doctor, because I worried for me, not to live any other ..."

Zack made the claim that he 'enjoys life', enough so that he makes the time and effort to be responsible and care for himself. He made reference to reducing his hours of work to maintain better health, and for the sake of spending time with his family. This idea was in line with William's comment (NZE group) about reformatting the taxi job into a lifestyle, so that drivers are taking responsibility for their own health and safety. In contrast, Nathan viewed 'any' opportunity to earn an income as being more important than self-care. This attitude was similar to that reported by members of the NZE group.

10.4 Theme 3: Cultural Issues as a Barrier to Accessing Healthcare

The researcher asked the group if they perceived that cultural or ethnic issues prevented them from trying to access health care services. The responses received were as follows:

Andrew said:

"Personally I don't think any culture is a variable you know."

Nathan added:

"Neither ... yeah neither do I." "I saw a documentary and um all the white people and a very very big lie ... don't tell people they are overweight they know it. We do know what's wrong. The only thing with human nature is it's very difficult to make a decision to do something about it, it's difficult..."

Harry also added:

"When you're sick, dying or if you're having a crash and your dying I don't think it really can make difference. Just if something wrong with you there's something wrong with you."

Group: responded together that the only thing that would stop them from going to the doctor was 'money'.

Similar to the Māori/Pacific peoples group, this group did not feel that cultural or ethnic issues inhibited seeking medical help. Most drivers agreed that the only variable that inhibited access to medical care was 'money'. Drivers acknowledged that seeking help was important, but the barriers (time and money) to actually accessing health care had a much larger influence on their decision to access help or not.

10.5 Summary

Similarly to the Māori/Pacific people's group, sleepiness was viewed as a health and safety concern. The issue of responsibility regarding health and well-being was articulated across all focus groups. It is an issue that needs further investigation and requires clarification from taxi companies and policy-makers. The very fact that drivers in these focus groups do not know where the responsibility lies legally is bewildering.

However, most drivers agreed that the primary onus of responsibility remains with the individual driver. Furthermore, drivers identified a range of issues that presented as shortcomings for them in accessing health care services. Factors such as the lack of time to visit the doctor, the restricted nature of the doctor's consultation, and the motivation to earn a livelihood, inhibited these drivers from accessing health care. Moreover, information that is freely available (e.g., the internet and books) appears to be more attractive to drivers rather than the 'time and costs' which are required when accessing health care services.

CHAPTER 11
INTERPRETATION OF FOCUS GROUP FINDINGS

There are two parts to this chapter. Part one will examine the main issues of concern that occurred across all focus groups. Four main themes were identified that were considered as barriers that inhibited taxi drivers from accessing health care services. They are:

- Sleepiness as a perceived health and safety risk
- Industry demands inhibited access to care
- Personal demands inhibited access to care
- Driver avoidance and dissatisfaction with GP services inhibited access to care

Part one concludes with consideration of the limitations of the study. Part two discusses a number of ethical dilemmas highlighted by the current study. These issues need to be considered if driver access to health services is to be improved.

Part I

11.1 Introduction

The majority of participants in the focus groups were selected because of their moderate to high pre-test risk of OSAS. In taxi driving accident risk associated with sleepiness is high, because of the large amount of time spent diving.

Excessive daytime sleepiness (EDS) was defined in this study as having an Epworth score greater than ten (ESS>10) (Johns, 1994; Johns & Hocking, 1997). At a personal level, sleepiness was defined individually by driver descriptions of physical and mental symptoms. Examples such as *'the body shutting down'*, *'feeling sleepy'*, and the unusual experience of visions of road markings, suggested drivers were aware of the symptoms and consequences of sleepiness. However not all drivers altered their behaviours in response to these symptoms.

Drivers' choices about how they behave when driving sleepy can affect their health and passenger safety. In order to understand driver behaviour, their work conditions and the historical context of the taxi industry must be taken into account, because these influence behaviour over a long period of time. Documenting how drivers viewed their health was also important, because it helps explain social and work behaviours, thus this contributes to the understanding of health determinants. Furthermore, the notion that poor health can lead to loss of license and therefore loss of income was a strong issue for these drivers. The following discussion reviews the four main themes that were common across all focus groups.

11.2 Sleepiness as a Perceived Health and Safety Risk

Perceived health risk

Drivers perceived that sleepiness affected their functioning as indicated by the following symptoms: *"the urge to sleep"*, *"body shutting down"*, *"tiredness"*, and *"I can see black lines ... white flashes"*. Their descriptions were often accompanied by lack of understanding about these symptoms *(e.g., "I feel scared" and "something* *doesn't feel right").* Despite these experiences, drivers believed that the effects of sleepiness were not a major health problem, therefore medical help was never sought.

There are several possible explanations for this belief. First, driver perceptions reflect the typical New Zealand taxi drivers' culture. That is, all drivers are aware of the risks of sleepiness whilst driving, but it is the culture to ignore the symptoms of sleepiness, because acknowledging it as a health problem might jeopardize their earning capacity. They were concerned about the loss of financial security, job security, or that their families will no longer share the same social and economic benefits as the rest of society. Drivers may have adopted this viewpoint because it serves as a coping strategy, allowing them to maintain employment and income. Second, drivers had no knowledge or awareness of the potential causes and explanations of sleepiness. From the outset of the focus group discussions, some drivers mentioned that they had no knowledge of sleepiness being symptomatic of a medical condition such as OSAS. Thus, ignorance may explain the failure of some drivers to consider sleepiness as a possible indicator of a health problem.

Mitler et al. (2005) suggests the concept of three types of sleepiness. (1) Physiological sleepiness refers to the biological drive for sleep (homeostatic and circadian processes). (2) Manifest sleepiness refers to the behavioural consequences of sleepiness. (3) Introspective sleepiness is an individual's self-report of their internal state. The Epworth Sleepiness Scale (ESS) measures introspective sleepiness. However, given the attitude that admitting to sleepiness may be risky for drivers, this measure needs to be interpreted with caution. Drivers gave multiple examples of manifest sleepiness, but no objective sleepiness measures were obtained.

Other factors were identified that may contribute to why drivers do not perceive sleepiness itself as a 'health problem'. Across all groups, it was reported that drivers believed that sleepiness was part of the *normal aging process*, or that driver's *lack the ability to recognise* the effects of sleepiness, or that drivers *prioritised other activities* in their daily life.

Sleepiness as part of normal aging

Viewing sleepiness as part of the normal aging process was a common perception amongst drivers. Furthermore, drivers considered sleepiness as inherent in the nature of their job, because it is a sedentary occupation. Therefore, most drivers did not associate sleepiness with their sleep habits and overall health. This perception was not surprising as many people do not view sleepiness as a serious health issue, and a likely explanation for this ignorance is the lack of understanding of the basic physiological need for sleep. The Background Chapter provided ample evidence about the importance of sleep and the effects of sleep deprivation on the waking function and health.

Drivers were correct in acknowledging that increasing sleepiness is part of the aging process, because changes in sleep patterns occur continuously with age. Especially in adulthood, sleep maintenance and sleep efficiency decreases with age (Bliwise, 2005). In addition, age-related changes in sleep are more pronounced in men. In the Sleep Health Heart Study (SHHS), there was a marked difference between men's and women's sleep architecture. For men, there was a significant decline in the average time spent in stages 3 and 4 with aging, as well as differences in every age group. Indeed, sex had a stronger effect than age in explaining the changes in sleep architecture (Redline et al., 2004).

Drivers' lack of ability to recognise the effects of sleepiness

Furthermore, Baldwin et al. (2004) found men and women answered questions on sleepiness differently. They reported that the ESS may be a more sensitive measure of subjective sleepiness among men than women. Therefore, drivers' inability to reliably recognise the effects of sleepiness, or to distinguish when it is normal or abnormal, is not unexpected.

Connors et al. (2002) case control study used the SSS to examine acute sleepiness among a representative sample of drivers in the Auckland metropolitan area, New Zealand. Driver-cases (n=571) involved in a car crash, where at least one person was seriously injured (hospitalised) or killed, and driver-controls (n=588) recruited while driving on public roads, were interviewed face-to-face or by telephone. After controlling for the effects of age, sex, alcohol, socioeconomic status, and ethnicity, the following three factors significantly increased the risk of MVA resulting in injury or death: (1) drivers with acute sleepiness scores (SSS score >4) had an eight fold increased risk of MVA, compared to drivers who scored one (most alert); (2) drivers who self-reported sleep duration was ≤ 5-hours sleep in the previous night had a 2.7 fold increased risk of MVA, compared to drivers who slept >5-hours in the previous 24-

hours; and (3) drivers who drove between 0200-0500 hours increased their risk of MVA by more than 500%, compared to drivers who drove at other times of the day. Of particular note, chronic sleepiness (ESS>10), symptoms of OSAS (regular snoring, episodes of choking and witnessed apnoeas), night shift-work, and sleep history in the previous week, were not significantly associated with MVAs. Although the prevalence of sleepiness was low (9.2% ESS$\geq$ 10), the authors concluded that sleep deprived drivers lacked the ability to judge the consequences of sleepiness.

Similarly, in North Carolina, Stutts et al. (1999) conducted a case-control study interviewing drivers identified as being asleep or fatigued from police-reported crashes, compared to drivers who were not classified as being asleep or fatigued. Drivers in sleep-related crashes reported having fewer hours of sleep the previous night, and one in five drivers stated sleeping less than four hours the night before their crash. It was assumed that drivers either routinely slept less, or had little sleep the night before their crash. Thus, sleep-deprived drivers lack the ability to judge the consequences of sleepiness.

Drivers prioritised other activities over health

There were key differences by ethnicity, in the perception of sleepiness as a health risk. The Māori/Pacific peoples group and drivers from the "other" ethnicities group concurred that sleepiness was a health risk. This was evident by drivers changing their work behaviour, such as logging off when tired, or going for a walk, or going home. The Māori/Pacific drivers in particular considered the needs and concerns of their family, and this was a distinguishing factor between this group and the others. The main reason underlying this different mindset and work ethic was that some drivers had experienced major lifestyle changes. That is, their awareness of the risks of poor health, sleepiness and driving were heightened compared to other drivers. On the other hand, some drivers did not hold a high regard for their personal health, because their motivation to attain financial security was a top priority.

Health concerns for drivers were predominantly reported as complaints from the drivers' sleeping partners and family members. In some cases, this was the only way that drivers acquired knowledge of a potential sleeping problem. Despite these complaints, drivers continued to ignore the fact that sleepiness may be symptomatic of an underlying sleep disorder. Some drivers (Paul and Harry) reported their disbelief in family members' description of their sleeping habits. Paul's reaction was particularly interesting, as he demonstrated 'disbelief' in how other's perceived his health and sleeping habits. This could be explained by: (1) having poor knowledge about the importance of good quality sleep, that is Paul does not understand the association between his sleep habits and disturbing other people's sleep; (2) personal hardiness allowed Paul to survive adverse consequences of his sleeping habits; or (3) Paul may not have a good relationship with his GP, which prevents him from seeking health care services. These explanations are in line with a review written by Tukuitonga and Finau (1997). They reported that Pacific people have the poorest knowledge about various health conditions (e.g., diabetes), which reflects poor access to health information. Furthermore, Davis et al. (1997) found GPs rated their rapport with Pacific people as the lowest. Another study reported financial, social, language and cultural factors as barriers that prevent Pacific peoples from accessing GP services (Gribben, 1993).

Research has shown that the sleep of bed-partners of individuals with OSAS is also affected. Effects included self-reported decrease in quality of life, increased somnolence, and reduced general health status (Parish & Lying, 2003; McArdle et al., 2001; Beninati et al., 1999; Kiely & McNicholas, 1997). Despite using different methods of evaluation, these studies found a general improvement in the overall quality of life and sleep quality among bed-partners of treated OSAS patients. It further indicated that family members and bed-partners have a better idea of the sufferer's sleeping problems.

Perceived safety risk

The Māori/Pacific peoples group and people of "other" ethnicities group paid more attention to the safety risks of sleepiness. These drivers were cognisant of the effects of sleepiness on their performance, alertness, and the risk of MVAs. In the Background Chapter, there is considerable evidence showing impaired performance and cognitive slowing occurs as a result of restricted sleep. The literature also demonstrated an association between sleepiness and MVAs among commercial drivers (Dalziel & Soames-Job, 1997a; Howard et al., 2004). From a different perspective, Åkerstedt (1991) argues that sleepiness is usually perceived before the individual falls asleep, and therefore sleepiness should be used as a warning that involuntary sleep may follow.

Åkerstedt is referring to the phenomenon known as micro-sleeps[24]. It is particularly dangerous for drivers because if sleepiness is severe enough, individuals experiencing micro-sleeps will completely cease interaction with the environment (Åkerstedt, 1988).

Why drivers continued to drive sleepy?

Drivers from the present study continued to work while apparently knowing the risks of driving while sleepy. It is well documented that sleepy driving increases the risk of accidents (Stutts et al., 2003; Yee et al., 2002; Stutts et al., 1999; Lyznicki et al., 1998; The American Thoracic Society, 1994). The question remains: *'Why do drivers ignore sleepiness and continue to drive?'*

First, there was a strong consensus among drivers that *sleepiness was inappropriate in the taxi industry*. This was transformed into *feeling or looking sleepy* meant drivers were *'unfit'* to work. This is compounded by stereotypical views associating sleepiness with being overweight or too lazy (Banno & Kryger, 2004). These critical views have been shown to be inhibiting factors for people in accessing health care services. Wittmann and Rodenstein (2004) reviewed patients' views on OSAS and treatment practices. Patients felt symptoms such as daytime sleepiness and snoring would not be a high priority for funded treatment, because society associated these symptoms with poor health and lifestyle. Medical professionals may also be an inhibiting factor, as they may hold prejudices against individuals who are obese (obesity is a robust predictor of OSAS). Schwartz et al. (2003) used the Implicit Associations Test (IAT) to assess implicit and explicit attitudes and feelings about fat and thin people. They also examined attitudes and personal experiences with obesity among clinicians and researchers (n=389) attending an international obesity conference. Their results showed that medical professionals exhibited significant anti-fat bias on the IAT. Compared with thin people, fat people were considered more lazy (0.68 ± 1.4; $t_{(129)}=5.7$; $p<0.0001$), stupid (0.19 ± 0.6; $t_{(148)}=3.8$; $p<0.0001$), and worthless (0.26 ± 1.2; $t_{(102)}=2.3$; $p<0.05$). Such findings suggest that some clinicians blame obese patients for their poor health status. It remains unclear whether these attitudes have an effect on clinicians' behaviour (e.g., treatment options offered). Regarding personal experiences with obese

[24] Micro-sleeps are characterised by the brain slipping in and out of very brief periods of sleep. The individual experiencing micro-sleeps generally has no awareness or control (Akerstedt, 1991).

people, one third of the sample and mostly clinicians indicated less anti-fat bias compared to those who worked indirectly with obese people (mainly students and researchers). In a sample of 259 obese patients surveyed using the Health Care Questionnaire at a university clinic, two thirds of participants indicated that most doctors did not comprehend the struggles of being overweight (Wittmann & Rodenstein, 2004). The literature indicates such barriers of prejudice are not new, and have been present long before OSAS was identified. For the current study, drivers may be indicating that it is the personal experience of being mistreated by health care professionals and the negative stigma associated with being unfit and overweight, that are preventing them from accessing health care.

Second, the members of the NZE group believed the *taxi driving culture* imposed demands on drivers to work long hours to the detriment of their health and safety. It is possible that drivers perceived this culture as part of their work ethic to work extended hours. There was a furtive element to this work ethic, which was the reported manipulation of the log book[25] system, and this behaviour is a marked characteristic of the taxi driving culture which permits higher earnings. There are regulatory limits on work hours[26], driving hours and rest periods to reduce the risk of fatigue, however these were not always respected by drivers in the current study.

Another characteristic of the 'taxi driving culture' was the 'bullet-proof' attitude which is usually established in the early years of taxi driving. This attitude was anecdotally reported across all three groups. It is a concern because it inhibits drivers' recognition of the need for adequate health and safety standards. The majority of participants from the focus groups were 'experienced' drivers, and their comments indicated that the taxi industry was partially responsible for the establishment of this attitude. That is, rapidly increasing numbers of taxi drivers and taxi organisations resulted from deregulation of

[25] The log book provides a record of a driver's work activity and enables enforcement officers to check compliance with the driving hours requirements. A driver must produce their log book to any enforcement officer for inspection when requested (LTNZ, Factsheet 2).

[26] A driver must: (1) not drive for more than 5.5 continuous hours; (2) must have at least a half hour rest after 5.5 hours of driving and before they do any more driving. Over a 24 hour period, a driver must: (1) not spend more than 11 hours driving; (2) not spend more than 14 hours on duty; (3) have at least nine continuous hours off-duty. In addition, after doing 66 hours driving, or 70 hours on-duty, a driver must have at least 24 hours continuous off-duty (LTNZ, Factsheet 2).

the industry in 1989 (Gwilliam, 2005; Reddish, 2004; Soon, 1999b). For this reason, drivers from the current study believed that more risk-taking (i.e., working beyond the maximum work hours, cheating on the log-book system) was necessary to achieve their financial goals. However, it is more than likely that chronic sleepiness might have affected some drivers' assessment of risk-taking (Harrison & Horne, 2000a), as well as reducing their ability to look after themselves. Dalziel and Job's (1997) study investigated 165 Sydney taxi drivers who exhibited higher risk-taking behaviours. On average 13% of sleepy drivers were more likely to experience falling asleep at the wheel, (compared to 9% of non-sleepy drivers, $F(1,147=8.1, p<0.01)$. One in five of the high risk drivers reported having a sleeping disorder, namely OSAS or another sleep problem. Dalziel and Job suggested that drivers who took on more risks by continuing to drive were fatigued.

In the current study, the risk of losing financial security far outweighed health and safety aspects of taxi driving, which is an attitude that relates to the taxi driving culture of risk-taking. This is in line with a study by Peltzer and Renner (2003) who investigated 130 South African taxi drivers via interviews using the Fatalism scale, and a 30-item questionnaire examining drivers' perceived causes of accidents. They found that careless driving ($r=0.208$, $p<0.05$), drivers' fraudulence ($r=0.246$, $p<0.01$), drivers' impatience and irritability ($r=0.281$, $p<0.001$), overconfidence ($r=0.269$, $p<0.01$), and lack of control ($r=0.302$, $p<0.001$) were positively correlated with risk-taking. The authors suggested drivers had a superstitious attitude (e.g., violating customs, witchcraft) towards accidents, and thus this contributed to a high level of risk-taking behaviour. It would be difficult to generalise their findings to other taxi drivers because the explanations were related to African ethnic and cultural practices.

A third reason why drivers continue to drive while sleepy is that *shift-work and social factors* such as partner-relationships and parenting also demand time and energy. These factors may play an additional role in explaining sleepiness (Monk, 2005).

As a final explanation, impaired cognition and performance secondary to an underlying (undiagnosed) sleep disorder such as OSAS may explain why drivers ignored the risks of sleepiness. The impaired cognitive effects of sleepiness have been well documented (Baulk, Reyner, & Horne, 2001; Corfitsen, 1993; Findley et al., 1995; Findley, Unverzagt, & Suratt, 1988; Greenberg, Watson, & Deptula, 1987; Harrison & Horne, 2000b; Harrison, Horne, & Rothwell, 2000; Horne & Wilkinson, 1985; Kollah, Namerow, Pasnau, & al., 1968).

The above considerations, and whether drivers are aware or not of an underlying sleep disorder, give rise to concerns of the lack of drivers' ability to know whether they are sleep impaired. This questions whether or not having 'knowledge' of symptoms and processes to access services would change a driver's decision about when to seek help. This is a major issue in the current study, as drivers indicated that if there were a greater awareness about sleepiness and sleep disorders such as OSAS, then drivers would heed the warnings and seek help. However, drivers contradicted this line of reasoning by prioritising income over seeking health care services, with or without knowledge about symptoms and risk. This was especially the case for the NZE group.

11.3 Theme 2: Perceived Industry Demands Inhibited Access to Healthcare

Industry demands were a major concern for drivers. Industry issues have their roots strongly embedded in a major policy shift in the late 1980s, when the Labour government decentralised the taxi industry. It is an important historical marker for this study, as drivers from all groups referred to it directly, thus effectively establishing it as a barrier to accessing health care. That is, to a large degree, many drivers transferred their blame for sleepiness and risky driving behaviours to the deregulated nature of the taxi industry.

11.3.1 The impact of deregulation

The 1989 legislation had a dramatic effect on the taxi industry in New Zealand. Some of the major impacts were also reported by the drivers in the focus groups. For instance, drivers were concerned about the permitted 'open entry' of new drivers and organisations. With deregulation, earning a living became much harder due to the increased number of drivers (Gaunt, 1996; Kang, 1998). In 1989, there were 107 operators and 2,762 taxis operating in New Zealand. By 1994, it had increased to 156 operators and 4,079 vehicles respectively (The Canberra Taxi Proprietors Association & Canberra Cabs, 2002). The urban areas observed the most change in the number of taxi organisations, number of vehicles, and the number of drivers. Soon (1999a) found the number of taxi companies trebled from 1989 to 1994 in the main city centres. The Executive Director of the New Zealand Taxi Federation (NZTF) reported that taxi driver numbers had grown 300% since deregulation in 1989, and that this is projected to increase in the near future. With the removal of quantity restrictions, other difficulties arose. This was evident by a number of unqualified drivers entering the workforce, characterised by the failure to demonstrate courtesy to customers, spoken language incompetence, and difficulties locating the right destinations (Kang, 1998), all of which increased stress levels and the competitiveness among drivers.

Another major impact of the 1989 Act was the termination of the regulatory role of the Director of Land Transport who authorised entry into the industry. Presently, an LTNZ regional officer carries out the 'fit and proper person' check (see Appendix 13).

The Taxi Industry Review Group (2000) of Canberra, Australia found that, rather than demand for service and company to company competition, fare changes post-deregulation were related to population. As anticipated, it was deemed to be an economic advancement for all at various levels of the industry including the customers. This was evident by the innovation of some taxi organisations offering new types of taxi services such as mini-buses and the promotion of 'executive' taxi services (Soon, 1999a). Customers, on the other hand, benefit from a diversity of services provided by licence holders and reduced waiting times. However, the benefit was not positive for taxi drivers, as reportedly there are queues of taxis awaiting customers due to the increased supply of drivers. Thus, drivers suffer in the long run.

Onus of responsibility for health and safety

For the current study, the competitive nature of the industry added pressure for drivers to work beyond regulated hours. However, there was disagreement among drivers about where the onus of responsibility lies for ensuring health and safety. Some drivers blamed the industry for pressuring them to work longer hours. Some drivers also believed that health and safety should be managed by the taxi companies, however not all agreed with this notion. Interesting to note was the discussion among drivers of different taxi organisations, as each company has their own policies and infrastructure, and this made it difficult for groups to arrive at a general consensus. For example, one taxi company in Wellington employed their own physician to carry out all medical examinations (Matthewson, 2005), and other organisations encouraged drivers to see their own GPs. This point demonstrates differences between companies that consider the health and well-being of drivers as a priority, while other companies do not. Drivers believe the ambiguity about responsibility resulted from deregulation, as companies could set up their own policy infrastructure.

In contrast, some drivers see the responsibility resting with individual taxi drivers, because they choose to work whilst being aware of the risks. As an owner-driver, under the Health and Safety in Employment (HSE) Act (1992), amended in 2003, both employers and employees are obliged to work together to prevent any harm that may arise out of work activities. Therefore, the primary responsibility to ensure good health and safety standards is a *joint affair*. In this act, the term 'healthy' is defined in a broad sense. It includes avoiding: work-related injuries and diseases, general health problems, stress from the work environment and from other procedures that may be contributing factors (Occupational Safety and Health Service & Department of Labour, 2003). It should be noted that the HSE Act does not require a formal written policy statement for health and safety, particularly if the staff numbers are less than 30 people. However, it endorses agreement between the employer and employees on implementation, and a system of employee participation in health and safety management (Occupational Safety and Health Service & Department of Labour, 2003).

11.3.2 Long work hours

Drivers in the current study who reported working beyond regulated hours were consistent with reports of taxi drivers from other studies (Dalziel & Soames-Job, 1997b; Machin & De Souza, 2004), where drivers were classified as high risk-takers when they continued to work when tired and with the knowledge that their chances of being involved in an accident increased. The present study attempted to understand the motivation behind drivers' risk-taking behaviours, and revealed a range of considerations: personal (e.g., risk-taking), contextual (e.g., shift-work times), environmental (e.g., competition), organisational (e.g., specific conditions) and policy-level (e.g., Land Transport 1989 Act) factors that suggest a deeper and complex interaction may also play an important role in influencing working conditions and driver behaviours.

Some studies have found that extended work duration is a key factor associated with sleep-related accidents (Connor, Norton, & Jackson, 2001; Philip et al., 2005; Stutts, Wilkins, Osberg, & Vaughn, 2003). Howard et al. (2004) found a relationship between chronic sleepiness and the use of illegal substances (e.g., narcotic analgesics) among their sample of commercial drivers, in order to maintain vigilance and wakefulness. For the current study, taxi drivers' risk-taking behaviours included the use of legal stimulants to aid their ability to continue driving beyond legal hours. Anecdotally, a taxi manager reported awareness of company drivers using illegal substances to maintain wakefulness in order to meet financial targets (Anonymous, 2003). Clearly this is an area that requires further in-depth investigation.

Deregulation was considered to contribute to long work hours, sleepiness, and poor health of taxi drivers, especially among drivers from the NZE group. No data was obtained from the group regarding their history of sleep, current health status, and tolerance for shift-work, so this could not be explored. However, this highlights a related issue regarding drivers taking responsibility for their own safety. The study by Stutt et al. (1999) of sleep-related crashes found that drivers who were identified as asleep or fatigued at the time of their crash were twice as likely to work multiple jobs, and that their primary job was outside normal work hours. Furthermore, they found that individuals who worked night shift had an increased risk of having sleep-related crashes compared to non-sleep related crashes (OR 5.72, 95% CI 3.22-10.16, $p<0.01$). It could be argued that the odds ratio may have been under-estimated, as the study was carried out retrospectively and drivers may not have been willing or able to recognise sleepiness as a contributing factor in crashes.

11.3.3 Shift work

According to Åkerstedt (1988) shift-work refers to an arrangement of work hours that utilises two or more shifts to cover the time needed for production. In the context of the current study, shift-work is considered to be any work pattern that does not permit people to sleep at their preferred time.

Taxi drivers work long and unsociable hours in order to make enough money. The times when drivers work are often not defined, only the total hours of work and rest. Compared to other shift-workers, their work patterns tend to be very unstructured. This raises some concerns for health and safety among taxi drivers, because the lack of structured work schedules facilitates drivers working beyond the regulatory limits. A number of studies have examined health and sleep problems among shift-workers. Richardson et al. (1989-90) and Akerstedt (1991) found that shift-work patterns have behavioural consequences such as increased work-related accidents and alcohol consumption. This is consistent with other studies (Akerstedt, 1988, , 1991; Gordon, Cleary, Parker, & Czeisler, 1986; Ingre & Akerstedt, 2004; Lushington, Lushington, & Dawson, 1997).

Drivers from the Māori/Pacific peoples group and drivers of "other" ethnicities group believed that taxi shift-work is particularly conducive to poor health due to its sedentary nature, and the inability to do regular exercise and physical activities. Shift-work has been posited to induce a greater risk of cardiovascular diseases such as angina and hypertension (Ingre & Åkerstedt, 2004; Quan et al., 1997; Moore-Ede & Richardson, 1985). Poor sleep hygiene and sleep loss can lead to negative behavioural states (e.g., overeating, alcohol consumption), which in turn increase the risk of OSAS and cardiovascular disease. Although existing studies do not show a causal link between chronic shift-work exposure and major public health diseases, the literature points to the demands of shift-work increasing the risk of compromised sleep and poor health practices, that can play a critical role in contributing to poor health (Richardson, Miner, & Czeisler, 1989-90).

Specific information on chronic health and sleep problems among taxi drivers in relation to shift-work patterns is limited. Dalziel and Jobs (1997) stated there was scant systematic research knowledge available on taxi drivers. More recently, a study carried out by Howard et al. (2004) surveyed 2,343 Australian commercial drivers. They found that, after adjusting for age, the likelihood of sleepiness increased when there was an increase in hours worked per week, or if drivers drove afternoon or night shift-work schedules. They also reported 24% of drivers had excessive sleepiness (defined by the ESS$\geq$ 11). In a sub-sample of 161 drivers who underwent PSG, a high proportion had SDB (59.6%), and OSAS (15.8%). For the sleepiest (5%) drivers, determined by the ESS and the FOSQ, there was an increased risk of accident involvement (OR 1.91, $p=0.02$, and OR 2.23, $p<0.01$, respectively) and multiple accidents (OR 2.67, $p<0.01$, and OR 2.39, $p=0.01$). The authors inferred that accident risk was associated with chronic sleepiness and drug use.

The ability to tolerate or cope with the demands of shift-work depends on an interaction between three types of factors: (1) circadian (the biological clock that regulates sleep-wake patterns); (2) sleep (the duration and quality of sleep achieved); and (3) domestic (the social and community aspects that affect behaviour) (Monk, 2005). In the current study, there were a small number of drivers who had approached taxi driving as a lifestyle, as a way of maintaining health and safety, and to ensure family well-being. These drivers took personal responsibility for maintaining health and safety, because of personal experiences of near misses or accidents, and for the sake of family well-being.

Shift-workers have to adapt their habits and lifestyle factors to their working hours and shift-work patterns (Stutts et al., 2003). A study carried out by Lushington et al. (1997) on nurses and their partners (n=50 couples) found that shift-work disrupted familial relationships, social life, and contributed to family conflict. The authors found that variable and unpredictable shift-work hours were conducive to poor social life. They suggested that shift-workers were better able to manage the demands of work and home by selecting preferred shift-work times (e.g., afternoon shift). This resembles the approach of those drivers in the current study, who tried to balance earning a living with their social life and family well-being.

Drivers did not give much information on their own coping strategies, aside from the common ideas such as, fresh air, refreshing oneself (e.g., splashing water on face), and drinking coffee, all of which have short term benefits at best (Gander, 2003). Little information about shift-work and sleepiness was acquired from the drivers, and this was probably due to drivers being extra cautious about expressing their views to avoid feeling intimidated, or being isolated by other drivers.

11.3.4 Concerns about the log book system

The log book system is a systematic means of monitoring drivers work hours to ensure they obey the regulatory limits. At an organisational level, they were seen as an effective way of standardising duty time, driving time, rest time, registering numbers of vehicles driven, and confirming the hubodometer readings of taxi vehicles (Land Transport Safety Authority, 2000). Under section 4B of the Land Transport Act 1989, drivers are required to retain a log book, or a copy of the log book indicating work hours and rest periods recorded in the last 24-hours, for inspection by an enforcement officer. Log books must be kept in storage for a period of 12 months.

Log books were implemented by the government in 1987, as commercial drivers were identified as being at risk because of their expectations to work long hours to maximise financial benefit (LTSA, 2000). The log book system was seen as a means of aiding administrative checks of driver compliance (LTSA, 2000). Inadequate sleep and sleep disorders were recognised as significant factors that may lead to lack of driver concentration, reduced alertness and accidents. Therefore, the government viewed the log-book system as a regime that drivers can use to self-monitor adequate sleep and rest periods (LTSA, 2000). In the case of an accident involving a taxi driver, log books can be reviewed to determine whether the accident was fatigued-related. In this way, the enforcement of the log book system can be seen as a safety measure to ensure that drivers have a systematic method of 'controlling' appropriate shift-work and rest periods.

However, drivers in the current study identified three significant loop-holes that compromised the log book system. First, log books were *randomly* checked by officials, so drivers did not feel that management structures took their work conditions seriously, therefore compliance was always going to be limited. Second, drivers can be *dishonest* with their recorded work hours, off duty hours and rest periods. The LTNZ recognised that drivers can falsify work hours entries in order to conceal their breaches of regulatory limits, however they do not have any evidence on how many drivers are breaching these limits (LTSA, 2000). A proposal to mandate electronic log books to overcome this problem was quashed due to the additional costs and feasibility of implementing such a system. Third, the log book system in effect encouraged drivers to work unsafely. That is, because drivers did not take the log books seriously, this increased their motivation to continue working whilst at risk. Therefore, the three loop holes in the log book system arguably paved the way for unsafe driving practices.

Drivers felt the taxi industry and the LTNZ have done little to improve working conditions, and the tension caused by the oversupply of taxi operators and the need to compete for an income has increased. The log book system has had a perverse effect on drivers, forcing them to be dishonest with their working hours, and allowing drivers to work unsafely. Recently, the LTNZ in conjunction with the NZTF successfully introduced a 3-year moratorium (as of late 2005), halting any new taxi drivers from entering the industry in New Zealand. However, this measure does not address the real issues that drivers face, because the current driver supply outweighs demand for services and this continues to increase the competitiveness among drivers. This is an area of concern that needs to be addressed by those at policy level, in dialogue with drivers.

11.4 Theme 3: Personal Demands Inhibited Access to Healthcare

This theme was the second most important theme. It was strongly articulated by the Māori/Pacific and "other" groups, and to a lesser degree by members of the NZE group. This theme has two components. The first component relates to financial security, and the second relates to demands imposed by family.

11.4.1 Financial security

This issue is centred on the need to meet financial targets, and was influenced by the 'taxi driver culture'. Most drivers spoke of this culture manifesting early in their taxi career experience, when there was a desire to work long hours in order to pay off their taxi business. It is assumed that, as part of the taxi driver culture, 'new' drivers take this attitude to 'overwork' placing themselves at greater risk of MVAs. Drivers were aware of the consequences of these risks, although this did not stop them from continuing to work in this manner. This issue is associated with the competitive nature of the job highlighted under theme two.

It could be argued that drivers feel the need to attain financial security in order to be healthy, to stabilise family affairs, and to participate in community and social activities. In a report by Howden-Chapman and Cram (1998), income inequality correlated with reported poor health, and they described financial security among people in the lower decile income range as being 'fluid' over time. Income instability may have been a motivating factor for participants to drive illegal hours, because their income varies on a daily basis. Income not only provides access to adequate health and education opportunities, it is a vital factor for community participation (e.g., taxi operational costs), and for upholding the dignity and identity of the family (e.g., pay house-hold bills, education fees). Thus, because taxi work does not guarantee fixed income, drivers are likely to experience income instability, and they perceive that being financially secure plays an important part in health and well-being. Maintaining financial security was prioritised over seeking help for existing health problems.

11.4.2 Demands imposed by family

There was agreement across all focus groups that working for a livelihood was important. Drivers from the Māori/Pacific group and people of "other" ethnicities in particular viewed family well-being as important. Most of the participants from the Māori/Pacific peoples group voiced a responsibility to their whānau and mokopuna. Bradley (Māori) typified this attitude. Similar views were expressed in a study undertaken by Durie et al. (1997) who interviewed 400 kaumātua aged 60 years and older. They found kaumātua led active lives, and were socially, physically and culturally involved within their own communities. With regards to whānau, they perceived their role as being that of a 'care-giver' and as 'significant contributors' to whānau wellbeing.

Māori drivers looked at health and well-being from a different perspective compared to the NZE and "other" ethnicities groups. Māori drivers took personal responsibility for their health and safety as professional drivers, in order to ensure the well-being of their whānau. This explains Bradley's motivation to work outside regulatory work hours in order to care for his sick wife, to bring up his children, and to ensure financial security.

It is a holistic concept which underlies how Māori perceive health. This is similar to how Māori in health is defined in public health terms:

"...focusing on empowering the whānau to take responsibility for their needs. Whānau provides the necessary cohesiveness and stability as a support to other societal structures ... The concept of Māori public health emphasises the importance of the overall wellbeing and status of people – tamariki, rangatahi, pakeke/matua, and kaumātua" *(p.13, Public Health Group 1997).*

It is important for Māori to define health for themselves. Māori are not a homogenous group and therefore, they should be able to define health specifically to their own conditions and later take responsibility for their own health concerns (Durie, 1998). The above definition of health fits with the position of the Māori drivers in the current study, who articulated their role in sustaining the well-being of whānau. Perceived health from a Pacific perspective was not explored further as no information was provided by the sole Pacific driver.

Whānau were the motivational drive for maintaining financial security. Two questions came to mind with regards to the demands imposed by whānau. The first question was: *'Why did the effects of sleepiness not motivate the drivers to seek health care?'* One possible explanation could be centred on the need to maintain identity. Durie (2000) stated good health for Māori was seen in their ability to develop, nurture and shape their cultural identity with whānau. For instance, drivers like Lewis and Bradley viewed their responsibilities in providing a *livelihood* as a part of ongoing whānau development. Therefore, obtaining income was vital to establish, nurture and sustain their cultural identity and health. This was similar to the perception of drivers of the "other" ethnicities group, who reported 'taxi driving' was an occupation which they had to accept in order to earn a livelihood. Thus, financial security allows for their cultural, social and family belonging to be established and sustainable in a new environment (i.e., drivers immigrated to New Zealand, and participating in community life).

The second question was: '*Did drivers avoid seeking help?*' There are some interesting issues here with regard to whānau demands. Three possible explanations were given as to why drivers might avoid seeking help. (1) There are negative connotations that society has placed on symptoms such as 'sleepiness' and 'snoring'. These symptoms are often associated with laziness, decreased work productivity, and are often the butt of jokes and humour. Such negative connotations have been considered factors that may inhibit patients with potential OSAS from accessing appropriate health care services (Banno & Kryger, 2004). This was associated with the feeling that drivers did not seek help, because they did not want to be recognised by other drivers as a risk to public safety. For example, two focus groups referred to a known driver with OSAS who had demonstrated risky driving behaviours, and he was not deterred from driving. (2) It could be that drivers are embarrassed to seek help. Drivers had explained that they did not need to seek help because they already knew what the problem was (e.g., obesity, high blood pressure), and having someone else inform them is not only embarrassing, but it made drivers feel ashamed. This was a reason why some drivers do not visit their GPs. Evidence supporting this was found by Rahaghi and Basner's (1999) study. Their findings indicated that patients with moderate to severe OSAS did not access sleep health services due to the lack of awareness of OSAS features, but also they did not report symptoms despite multiple encounters with their doctors. (3) Family members were often reported as the source of complaints about drivers' sleep habits, although most drivers had initially ignored these complaints. The complaints arose because the sleeping habits, mainly snoring, affected the quality of sleep for family members. A growing number of studies have found 'bed-partners' of undiagnosed and diagnosed OSAS individuals are affected by sleeping habits such as snoring and choking (McArdle, Kingshott, Engleman, Mackay, & Douglas, 2001; Parish & Somers, 2004; Punjabi, Bandeen-Roche, & Young, 2003; Reuveni et al., 2004; Weaver et al., 2003). Drivers did not seek help after initial family complaints because they did not want to risk any financial losses with their taxi business. Alternatively, some drivers had no knowledge of the symptoms of OSAS. This is consistent with a study by Dagan et al. (2006) of 153 professional drivers. They found 77% of drivers had OSA and 19% had severe sleepiness (as measured by the Multiple Sleep Latency Test), however drivers had not reported any symptoms of OSA and EDS. This is further supported by another study that found OSAS patients who did not report symptoms to their doctors for unknown reasons (Rahaghi & Basner, 1999). Overall, it appears that drivers avoided going to the doctor for multiple reasons (some outlined above and some unknown). Those drivers who sought medical help did so because their sleeping habits disturbed the sleep quality and the well-being of their family.

11.5 Theme 4: Fear of Loss of Job and Dissatisfaction with GP Services Inhibited Access to Care

This theme is one of the most interesting findings from the current study, because it relates to the themes previously discussed, and identifies some key concerns for further research. This theme is separated into two key areas identified from the findings, *ignorance* and *fear*.

11.5.1 Ignorance

Driver ignorance

In the current study, ignorance was referred to as having no knowledge or lack of awareness about the underlying causes and risks of sleepiness. From reviewing the findings as a whole, it appeared that drivers identified two factors that may explain driver ignorance.

Lack of knowledge of sleepiness as a potential health problem

Drivers reported that they had no knowledge or awareness that daytime sleepiness could be associated with a medical condition. In general, the issue of sleepiness was ignored by drivers as they considered it to be normal, or related to aging. This issue was in line with a study by Weaver et al. (2003) of recently diagnosed OSAS patients (n=213) who were surveyed using the SEMSA[27] to examine patient beliefs about OSA and CPAP treatment. They found that approximately half of the patients did not perceive problems with concentration, falling asleep while driving, or having an accident, as being related to OSAS. Moreover, about half of the OSAS patients did not perceive, or were not

[27] SEMSA: Self-Efficacy Measure for Sleep Apnoea – designed to assess adherence-related cognitions (Weaver et al., 2003).

knowledgeable about, the common risks associated with OSAS. Other studies have reported that lack of knowledge and awareness is symptomatic of shift-work effects (Akerstedt, 1988, , 1991; Richardson, Miner, & Czeisler, 1989-90). For most of the drivers, ignorance was overcome by either personal experience of near misses, or accidents, or when they were informed by significant others (e.g., family members).

Interestingly, some drivers held a degree of 'disbelief' in the notion that sleepiness could be an indicator of a severe medical condition. The researcher perceived this attitude as a coping strategy for drivers in trying to *save face,* particularly given the limitations that could be placed on their employment and financial status.

Lack of knowledge and awareness about available health services

Drivers reported lack of knowledge about who to see in the first instance. As described in the third theme, family members often complained to the drivers about their sleeping habits, but the complaints usually did not lead to action because drivers did not know what to do. This explanation is supported by a study by Rahaghi and Basner (1999) who found that patients referred to a sleep clinic, and subsequently diagnosed with OSAS, had not reported any symptoms or complaints to their physician despite multiple visits. This lead to a significant delay in diagnosis (i.e., 7 years delay in referral to sleep specialist). They further reported that part of the problem lies with physicians not asking the right questions about sleep disorders. It is not certain whether having knowledge about available diagnostic and treatment services would have an impact on changing drivers' behaviours, as striving for financial security has been shown to take priority over personal health and safety.

Ignorance of the medical profession

In conjunction with poor driver awareness, ignorance was compounded by those in the medical profession at the primary care level. It was clear from the groups' discussions that GPs had little knowledge and awareness of OSAS symptoms. This was evident by drivers' reports of doctors never asking questions about sleepiness, accident involvement since last seen, sleep hygiene, and other sleeping problems. This is in line with findings of Rahaghi and Basner (1999). Nugent and workers (2001) also reported that physicians failed to investigate sleepiness, its consequences and other sleeping problems when taking a medical history among a sample of middle-aged Irish males (n=2,364) who complained of EDS. This issue raises some serious concerns which will be discussed in Part Two.

Part of the explanation for GPs' limited knowledge lies in the lack of sleep education given during medical training. Taskforce 2000 was a study set up by the American Sleep Disorders Association (ASDA) and the Sleep Research Society (SRS). Its purpose was to identify and address any deficiencies in sleep education among ASDA and SRS undergraduate and graduate medical trainees. The study was conducted in two phases. In the first phase, a post-card survey was mailed to 3,100 members with the aim of identifying how many members were involved in sleep. It received 808 complete responses (26% response rate). The second phase of the study included an in-depth questionnaire mailed to members who responded to the post-card survey (response rate 32.2%). The survey covered a range of questions about the content and methods of current teaching in sleep, use of resources, barriers inhibiting implementation, and evaluation and effectiveness of teaching. Results from the post-card survey phase indicated that 65% of the respondents were involved in teaching sleep, and 30% were willing to teach if an opportunity arose. The majority of teaching occurred in the clinical years, while less occurred in residency and fellowship years. From the in-depth survey, the mean teaching time per course topic on sleep and sleep disorders was 2.11 hours (range: 0.75 – 10.0, sd=1.98), and education was primarily by lecture. Thirty percent of the respondents indicated the need for better teaching resources, and a further 8% requested more clinical materials. The most common obstacle to effective teaching was the lack of sleep education in the curriculum, and the need for better teaching resources (Rosen et al., 1998). The Taskforce suggested that sleep education should be a high priority for medical practitioners, with greater teaching efforts required during medical training. Similarly, in New Zealand, at the Wellington School of Medicine and Health Sciences, University of Otago, fifth year medical students are provided with a two hour tutorial-based training at the sleep clinic (Campbell, 2006). Presumably, each medical school differs in its approach to training students about sleep physiology and sleep disorders.

In the current study, the researcher had attempted on two separate occasions to investigate these issues by way of a focus group discussion with Wellington-based GPs, outlined under section 11.6. In the event, doctors were interested in OSAS but would not commit the time to participate in a group discussion outside work hours, which may be an indication of their level of interest. Alternatively, it could be an indication that other research methods may be more effective for GPs (e.g., postal questionnaire).

Another area that demonstrated the lack of knowledge and awareness at primary care level was seen in a screening form for clinical referrals to the sleep specialist, currently being used by members of the Wellington Independent Practitioners Association (WIPA). It incorporates the multivariate predictive tool devised by Mihaere (2004). In a review of its draft form it omitted the 'occupation' label. The researcher recommended the inclusion of this label, especially considering the context of the current study, where professional drivers are experiencing barriers to accessing health care services. It is arguable that, due to the increased risk of accidents for professional drivers, they should be given priority over other less at-risk occupational groups.

11.5.2 Avoidance

Avoiding additional expenses

To maintain a P-endorsement license, every five years drivers are required to obtain a medical certificate that indicates that minimum health criteria set by the LTNZ have been met. In the past, this process occurred on an annual basis, and the change to five-yearly intervals was intended to lessen the burden of administration due to the increasing number of taxi drivers. There were several issues that arose with regard to visiting the doctor between required medical check-ups.

Avoiding doctor visits

Drivers chose not to seek help from their GPs for two reasons. First, the *costs* imposed were a deterrent. Medical fees for a general consultation vary between surgeries and regions. As an example, at one Wellington-based GP surgery it costs $58.00 for an adult not eligible for a Community Services Card (CSC)[28], or under the Primary Health

[28] Community Services Card (CSC): also known as the Health Card or Discount Card. The purpose of the card is to help families or individuals on low to moderate incomes to pay for GP visits ($43.00) and medical prescriptions (Ministry of Health, 2005)

Organisation (PHO)[29] subsidy. In comparison, at another Wellington-based surgery, patients pay $65.00 per visit for a 15-minute consultation. It should be noted that costs depend on whether medical practices are part of a PHO and are funded under the interim funding formula[30]. In a report from the National Health Committee (1998), poor access to preventative health care and early intervention was associated with socio-economic status, where more affluent people had better access to high quality health services, compared to those in lower socio-economic levels. Taxi drivers are different from other occupational groups because income is not guaranteed on a daily basis. Therefore, not only do high medical costs deter drivers from accessing GPs, but drivers do not want to risk 'any' opportunity to earn an income.

Second, doctors' consultation sessions were also an issue of concern for drivers. They reported that *restrictive consultation times* (usually 15 minutes) were not conducive to improving access to care because little can be achieved in such a limited time-frame. Drivers felt that doctors provided little information to patients, or failed to recognise symptoms of OSAS, thus patients risk being mis-diagnosed, and are left with the feeling of being mis-treated. This concern is supported by previous literature (Nugent et al., 2001; Reuveni et al., 2004; Wadden et al., 2000). In New Zealand, the limited appointment times could be a direct result of the primary care health reforms, and new GPs' contractual arrangements introduced in the mid 1990s, with the establishment of the Independent Practice Association (IPA). The IPA represented GPs collectively, enabling them to regulate their own services (Barnett & Barnett, in Davis & Dew, 1999). This meant allied health professionals (e.g., nurses) played a more active role in providing primary health services, effectively reducing GPs' clinical contact hours and enabling them to undertake alternative work or professional development. It has been argued that GP services were being re-designed to serve business purposes rather than the actual health needs of the community (Barnett & Barnett, in Davis & Dew, 1999). One negative consequence is that drivers use other non-conventional sources of information, such as resorting to the internet, or reading books relevant to their perceived symptoms. It is reasonable to conclude that medical costs and restrictive

[29] PHO currently subsidises individuals in the 6-18 years group and 65 years+ group ($31.00).
[30] The interim funding formula is a model that recognises ethnicity and deprivation alongside age and sex as determinants of population needs (Ministry of Health, 2005)

appointment times are barriers to care for taxi drivers. The risk of the 'self-help' approach is that drivers lack the knowledge and training to make a differential diagnosis or select the most appropriate treatment.

11.5.3 Personal fear as a barrier to accessing health care

Personal fear of accessing health care was evident across all focus groups. However, it was primarily evident among members of the Māori/Pacific and "other" ethnicities groups. In hindsight, it was expected that drivers from the "other" ethnicities group would experience or perceive more fear and anxiety, because of their immigrant status in New Zealand. This expectation was evident where some drivers shared their experiences regarding the lack of employment opportunities. Personal fear related mostly to the fear of losing financial security.

Fear of losing financial security

The possibility of losing employment and the risk of financial losses was a serious concern for drivers in the current study. It was evident from the focus group findings that drivers feared doctors' visits because they were afraid of finding out about having a health problem. As an example, members from the Māori/Pacific peoples group stated:

"...might open up a can of worms"... "...they'll send you off for more tests and that'll delay you getting a certificate"...

The drivers were concerned about two primary issues. The first was the risk of being informed about a serious medical condition that could incur further tests and medical costs. This was a major issue for drivers, because it could also place restrictions on their ability to earn a living. A strong message from the discussion was that drivers feared having a medical condition that could lead to a loss of license.

The second primary issue evident from the discussion was the additional stress of having a major health condition, particularly in this occupation where income is not guaranteed. Embedded in this explanation is the fear of additional costs such as ongoing medical costs, laboratory fees, and work absences, which represent a burden for the drivers and their families.

11.6 Limitations of the Study

This study was carried out as an *exploratory* exercise. It established a research-based approach for understanding the views of taxi drivers. There are several limitations to the study that are outlined below.

11.6.1 Limitations of reliability and validity

Evaluating qualitative research for reliability and validity is a controversial issue. However, Beck (1993) has developed guidelines for improving reliability and validity which were used in the current study. The terms 'creditability', 'fittingness' and 'auditability' are used to refer to internal validity, external validity and reliability, respectively. Guba and Lincoln (1981) suggested this naturalistic approach, because it was more befitting of qualitative research.

Creditability (internal validity)

This term refers to how faithful the findings of the study are to the experiences of the participants. That is, the findings should be lucid, faithful and have a meaningful representation of the participants' experiences and perceptions. It also refers to how the research question was assessed (i.e., triangulation[31]). To improve the creditability of the current study, the researcher and assistant researcher took observational notes of any participant-researcher interactions, and where appropriate these have been incorporated into the findings and interpretation. The researcher acknowledged that her approach in the focus group discussions was more directive than usually recommended. However this was necessary to achieve the study objectives, as well as to encourage active participation (i.e., a positivist/inductive approach).

A full copy of the group discussion transcript was mailed to all participants to allow them opportunity to make clarifications and revisions. At a later date, a summary of the

[31] Triangulation is the use of multiple methods of data collection to determine the congruence of the findings (Beck, 1993).

main themes was mailed to the participants, so changes could be recommended and feedback elicited. This process was strongly endorsed by Greenbaum (1998) and Krueger (1993) as good practice. A period of three weeks was permitted for feedback on the transcripts and summaries, and any returned comments were incorporated into the analyses and findings. It is acknowledged that the notion of creditability should not be based on a simple correspondence between the participants and the researcher. Ideally, it requires further in-depth interviews or follow-up discussions. However, this was not feasible within the timeframe and limited resources available.

An attempt was made to provide triangulation. Triangulation is the use of multiple research methods to investigate the research question in order to gain a more valid and complete overview of the investigated phenomena (McKinlay, Plumridge, & Daley, 1999). An attempt was made to conduct a separate focus group study with GPs, to investigate the barriers to care for professional taxi drivers. In January 2005, 50 GPs in the Wellington region were randomly selected from the telephone directory. An information sheet explaining the objectives of the study, and preliminary findings from the survey questionnaire and focus groups, were provided for context. A consent form along with session dates and times was also provided. The same follow-up procedure utilised for focus group volunteer retention was also used, however only one GP consented to participate. Two months later, a second attempt to recruit GPs was made. We decided to target GPs (n=42) who had previously referred patients to the regional sleep clinic, to participate in a focus group study utilising the same procedures for the recruitment and retention of volunteers. Two GPs agreed to participate in the study. However, there was also feedback from GPs who declined to participate in the study, commenting on the need to investigate better access to OSAS health services. Other research approaches might have been more compatible with the work commitments and availability of GPs.

Fittingness (external validity)

This term refers to how representative the data are as a whole, and the means used to establish that the participants and their responses are typical (Guba & Lincoln, 1981). It is difficult to conclude with certainty that the findings of the study are representative of the views and experiences of the wider taxi community. Additional studies would be needed to establish a degree of external validity.

Auditability (reliability)

In quantitative science, reliability refers to how consistent the findings would be if the experiment were repeated. However, in qualitative research auditability refers to the ability of another researcher to follow the same decision-making pathway. In practical terms, this refers to the methods used to select participants, procedures and instruments used to collect the data, and whether an independent researcher would analyse and code the themes similar to the principal researcher (Guba & Lincoln, 1981).

The researcher and assistant researcher compared and contrasted statements and notes from each focus group. The purpose was to solidify any 'first impressions' of the focus group, and to clarify themes that occurred across the focus groups (Krueger, 1993). This process was critical for the establishment of themes.

In the current study, the following steps were taken to improve auditability:

- By keeping a clear decision trail used by the researchers (e.g., written notes, journal).
- Specification of selection criteria for participation.
- The combined use of digital recording and transcription, and the researchers' observational notes.
- Debriefing, in which both the researcher and the assistant researcher summarised the discussions, and later independently established similar themes and categories.

The limitations of the study's reliability and validity related primarily to the lack of triangulation, and the inability to demonstrate fittingness. However, this was the first study on taxi drivers utilising this research approach, and further similar studies are needed to confirm the generalizability of its findings.

11.6.2 Other limitations

There are five additional limitations of the study. The first is the lack of background information about the participants. Critical information such as in-depth medical history, current health status, socio-economic status, appropriate shift-work measures and sleep patterns, could have provided additional context to participants' perceptions. It is not known whether drivers would share such information, therefore further consultation with drivers is recommended regarding the benefits and how such information could be best collected for future research.

The second limitation was the lack of information on the sleep patterns of drivers using objective measures leading up to the focus group session. This could have provided insight into shift-work patterns, complementing the focus group data. Sleep patterns are commonly measured by wrist actigraphy[32]. Limited time, funding and resources prevented this information from being collected.

The third limitation was the lack of personality profiles or other attitudinal scales that could have provided additional information on drivers' perceptions and reasoning, particularly in relation to mood states and cognitive processes. Again, such information would have complemented the findings of the current study. Examples of complementary tests that could be of use in the future are: the SEMSA (Weaver et al., 2003), the SF-36 Health Survey, or the Functional Outcomes of Sleep Questionnaire (FOSQ) (Howard et al., 2004)

The fourth limitation of the study was the lack of participation of Pacific peoples in the focus group. The reason for their non-participation remains unknown. However, their input may have contributed valuable information, such as describing different driving behaviours, and identifying other barriers to care specific to Pacific peoples.

The final limitation of the study was the failure of the Wellington GP focus groups. Obtaining insight from GPs would have provided an important bridge to identifying the

[32] Wrist actigraphy is based on a wrist-worn device that measures the frequency and degree of wrist movement, and correlates well with polysomnographic measures of sleep (Signal et al. 2006).

barriers to care. However, the lack of availability and interest portrayed by GPs indicates that OSAS and sleep complaints may not be considered an important public health problem. Alternatively, it may be indicative of the lack of education and knowledge in this area.

Part II

11.7 Ethical Considerations

This part of the discussion chapter considers important issues identified during the current focus group study. The premise underlying this section is not based on scientific ethics, rather it is based on the basic ethics and morals of the main stakeholders in this study (i.e., taxi drivers, taxi companies, LTNZ, NZTF, GPs, and the appropriate legislation). The purpose of this section is to examine a number of ethical issues identified during the study, in the interests of facilitating future research on issues of access to health services, and OSAS among professional taxi drivers.

The first issue encountered was the resistance of taxi organisations, as they were anxious that the study could expose the industry in a critical or unhelpful light. At a meeting between the researcher and local taxi managers, the notion of *'big brother'* was discussed. This notion was aligned to a television reality show (called *Big Brother*) which publicly exposed intimate details and daily activities of volunteers. Taxi managers were not comfortable with the idea of having an academic institution examine the daily affairs of taxi drivers, as they feared any negative public exposure may place their professionalism and services at risk. Added to this, access to information and data about taxi drivers was difficult, which almost jeopardised the project. Establishing rapport, and ongoing consultation with the NZTF and local managers, permitted the study to continue.

Ethical concerns were considered at three levels:

- Cultural concerns
- The individual level
- The organisational level

11.7.1 Cultural Concerns

There is clinic-based evidence of Māori/Pacific peoples presenting at sleep services with disproportionately severe OSAS (Baldwin et al., 1998). This pattern of health service utilisation suggests that Māori/Pacific peoples are possibly experiencing barriers to care. Physical accessibility may not be the main issue, as indicated by a study by Middleton et al., (1999) who examined 94 patients who attended a clinic in Western Samoa. Patients heard about the sleep clinic services *by word of mouth*, and the authors found that severe OSAS was a significant and under-recognised problem in Samoa. Given how easy it was for people to attend their clinic, they suggested that physical accessibility to care was not a major problem. Although in New Zealand, physical accessibility is considered one of the major barriers, and this is accompanied by other barriers such as ignorance and fear. The current study hypothesised that Māori/Pacific drivers do experience barriers when accessing care for sleep complaints and OSAS symptoms. However, Māori/Pacific drivers reported good relationships with their GPs, and that they did not believe what previous research had shown. This is in contrast to what other studies have reported (e.g., poor relationships with GP, do not have the time to see the GP) (Ministry of Health, 2004b; Tukuitonga & Finau, 1997).

There is considerable evidence indicating that disparities exist between Māori/Pacific peoples and non-Māori and non-Pacific peoples in access and use of health services (Howden-Chapman & Cram, 1998). For example, a study carried out by Ratima et al. (1993) examined health needs assessment of Māori in Palmerston North. They found existing health services were not meeting Māori needs, and that the majority of Māori (1 in 3) experienced barriers when attempting to access care. The barriers to care were identified as being costs associated with health services, travelling distance to health care services, health services that were not culturally appropriate, and scant knowledge of health services. Similar barriers were identified in the current study as deterrents for drivers, especially among Māori/Pacific people and drivers of "other" ethnicities. Thus, drivers perception that there are 'no cultural or ethnic barriers to care' conflicts to some extent with the barriers they listed. Interestingly, some drivers from the Māori/Pacific peoples group perceived that 'cultural' aspects of ethnic disparities and the political issues around The Treaty of Wāitangi were primarily driven by the dominant New Zealand European culture. Drivers did not believe such issues affected their line of work, family or health circumstances. It is possible that in Wellington, services are more culturally appropriate and that Māori taxi drivers in particular are motivated to seek health care for safety reasons. Alternatively, it is possible that the experiences of the particular drivers in the current study are exceptional.

11.7.2 Ethical concerns for individual drivers

Tension of responsibility

One of the main issues identified by the researcher was the issue of '*onus of responsibility*'. There was considerable disagreement between drivers as to *who* is responsible for their overall health and well-being. Reference to the relevant legislation is appropriate here.

Health and Safety Act (HSE) (1992)

As some taxi drivers are 'self-employed' shareholders of a taxi company, effectively they are considered as 'employers'. The Occupational Safety and Health Service (OSH) of the Department of Labour (2003) has set up guidelines for employers to maintain a healthy and safe workplace. The HSE 1992 Act endorses effective communication between employers and employees to systematically identify hazards and to manage them (Occupational Safety and Health Service & Department of Labour, 2003). An amendment to the HSE Act in 2003 extended its coverage to include professional drivers, and it now recognises fatigue and shift-work as occupational hazards. The HSE Act (1992) does not require any formal written statement of health and safety policies. However, it does encourage the employer and employee to reach an agreement on health and safety policies as good practice. That is, 'best practice' standards depend on employers and employees taking on a *joint responsibility* for health and safety. Moreover, employers need to ensure that "all practicable steps" have been taken to manage hazards in the workplace. There is an expectation that the employer should be aware of and understand: (1) how their industry could harm someone; (2) the likelihood of harm; (3) how much is known about how to prevent harm; and (4) the availability and costs of safeguards (Department of Labour, 2006). From the current study, it appears that owner-drivers were not well informed about this expectation, as demonstrated by the disagreement between drivers' about the roles of the company and taxi driver in ensuring safe driving practices.

In the NZE group there was confusion and disagreement over the use of napping as a method of overcoming sleepiness when a driver is 'on duty'. Clearly, managing driver fatigue in this manner was not standard practice for all taxi drivers. With endorsement from the Department of Labour, the LTNZ produced the document, 'Your Safe Driving Policy'. It was developed to encourage companies to implement a safe driving policy that complies with the HSE Act (1992), and the ACC and employer responsibilities under the Injury Prevention, Rehabilitation and Compensation Act (2001) (see Appendix 14 for legal obligations). It is recommended that the safe driving policy includes driver education programmes, including strategies to reduce driver fatigue. In implementing such a policy, there is an implied assurance that all drivers are aware of, and comply with the legal requirements for commercial driving. The present study suggests that, drivers who are not covered by such a policy tend to be confused and/or disagree about managing driver fatigue. Moreover, the lack of a regulatory requirement for safe driving policies also contributes to the confusion and disagreement among drivers.

It is common practice for some organisations to use industry codes of practice. The NZTF have professional codes of practice, however these were not available to non-federated members. How these codes of practice are disseminated and monitored among taxi companies and owner-drivers is unknown. For taxi companies that are not associated with the NZTF, the assumption is that they have no fonnal codes of practice (Reddish, 2003; Soon, 1999a, , 1999b). The non-standardised approach across taxi organisations and drivers is a concern, as 'federated' and 'non-federated' drivers operate on different expectations and values. The difference between the two can be translated into 'best practices' for providing good services (i.e., according to codes of practice) versus working solely for an income (i.e., no codes of practice). As an example from a related industry, the trucking industry in Western Australia and in the Northern Territory operates under a code of practice for commercial drivers providing guidance on fatigue management, under the Occupational Safety and Health (OSH) Act 1984 of Western Australia. Drivers have access to policies and information on fatigue and sleep. There are recommendations for shift-work schedules, and medical health and fitness criteria, and these are available to all drivers. However, unlike the situation in New Zealand, this code of practice operates in the absence of prescriptive driving hours limits, which do not exist in Western Australia or the Northern Territory.

Experience from the drivers in the current study indicated that sleepiness was a major safety issue. Although the responsibility for health and safety is placed on owner-drivers, a written health and safety policy is not legally required. Thus, the locus of responsibility is clear in the HSE Act (1992), how to meet that responsibility is not prescribed. This is a concern because some drivers continue to take advantage and misuse the flexible nature of the taxi industry. Fatigued or sleepy drivers can continue to work whilst having knowledge of the consequences. With this risky behaviour, drivers effectively flout the HSE Act, because they are not legally required to agree to a safe driving policy.

11.7.3 Ethical issues concerning medical practitioners and sleep services

Medical practitioners

From the review of the findings, medical practitioners were considered by drivers as important players in providing the basic medical tests for health and fitness. They were also seen as bearers of health information for drivers, and gate-keepers for drivers to access specialist health services. The main concern expressed was that doctors lacked knowledge and awareness of OSAS symptoms and risk factors. Most drivers reported that their doctor did not routinely ask questions regarding OSAS symptoms. Some drivers were told that sleepiness was part of the normal aging process, or that they just needed to lose weight. This same issue has been identified by other studies (Banno & Kryger, 2004; Nugent et al., 2001; Rahaghi & Basner, 1999; Reuveni et al., 2004). The main outcome from all these studies (including the current study) is the recommendation to improve physician knowledge about OSAS and other sleep disorders.

Medical practitioners also play an important role in ensuring people are fit to drive. In 2002, the Land Transport Safety Authority published a booklet called *Medical Aspects of Fitness to Drive* (see Appendix 1). It was intended to be a guide for medical practitioners, optometrists and occupational therapists. The booklet outlines factors for doctors to consider when determining if a driver's fitness is an acceptable risk to themselves and other road users. According to the booklet,

"Medical practitioner assessment is required to evaluate the cause of symptoms, assess the severity of sleepiness, provide initial treatment recommendations and, where appropriate, refer an individual for specialist evaluation." (p.131)

Where a medical practitioner is aware of medical conditions and other factors that affect the ability to drive safely, they should inform the Chief Medical Advisor. This relies on all medical practitioners having the knowledge and awareness of causes of EDS, OSAS symptoms and risk factors. As indicated in the current study and in the literature, this is not the case. Part of the problem lies in the symptom reports by patients (drivers) and the accuracy of their accounts in relation to EDS and related MVAs. Medical practitioners can only act in accordance with the information provided. As demonstrated by the current study, taxi drivers did not report their symptoms or concerns, because they did not want to risk financial losses. Other studies reported the same behaviour, where commercial drivers did not want to risk personal identification or job security (Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997b; Howard et al., 2004).

Doctors are advised to recommend that driving should cease particularly if an individual meets a high-risk OSAS profile (p. 132, section 10.1.1 of the guide book):

- Individuals are *suspected* of having OSAS, particularly where there is a high level
- of concern about the risk of excessive sleepiness while driving, and/or while the
- individual is waiting for diagnosis confirmed via a sleep study. Individuals
- complain of severe EDS and have a history of sleep-related MVAs.
- Individuals who had a sleep study that shows severe OSAS that is either
- untreatable, or the individual is non-compliant with the available treatment.

Under these circumstances, the medical practitioner should inform the Director of the LTNZ under section 18 of the Land Transport Act, amended in 1998 (section 1.4). In the current study, there was confusion and concern from drivers about losing their job because they were afraid the doctor would inform the LTNZ about their health status. However, this is not necessarily the case. Depending on the severity of the disorder, drivers may only cease driving temporarily when medical practitioners are: (1) aware of the medical condition, (2) the condition is not currently treated, or (3) drivers do not follow through with the prescribed treatment plan. Thus, drivers' *misperception* of automatically losing their license permanently may have inhibited them from accessing health care when it was necessary. It should be remembered that OSAS is highly treatable, so driving can continue, depending on patient compliance with treatment. Also, depending on the severity of the disorder, a driver can continue to drive under specific conditions (e.g., restricted work hours, or work under the supervision of the medical practitioner), as was the case with Gary (NZE group) and Harry ("others" ethnicities group).

Sleep services

Polysomnography is essential for confirming a diagnosis of OSAS. It also allows the assessment of OSAS severity, and ensures rational treatment planning (Neill, Taylor, & Whyte, 2002). However, to obtain a polysomnographic sleep study requires referral to a specialist sleep physician. This problem is compounded by the lack of health services for objective diagnostic tests of sleepiness and OSAS, at a local and national level. This is a cause for concern because it may be a barrier to professional drivers obtaining best quality care. The limited availability of diagnostic services for OSAS is due to a lack of trained health professionals and health funding allocated to sleep investigations (LTSA, 2002). This has led to long waiting lists, and the practice of post-treatment management being returned to the patient's GP. Anecdotally, it has been reported that non-compliance and other management issues relating to the use of CPAP can be exacerbated by the lack of GP knowledge and training in sleep medicine (Campbell, 2005). A study designed to look at developing cost-effective services for the diagnosis and treatment services of OSAS in New Zealand is in progress at the Sleep/Wake Research Centre. Results from that study will shed light on the social and economic costs of OSAS, and provide guidance for public health strategies to reduce OSAS prevalence nationwide (Gander, Mihaere, Scott, & Scott, 2006).

11.7.4 Ethical issues regarding the role of taxi organisations

The NZTF is an incorporated society representing approximately 50% of the taxi industry (LTNZ, 2005). It advocates quality management and services in the passenger service industry (LTNZ, 2005). There are various member organisations affiliated with the NZTF, for example limousines and minibuses. For organisation members, at a national level the federation offers: (1) information about how to provide efficient and economic services to passengers; (2) advice to enhance passenger services; (3) advocacy in a political environment for equitable services; (4) collecting information from members in their respective transportation region and disseminating it; and (5) quality standards for drivers and their vehicles in order to maintain professional and safe work conduct. Whilst membership is not a legal requirement, new taxi companies and drivers are encouraged to join. This was a concern for the researcher, because it meant there is a two-tiered system in taxi operations. On the one hand, affiliated company members operate under professional standards, whilst on the other hand there are 'other' companies who have minimum standards resulting in poor drivers and vehicle compliance (LTNZ, 2005). Very little is known about non-affiliated taxi organisations and that makes commenting difficult. One solution would be a regulatory requirement for drivers to be members of a national association. In this way, national quality standards for all drivers could address driver and passenger safety. However, under the current political climate, drivers would not find this very palatable.

CHAPTER 12
CONCLUSIONS & RECOMMENDATIONS

Untreated OSAS is associated with increased risk of stroke, diabetes, hypertension and cardiovascular disease (Bixler et al., 2000; Grunstein, Stenlof, Hedner, & Sjostrom, 1995; Harris, 2003; Mohsenin, 2004; Newman et al., 2001; Nieto et al., 2000; Parish & Somers, 2004; Phillips, 2005; Raymond, Clayton, & Chappell, 2003; Richman et al., 1994; Simard et al., 2004; Verrier & Mittleman, 2005; Young & Javaheri, 2005; Young, Peppard, & Taheri, 2005), and it can even be fatal (Ancoli-Israel et al., 1996; Bliwise, Bliwise, Partinen, Pursley, & Dement, 1988; Lindberg et al., 1998; Pack, 2006; Redline & Strohl, 1999). Untreated OSAS among taxi drivers is a particular health and safety concern due to the sedentary nature of the job, unstructured shift-work, and the pressures of income instability in a competitive industry. This is an example of how socio-economic factors can affect health outcomes (Howden-Chapman & Cram, 1998).

Untreated OSAS also increases the risk of MVAs and injury (Findley et al., 1995; Findley, Unverzagt, & Suratt, 1988; Teran-Santos, Jimenez-Gomez, Cordero-Guevara, & Burgos-Santander., 1999; Wu & Yan-Go, 1996; Young, Blustein, Finn, & Palta, 1997). Obtaining successful treatment is dependent on patient compliance with CPAP, which reduces the MVA risk back to population norms (Findley et al., 1989; George, 2001, , 2004). For taxi drivers, the MVA risk is compounded by the fact that they spend a considerable amount of time driving, thus they have a high exposure to accident risk. The oversupply of taxi drivers and the inadequate enforcement of the log book system, encourages driving excessive hours, which also increases the risk of MVAs.

The survey questionnaire supports the hypothesis that OSAS symptoms and risk factors are common among this sample of taxi drivers, and especially prevalent among Pacific people, followed by Māori. The crude pre-test risk of OSAS (15%) was reasonably high, although the limitations of the study prevent accurate estimation of the population prevalence of OSAS. The findings are also limited by the lack of statistical power, however they are consistent with previous studies suggesting that OSAS is a public health and safety concern among professional drivers (Carmona et al., 2000; Charlton, Baas, & Alley, 2003; Dalziel & Soames-Job, 1997a, , 1997b; Howard et al., 2004; Hui et al., 2002).

Overall, the research was predicated on the expectation of differences by ethnicity in the questionnaire and focus groups studies. In the questionnaire study, logistic regression modelling did not identify any differences by ethnicity after controlling for potential confounding factors. However, the study had limited power to detect differences by ethnicity because of the limited number of Māori and Pacific participants, which resulted in very large confidence intervals on measures for these groups. For example, the univariate relationship between Pacific ethnicity and the increased likelihood of reporting always snoring was no longer significant after controlling for neck circumference and night work (Table 4.14). The independent odds ratio was 1.62, with a confidence interval of 0.50-5.27. It is possible that being of Pacific ethnicity was an independent risk factor, but that the study was underpowered to detect it. Interestingly, in the focus groups, difference by participants in the Māori/Pacific group were atypical in having a trusting relationship with their GPs, and/or being aware of their health conditions, and/or in taking responsibility for their well-being. An alternative explanation could be that the use of focus groups may have discouraged some drivers who do experience barriers to care from giving their perspectives. If this was the case, then 1:1 interviews may have been a better alternative. However, it is not certain whether such drivers would come forward even if this approach was offered.

The focus group discussions identified a range of barriers to care. These are summarised below, followed by recommendations specifically targeted for health and transport policy-makers, GPs, taxi company managers and taxi drivers.

12.1.1 Sleepiness was not considered symptomatic of a health problem

For the majority of drivers, sleepiness was recognised as a safety risk, but not considered a possible symptom of a medical condition. Sleepiness was explained as a normal part of aging, or the result of a sedentary job. It was not explicitly recognised as a result of lack of sleep or of sleep disruption, by OSAS for example.

Recommendations

1. That education about sleep, sleepiness, and fatigue management be mandatory and tested as part of the P-endorsement license process. Information such as good strategies used by some drivers could be incorporated. This includes power napping, taking regular breaks for exercise, and encouraging drivers to stop work when fatigue, tiredness or sleepiness impacts on their cognitive and performance abilities. However, it is not certain that such information would increase driver utilisation of health services for the following reasons.

    - Drivers are insecure about earning a living due to the oversupply of taxi drivers, especially as day-to-day income is variable.
    - Some drivers' attitudes about their own health limit their utilisation of health services. This was evident by: (1) the fact that financial security was prioritised ahead of personal health, or it was seen as a vital component of maintaining health in the broader context, which includes meeting whānau responsibilities; (2) the 'taxi culture' accepts risk-taking by driving long hours, particularly early in a career when vehicles and company membership must be paid off; (3) some drivers expressed disbelief when informed by family members of their disruptive sleep habits (witnessing apnoeas and loud snoring). This may be linked to ignorance and fear; and (4) it is reasonable to believe that chronic sleepiness and untreated OSAS affected the decision making and risk assessment of some drivers (Bonnet, 1985; Corfitsen, 1993; Dalziel & Soames-Job, 1997b; Greenberg, Watson, & Deptula, 1987; Harrison & Horne, 2000a; Harrison, Horne, & Rothwell, 2000).
    - Seeing a GP involves several potential threats to their livelihood such as: (1) time out from driving, which means loss of income to attend the appointment; (2) the costs of the appointment and the recommended medical treatment is a deterrent in accessing care; and (3) the risk of being diagnosed with a health problem that could lead to loss of a driver's taxi license and livelihood.
    - Some drivers are not confident about the services provided by GPs. This was recognised by: (1) the perceived lack of GP knowledge about sleepiness,

OSAS, and sleep problems in general; (2) a 15-minute appointment does not allow for meaningful discussion of issues; (3) some drivers were embarrassed, or felt that GPs would respond to their reports of sleepiness and snoring by telling them to lose weight; and (4) drivers are not necessarily honest with their GPs, because of their fears about being diagnosed with a health problem that could lead to the loss of license. On the other hand, driver's fears in this regard are based on poor understanding of the conditions around license withdrawal.

2. The recently introduced moratorium on new taxi licenses should help reduce competitive pressures in the industry. Based on the findings of this study, the implementation of this moratorium is commended.

3. Improvements in the log book system such as electronic, tamper-proof logs, and better policing of driving hours might discourage excessive driving hours, and create a level playing field for drivers and companies who are more safety conscious.

4. One solution to improve drivers' confidence in, and utilisation of GPs, would be to have specialist medical physicians that independently examine health and fitness for driving medicals. This is done for pilots' medical examinations for fitness to fly (Gander, 2006a).

The improvement in the knowledge training of GPs could substantially improve access to sleep specialist services. This might also increase drivers' confidence in health services.

12.1.2 Responsibility for occupational health and safety

There was confusion over who is responsible for safe work practices. The Māori/Pacific drivers were more likely to accept personal responsibility, compared to the NZE drivers. Companies belonging to the NZTF are more likely to adopt industry codes of practice and have safe driving policies.

Of note, it was hypothesized that ethnicity also affected drivers' access to health care services. However, Māori/Pacific drivers refuted this assumption, as most reported good relationships with their GP. This contrasts with other studies which have demonstrated ethnic barriers to care (Baxter, 2002; Ministry of Health, 2004b; Tukuitonga & Bindman, 2002; Tukuitonga & Finau, 1997; Westbrook, Baxter, & Hogan, 2000). The Māori/Pacific drivers were the only group who described changing their driving behaviour when they felt sleepy (e.g., logging off, going home, and exercising). This demonstrated that these drivers seemed generally more aware of sleepiness as a health and safety risk.

Recommendations

1. That all taxi companies be required to have at least a safe driving policy. It is recognised that mandatory requirements run counter to the prevailing climate in occupational health and safety legislation, but this measure could improve industry safety, and provide a fair playing field for drivers and companies who adhere to safe work practices.

12.1.3 Issues relating to the medical profession

GPs play a significant role in helping drivers stay healthy. They are a source of health information, and they are the 'gate-keepers' to access other specialist health services. However, it was clear that GPs lacked the education and knowledge about sleep and related disorders.

There is also a lack of clinicians with specialist training in sleep medicine, and insufficient funding of sleep services to meet population needs (Neill, Taylor, & Whyte, 2002).

Recommendations

1. GPs need better education and up-skilling about sleep disorders including OSAS, and in managing professional drivers and shift-workers. Part of the responsibility lies with the LTNZ, who should ensure that drivers and medical

practitioners have access to clear information on license suspension and reinstatement, based on personal health status.

2. It is recommended that the Ministry of Health (New Zealand) undertake an initiative to develop a systematic and cost-effective approach to the provision of sleep medicine services. There is already a considerable amount of epidemiological data to guide such an initiative (Gander, Marshall, Harris, & Papaarangi, 2005; Gander, Marshall, Harris, & Reid, 2005; Harris, 1998, , 2003; Marshall, Bolger, & Gander, 2004; Marshall, Gander, & Neill, 2003; Mihaere, 2004; Neill, Taylor, & Whyte, 2002). Studies are also currently underway to estimate the economic and social costs of OSAS in New Zealand, and to develop models for simulating the cost effects of introducing different treatment approaches (Gander, 2006a).

12.1.4 Recommendations for future research with taxi drivers

There are two major strengths evident from this study. The first strength was the qualitative research approach, which has proven to be a successful method for obtaining rich contextual information. No questionnaire or interview could have allowed for a wide scope of personal experiences and issues to be explored, discussed, agreed, and disagreed upon. This was the power of the focus group approach. The second strength was the successful identification of barriers to care for professional drivers, as well as the identification of gaps for future research. The mixture of quantitative and qualitative research methods is important to obtain a holistic overview of OSAS among taxi drivers, and to investigate barriers to accessing health care. Future research should consider this approach.

Careful attention to consultation with various stakeholders (e.g., individual drivers, taxi companies, GPs, NZTF, and LTNZ) is necessary for further research projects. This is essential to ensure data accuracy, and to increase the likelihood that research findings will lead to improved health and safety for drivers. Additional research is needed in the following areas.

- A national survey questionnaire study is needed to estimate the prevalence of OSAS symptoms and the risk of MVAs among taxi drivers. This could be complemented by more detailed studies of a subset of drivers, using objective measures such as home-based PSG and official accident data.
- More detailed information is needed about the nature and conditions of drivers' shift-work patterns, and their relationship to sleepiness, fatigue, driving behaviours, and personal coping strategies.
- It is recommended that qualitative approaches complement questionnaire surveys. Focus groups could be composed of different groups of drivers to answer different research questions. For example, drivers from the same taxi company would provide a better understanding of a company's health and safety policies and practices.
- Key informant interviews may serve as a more pragmatic approach with personnel at company management level, transport policy-makers, and GPs, to examine administrative issues and referral processes. Such information will aide in developing decision rules for the assessment and treatment of OSAS (and other sleep disorders) among professional taxi drivers.
- There is a need to investigate the impact of OSAS on the quality of life of professional drivers and their families. This could provide additional information about barriers to, and through care.

In conclusion, the present study adds a wealth of information identifying factors that inhibited access to health services for taxi drivers with sleep problems. The findings from the focus groups strongly reinforce the position that it is not simply a matter of providing more specialist sleep services. Rather, it is also vital to understand the factors which encourage or discourage at-risk groups from using these services. The breadth of issues raised reinforces the wide-ranging effects of socio-economic factors on health (Banno & Kryger, 2004; Gander, Marshall, Harris, & Reid, 2005; Harris, 2003; Howden-Chapman & Cram, 1998). The most outstanding barrier to care identified in this study was that earning a living was prioritised higher than personal health and safety. The challenge remains not only to improve drivers' knowledge and understanding of health and safety, but also to address the systemic issues in health care services and in the taxi industry, that currently represent barriers to drivers accessing care for OSAS and other sleep-related problems.

REFERENCES

Akerstedt, T. (1988). Sleepiness as a consequence of shift work. *Sleep, 11*(1), 17-34.

Akerstedt, T. (1991). Sleepiness at work: effects of irregular work hours. In T. Monk (Ed.), *Sleep, sleepiness and performance*. Chichester: John Wiley & Sons Ltd.

Aldrich, M. (1989). Automobile accidents in patients with sleep disorders. *Sleep, 12*(6), 487-494.

American Academy of Sleep Medicine. (1999). Sleep-related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research. *Sleep, 22*(5), 667-689.

American Academy of Sleep Medicine. (2005). *The international classification of sleep disorders* (Second ed.). Westchester, IL: American Academy of Sleep Medicine.

American Sleep Disorders Association. (1997). *The international classification of sleep disorders (revised), diagnostic and coding manual.* Minnesota: Davies Printing Company.

Ancoli-Israel, S., Gehrman, P., Kripke, D., Stepnowsky, C. J., Mason, W., Cohen-Zion, M., et al. (2001). Long-term follow-up of sleep disordered breathing in older adults. *Sleep Medicine, 2*, 511-516.

Ancoli-Israel, S., Kripke, D., Klauber, M., Fell, R., Stepnowsky, C., Estline, E., et al. (1996). Morbidity, mortality and sleep-disordered breathing in community dwelling elderly. *Sleep, 19*, 277-282.

Anonymous. (2003). Tele-communication with a Wellington taxi company manager about work habits of drivers. Wellington.

Arand, D., Bonnet, M., Hurwitz, T., Mitler, M., Rosa, R., & Sangal, R. B. (2005). The clinical use of the MSLT and MWT. *Sleep, 28*(1), 123-144.

Ayappa, I., & Rapoport, D. M. (2003). The upper airway in sleep: physiology of the pharynx. *Sleep Medicine Reviews, 7*(1), 9-33.

Ayas, N., White, D., Manson, J., Stampfer, M., Speizer, F., Malhotra, A., et al. (2003). A prospective study of sleep duration and coronary heart disease in women. *Arch Intern Med, 163*, 205-209.

Bahammam, A., Delaive, K., Ronald, J., Manfreda, J., Roos, L., & Kryger, M. (1999). Health care utilization in males with obstructive sleep apnea syndrome two years after diagnosis and treatment. *Sleep, 22*(6), 740-747.

Baldwin, D., Kolbe, J., Troy, K., Belcher, J., Gibbs, H., Frankel, A., et al. (1998). Comparative clinical and physiological features of Maori, Pacific Islanders and Europeans with sleep related breathing disorders. *Respirology, 3*(253-260).

Banno, K., & Kryger, M. (2004). Factors limiting access to services for sleep apnea patients. *Sleep Medicine Reviews, 8*(4), 253-255.

Barnes, M., McEvoy, R., Banks, S., & al., e. (2004). Efficacy of positive airway pressure and oral appliance in mild to moderate obstructive sleep apnea. *Am J Respir Crit Care Med, 170*, 773-780.

Bassetti, C. (2005). Sleep and stroke. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition.* Philadephia: W.B.Saunders Company.

Bassetti, C., Aldrich, M., Chervin, R., & Quint, D. (1996). Sleep apnea in the acute phase of TIA and stroke. *Neurology, 47*, 1167-1173.

Baulk, S. D., Reyner, L. A., & Horne, J. A. (2001). Driver sleepiness - evaluation of reaction time measurement as a secondary task. *Sleep, 24*(6), 695-698.

Baxter, J. (2002). *Barriers to health care for Maori with known Diabetes: a literature review and summary of issues.* Wellington: New Zealand National Working Group on Diabetes.

Bearpark, H., Elliott, L., Grunstein, R., Cullen, S., Schneider, H., Althaus, W., et al. (1995). Snoring and sleep apnea. A population study in Australian men. *Am J Respir Crit Care Med, 151*(5), 1459-1465.

Becker, H., Jerrentrup, A., Ploch, T., Grote, L., Penzel, T., Sullivan, C., et al. (2003). Effect of nasal continuous positive airway pressure treatment on blood pressure in patients with obstructive sleep apnea. *Circulation, 107*, 68-73.

Beebe, D. W., Groesz, L., Wells, C., Nichols, A., & McGee, K. (2003). The neuropsychological effects of obstructive sleep apnea: a meta-analysis of norm-referenced and case-controlled data. *Sleep, 26*(3), 298-307.

Belenky, G., Wesensten, N., Thorne, D., Thomas, M., Sing, H., Redmond, D., et al. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *Journal of Sleep Research, 12*, 1-12.

Bittencourt, L. R., Suchecki, D., Tufik, S., Peres, C., Togeiro, S., Da Cunha Bagnato, M., et al. (2001). The variability of the apnoa-hypopnea index. *Journal of Sleep Research, 10*, 245-251.

Bixler, E., Vgontzas, A., Lin, H.-M., Have, T., Leiby, B., Vela-Bueno, A., et al. (2000). Association of hypertension and sleep-disordered breathing. *Arch Intern Med, 160*, 2289-2295.

Bixler, E., Vgontzas, A., Lin, H., Ten Have, T., Rein, J., Vela-Bueno, A., et al. (2001). Prevalence of sleep-disordered breathing in women: effects of gender. *Am J Respir Crit Care Med, 163*(3 Pt 1), 608-613.

Bixler, E., Vgontzas, A., Ten Have, T., Tyson, K., & Kales, A. (1998). Effects of age on sleep apnea in men: I. Prevalence and severity. *Am J Respir Crit Care Med, 157*(1), 144-148.

Bliwise, D. (2005). Normal aging. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Bliwise, D., Bliwise, N., Partinen, M., Pursley, A., & Dement, W. (1988). Sleep apnea ad mortality in an aged cohort. *American Journal of Public Health, 78*, 544-547.

Bonnet, M. (1985). Effect of sleep disruption on sleep, performance and mood. *Sleep, 8*(1), 11-19.

Bonnet, M. (2005). Acute sleep deprivation. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition*. Philadelphia: W.B.Saunders Company.

Bonnet, M., & Arand, D. (2005). Performance and cardiovascular measures in normal adults with extreme MSLT scores and subjective sleepiness levels. *Sleep, 28*(6), 685-693.

Borbely, A., & Achermann, P. (2000). Sleep homeostasis and models of sleep regulation. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine*. Philadelphia: W.B.Saunders Company.

Bradley, T., & Floras, J. (2003). Sleep apnea and heart failure: Part I Obstructuve sleep apnea. *Circulation, 107*, 1671-1678.

Bradley, V., & O'Neill, D. C. (2005). Cardinal manifestations of sleep disorders. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine*. Philadephia: Elsevier Saunders.

Brendel, D., Reynolds, C., Jennings, J., Hoch, C., Monk, T., Berman, S., et al. (1990). Sleep stage physiology, mood, and vigilance responses to total sleep deprivation in health 80-year olds and 20-year olds. *Psychophysiology, 27*(6), 677-685.

Campbell, A. (2005). Academic Mentor: Outline of OSA services in New Zealand. Wellington.

Campbell, A. (2006). Email discussion about sleep medicine education with medical students. Wellington.

Carmona, B., Capote, G., Botebol, B., Garcia, L., Sanchez, A., & Castillo, G. (2000). Assessment of excessive day-time sleepiness in professional drivers with suspected obstructive sleep apnea syndrome. (Abstract). *Archivos de Bronconeumologia, 36*(8), 436-440.

Carskadon, M., & Dement, W. (1982). The multiple sleep-latency test: what does it measure? *Sleep, 5(Suppl)*, 248-255.

Carskadon, M., & Rechtschaffen, A. (2005). Monitoring and staging human sleep. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition*. Philadephia: W.B.Saunders Company.

Carskadon, M., & Roth, T. (1991). Sleep restricition. In T. Monk (Ed.), *Sleep, sleepiness and performance*. Chichester: John Wiley & Sons.

Cassel, w., Ploch, T., Becker, C., Dugnus, D., Peter, J. H., & von Wichert, P. (1996). Risk of traffic accidents in patients with sleep-disordered breathing: reduction with nasal CPAP. *European Respiratory Journal, 9*(12), 2606-2611.

Charlton, S., Baas, P., & Alley, B. (2003). *Analysis of fatigue levels in New Zealand taxi and local-route truck drivers*. Hamilton: Land Transport Safety Association.

Charmaz, K. (1994). The Grounded Theory Method: An explication and interpretation. In B. Glaser (Ed.), *More Grounded Theory Methodology: a reader* (pp. 96-99): Sociology Press.

Chase, M., & Morales, F. (2005). Control of motorneurons during sleep. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition*. Philadelphia: Elsevier Saunders.

Chervin, R. (2005). Use of clinical tools and tests in sleep medicine. In M. Kryger, T. Roth & W. Dement (Eds.), *Priniciples and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Esleviers Saunders.

Clayton, D., & Hills, M. (1993). *Statistical models in epidemiology.* New York: Oxford University Press.

Connor, J., Norton, R., Ameratunga, S., Robinson, E., Civil, I., Dunn, R., et al. (2002). Driver sleepiness and risk of serious injury to car occupants: population based case control study. *Bmj, 324*(7346), 1125.

Connor, J., Norton, R., Ameratunga, S., Robinson, E., Wigmore, B., & Jackson, R. (2001). Prevalence of driver sleepiness in a random population-based sample of car driving. *Sleep, 24*(6), 688-694.

Connor, J., Norton, R., & Jackson, R. (2001). The role of driver sleepiness in car crashes: a systematic review of epidemiological studies. *Accident Analysis and Prevention, 33*, 31-41.

Corfitsen, M. (1993). Tiredness and visual reaction time among nighttime cab drivers: a roadside survey. *Accident Analysis and Prevention, 25*(6), 667-673.

Crengle, S. (2000). The development of Maori primary care services. *Pacific Health Dialog, 7*(1), 48-53.

Czeisler, C., Buxton, O., & Khalsa, S. (2000). The human circadian timing system and sleep-wake regulation. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and practice of sleep medicine, 3rd Edition* (Third ed.). Philadephia: W.B. Saunders Company.

Czeisler, C., Zimmerman, J., Ronda, J., Moore-Ede, M., & Weitzman, E. (1980). Timing of REM sleep is coupled to the circadian rhythm of body temperature in man. *Sleep, 2*(3), 329-346.

Dalziel, J., & Soames-Job, R. (1997a). Motor vehicle accidents, fatigue and optimism bias in taxi drivers. *Accident Analysis and Prevention, 29*(4), 489-494.

Dalziel, J., & Soames-Job, R. (1997b). Risk-taking and fatigue in taxi drivers. *Unpublished paper.*, 1-8.

Davies, R., Turner, R., Crosby, J., & Stradling, J. (1994). Neck circumference and other clinical features in the diagnosis of the obstructive sleep apnoea syndrome. *Thorax, 47*, 101-105.

Delaibatiki, M. (2003). *Obstructive sleep apnoea syndrome: symptoms and risk factors among New Zealand adults. Pacific people's report.* Wellington: Wellington School of Medicine.

Department of Labour. (2006). Guidance on the application of the duty to take "all practicable steps".

Devoto, A., Lucidi, F., Violani, C., & Bertini, M. (1999). Effects of different sleep reductions on daytime sleepiness. *Sleep, 22*(3), 336-343.

Dew, K. (2001). Lecture notes: Social Research Methods. Wellington.

Dijk, D., & Franken, P. (2000). Interactions of sleep homeostasis and circadian rhymicity: dependent or independent states. In M. Kryger, T. Roth & C. Dement

(Eds.), *Principles andpractice of sleep medicine.* Philadelphia: W.B.Saunders Company.

Dinges, D. (1992). Probing the limits of functional capability: the effects of sleep loss on short-duration tasks. In R. Broughton & R. Ogilvie (Eds.), *Sleep, Arousal, and Performance.* Boston: Birkhauser.

Dinges, D. F., Pack, F., Williams, K., Gillen, K. A., Powell, J. W., Ott, G. E., et al. (1997). Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep, 20*(4), 267-277.

Duran, J., Esnaola, S., Rubio, R., & Iztueta, A. (2001). Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 years. *Am J Respir Crit Care Med, 163*, 685-689.

Durie, M. (1998). *Whaiora: Maori health development* (Second ed.). Auckland: Oxford University Press.

Durie, M., Allan, G., Cunningham, C., Edwards, W., Forster, M., Gillies, A., et al. (1997). *Oranga Kaumatua: the health and wellbeing of older Maori people.* Wellington: Ministry of Maori Development.

Dyken, M., Somers, V., Yamada, T., & al., e. (1996). Investigating the relationship between stroke and obstructive sleep apnoea. *Stroke, 27*, 401-407.

Ekici, A., Ekici, M., Kurtipek, E., Keles, H., Kara, T., Tunckol, M., et al. (2005). Association of asthma-related symptoms with snoring and apnea and effect on health-related quality of life. *Chest, 128*(5), 3358-3363.

Engleman, H. M., Kingshott, R. N., Martin, S. E., & Douglas, N. J. (2000). Cognitive function in the sleep apnea/hypopnea syndrome (SAHS). *Sleep, 23 Suppl 4*, S102-108.

Engleman, H. M., Martin, S. E., & Douglas, N. J. (1994). Compliance with CPAP therapy in patients with the sleep apnoea/hypopnoea syndrome. *Thorax, 49*(3), 263-266.

Ferguson, K., & Lowe, A. (2005). Oral appliances for sleep-disordered breathing. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Ferini-Strambi, L., Zucconi, M., Castronovo, V., Garancini, P., Oldani, A., & Smirne, S. (1999). Snoring & sleep apnea: a population study in Italian women. *Sleep, 22*(7), 859-864.

Findley, L., Fabrizio, M., Knight, H., Norcross, B., LaForte, A., & Suratt, P. (1989). Driving simulator performance in patients with sleep apnea. *American Reviews of Respiratory Disorders, 140*, 529-530.

Findley, L., & Suratt, P. (2001). Serious motor vehicle crashes: the cost of untreated sleep apnoea. *Thorax, 56*(7), 505.

Findley, L., Unverzagt, M., Guchu, R., Fabrizio, M., Buckner, J., & Suratt, P. (1995). Vigilance and automobile accidents in patients with sleep apneoa and narcolepsy. *Chest, 108*(3), 619-624.

Findley, L., Unverzagt, M., & Suratt, P. (1988). Automobile accidents involving patients with obstructive sleep apnea. *American Reviews of Respiratory Disorders, 138*, 337-340.

Fitzpatrick, R., & Boulton, M. (1994). Qualitative methods for assessing health care. *Quality in Health Care, 3*(107-113).

Flemons, W., Douglas, N., Kuna, S., Rodenstein, O., & Wheatley, J. (2004). Access to diagnosis and treatment of patients with suspected sleep apnea. *American Journal of Respiratory Critical Care Medicine, 169*, 668-672.

Flemons, W., Littner, M., Rowley, J., Gay, P., Anderson, W., Hudgel, D., et al. (2003). Home diagnosis of slee apnea: a systematic review of the literature.

Flemons, W., & Whitelaw, W. (2002). Clinical features of obstructive sleep apnea syndrome. In W. Mcnicolas & E. Phillipson (Eds.), *Breathing disorders in sleep.* London: W.B. Saunders.

Fogel, R., Malhotra, A., Dalagiorgou, G., Robinson, M., Jakab, M., Kikinis, R., et al. (2003). Anatomic and physiologic predictors of apnea severity in morbidly obese subjects. *Sleep, 26*(2), 150-155.

Furuta, H., Kaneda, R., Kosaka, K., Arai, H., Sano, J., & Koshino, Y. (1999). Epworth sleepiness scale and sleep studies in patients with obstructive sleep apnea syndrome. *Psychiatry and Clinical Neurosciences, 53*, 301-302.

Gander, P. (2003). *Sleep in the 24-hour society.* Lower Hutt: The Open Polytechnic of New Zealand.

Gander, P. (2006a). Discussion about recommendations to policy-makers. Wellington.

Gander, P. (2006b). Discussion about the use of neck size compared to shirt collar sizes. Wellington.

Gander, P., Marshall, N., Harris, R., & Papaarangi, R. (2005). Sleep, sleepiness and motor vehicle accidents. *Australian New Zealand Journal of Public Health, 29*, 16-21.

Gander, P., Marshall, N., Harris, R., & Reid, P. (2005). The epworth sleepiness scale: influence of age, ethnicity, and socioeconomic deprivation. Epworth sleepiness scores of adults in New Zealand. *Sleep, 28*(2), 249-253.

Gander, P., Mihaere, K., Scott, H., & Scott, G. (2006). An Economic Tool to Aid Planning of OSAS Treatment Services *Sleep (submitted).*

Gaunt, C. (1996). Taxicab deregulation in New Zealand. *Journal of Transport Economics and Policy, 30*(1), 1996.

George, C. (2001). Reduction in motor vehicle collisions following treatment of sleep apnoea with nasal CPAP. *Thorax, 56*, 508-512.

George, C. (2004). Sleep 5: driving and automobile crashes in patients with obstructive sleep apnoea/hypopnea syndrome. *Thorax, 59*, 804-807.

George, C., & Smiley, A. (1999). Sleep apnoea and automobile crashes. *Sleep, 22*(6), 790-795.

Gillings, M. (2004). Personal Communication. Wellington.

Glaser, B. (1995). *Grounded Theory: 1984-1994.* California: Sociology Press.

Gordon, N., Cleary, P., Parker, C., & Czeisler, C. (1986). The prevalence and health impact of shiftwork (Abstract). *American Journal of Public Health, 1986*(10), 1225-1228.

Goulding, C. (2002). *Grounded Theory: a practical guide for management, business and market researchers.* London: SAGE Publications Inc.

Greenbaum, T. (1998). *The handbook for focus group research* (Second ed.). London: Sage Publications.

Greenberg, G., Watson, R., & Deptula, D. (1987). Neuropsychological dysfunction in sleep apnea. *Sleep, 10*(3), 254-262.

Greenhalgh, T., & Taylor, R. (1997). Papers that go beyond numbers (qualitative research). *British Medical Journal, 315*, 740-743.

Gribben, B. (1993). Satisfaction with access to general practitioner services in south Auckland. *New Zealand Medical Journal, 106*, 360-362.

Grunstein, R. (2005). Continuous Positive Airway Pressure Treatment for obstructive sleep-apnea-hypopnea syndrome. In M. Kryger, T. Roth & W. Dement (Eds.), *Priniciples and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Grunstein, R., Stenlof, K., Hedner, J., & Sjostrom, L. (1995). Impact of obstructive sleep apnea and sleepiness on metabolic and cardiovascular risk factors in the Swedish Obese Subjects Study (Abstract). *International journal of Obes Relat Metab Disord, 19*, 410-418.

Guba, E., & Lincoln, Y. (1981). *Effective evaluation.* San Francisco: Jossey-Bass.

Guilleminault, C., & Bassiri, A. (2005). Clinical features and evaluation of obstructive sleep apnea-hypopnea syndrome and upper airway resistance syndrome. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition.* Philadelphia: W.B.Saunders Company.

Gurubhagavatula, I., Maislin, G., Nkwuo, J. E., & Pack, A. I. (2004). Occupational Screening for Obstructive Sleep Apnea in Commercial Drivers. *Am. J. Respir. Crit. Care Med.*, 200307-200968OC.

Haakanen, H., Summala, H., Partinen, M., Tiihonen, M., & Silvo, J. (1999). Blink duration as an indicator of driver sleepiness in professional bus drivers. *Sleep, 22*(6), 798-802.

Harrington, M., & Mistlberger, R. (2000). Anatomy and physiology of the mammalian circadian system. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 3rd Edition* (Third ed.). Philadelphia: W.B. Saunders Company.

Harris, R. (1998). *Sleep patterns among adults in the Wellington region (Pilot Study).* Wellington: Te Ropu Rangahau Hauora a Eru Pomare & the Sleep/Wake Research Centre.

Harris, R. (2003). *Obstructive sleep apnoea syndrome: symptoms adn risk factors among Maori and non-Maori adults in Aotearoa.* Unpublished Masterate Thesis, Otago, Wellington.

Harrison, Y., & Horne, J. A. (2000a). The impact of sleep deprivation on decision making: a review (Abstract). *J Exp Psychol Appl, 6*(3), 236-249.

Harrison, Y., & Horne, J. A. (2000b). Sleep loss and temporal memory. *Q J Exp Psychol A, 53*(1), 271-279.

Harrison, Y., Horne, J. A., & Rothwell, A. (2000). Prefrontal neuropsychological effects of sleep deprivation in young adults--a model for healthy aging? *Sleep, 23*(8), 1067-1073.

Henneken, C., & Buring, J. (1987). *Epidemiology in medicine.* Boston: Little, Brown and Company.

Henwood, K., & Pidgeon, N. (1995). Grounded theory and psychological research. *Feminism and Psychology, 5*(1), 7-30.

Hobson, J., Pace-Schott, E., & Stickgold, R. (2000). Dreaming and the brain: towards a cognitive neuroscience of conscious states. (Abstract). *Behavioural Brain Science, 23*, 793-842.

Hoffstein, V., & Mateika, S. (1992). Differences in abdominal and neck circumferences in patients with and without obstructive sleep apnoea. *Eur Respir J, 5*, 377-381.

Hoffstein, V., Mateika, S., & Hanly, P. (1995). Snoring and arousals: a retrospective analysis. *Sleep, 18*(10), 866-872.

Horne, J. A. (1991). Dimensions to sleepiness. In T. Monk (Ed.), *Sleep, sleepiness and performance.* Chichester: John Wiley & Sons Ltd.

Horne, J. A., & Wilkinson, S. (1985). Chronic sleep reduction: daytime vigilance performance and EEG measures of sleepiness, with particular reference to 'practice effects' (Abstract). *Psychophysiology, 22*, 69-78.

Howard, M. E., Desai, A. V., Grunstein, R., Hukins, C., Armstrong, J. G., Joffe, D., et al. (2004). Sleepiness, sleep disordered breathing and accident risk factors in commercial vehicle drivers. *Am. J. Respir. Crit. Care Med.*

Howden-Chapman, P., & Cram, F. (1998). *Social, economic and cultural deteminants of health.* Wellington: National Health Committee.

Hui, D. S. C., Chan, J. K. W., Ko, F. W. S., Choy, D. K. L., Li, T. S. T., Chan, A. T., et al. (2002). Prevalence of snoring and sleep-disordered breathing in a group of commercial bus drivers in Hong Kong. *Internal Medicine Journal, 32*(4), 149-157.

Incalzi, R., Marra, C., Salvigni, L., Petrone, A., Gemma, A., Selvaggio, D., et al. (2004). Does cognitive dysfunction conform to a distinctive pattern in obstructive sleep apnea syndrome? *Journal of Sleep Research, 13*, 79-86.

Ingre, M., & Akerstedt, T. (2004). Effect of accumulated night work during the working lifetime, on subjective health and sleep in monozygotic twins. *J Sleep Res, 13*(1), 45-48.

James, A., Palmer, L., Kicic, E., Maxwell, P., Lagan, S., Ryan, G., et al. (2005). Decline in lung function in the Busselton health study. *Am J Respir Crit Care Med, 171*, 109-114.

Jenni, O., Achermann, P., & Carskadon, M. (2005). Homeostatic sleep regulation in adolescents. *Sleep, 28*(11), 1446-1454.

Johns, D. (1991). A new method for measuring daytime sleepiness: the epworth sleepiness scale. *Sleep, 14*, 540-545.

Johns, M. (1992). Reliability and factor analysis of the epworth sleepiness scale. *Sleep, 15*(4), 376-381.

Johns, M. (1994). Sleepiness in different situations measured by the epworth sleepiness scale. *Sleep, 17*(8), 703-710.

Johns, M., & Chervin, R. (2000). Letter to the Editor: The multiple sleep latency test and epworth sleepiness scale in the assessment of daytime sleepiness. *Journal of Sleep Research, 9*, 399-401.

Johns, M., & Hocking, B. (1997). Excessive daytime sleepiness: daytime sleepiness and sleep habits of Australian workers. *Sleep, 20*(10), 844-849.

Jones, L. (1994). *The Social Context of Health and Health Work.* Basingstoke: Macmillan.

Kang, C.-H. (1998). *Taxi Deregulation: international comparison.* University of Leeds, Leeds.

Kapsimalis, F., & Kryger, M. (2002a). Gender and obstructive sleep apnea syndrome, Part 1: Clinical features. *Sleep, 25*(4), 412-419.

Kapsimalis, F., & Kryger, M. (2002b). Gender and obstructive sleep apnea syndrome, Part 2: Mechanisms. *Sleep, 25*(5), 499-505.

Katz, I., Stradling, J., Slutsky, A. S., Zamel, N., & Hoffstein, V. (1990). Do patients with obstructive sleep apnea have thick necks? *Am Rev Respir Dis, 141*(5 Pt 1), 1228-1231.

Kim, J., In, K., Kim, J., You, S., Kang, K., Shim, J., et al. (2004). Prevalence of sleep-disordered breathing in middle-aged Korean men and women. *Am. J. Respir. Crit. Care Med., 170*, 1108-1113.

Kollah, E., Namerow, N., Pasnau, R., & al., e. (1968). Neurological findings during prolonged sleep deprivation. *Neurology, 18*, 836-840.

Kribbs, N. B., Pack, A. I., Kline, L. R., Smith, P. L., Schwartz, A. R., Schubert, N. M., et al. (1993). Objective measurement of patterns of nasal CPAP use by patients with obstructive sleep apnea. *Am Rev Respir Dis, 147*(4), 887-895.

Kripke, D., Klauber, M., Wingard, D., & al., e. (1998). Mortality hazard associated with prescription hypnotics. *Bio Psychiatry, 43*, 687-693.

Krueger, R. A. (1993). Quality control in focus group research. In D. Morgan (Ed.), *Successful focus groups.* (pp. 65-85). Newbury Park, London & New Delhi: Sage.

Land Transport New Zealand. (2005). Driving regulations hours.

Land Transport Safety Authority. (2000). *Driving hours and log books review: LTSA preferred policy proposal.* Wellington: Land Transport Safety Authority.

Last, J. (1995). *A dictionary of epidemiology* (3rd ed.). New York: Oxford University Press.

Lindberg, E., Christer, J., Svardsudd, K., Gislason, T., Jerker, H., & Boman, G. (1998). Increased mortality among sleepy snorers: a prospective population-based study. *Thorax, 53*, 631-637.

Lurbe, E., Kesani, A., & al., e. (2002). Increase in nocturnal blood pressure and progression to microalbuminuria in type I diabetes. *New England Journal of Medicine, 347*, 797-805.

Lushington, W., Lushington, K., & Dawson, D. (1997). The perceived social and domestic consequences of shiftwork for female shiftworkers (nurses) and their partners. *Journal of Occupational Health and Safety:Australia-New Zealand, 13*(5), 461-469.

Lyznicki, J., Doege, T., Davis, R., & Williams, M. (1998). Sleepiness, driving, and motor vehicle crashes. *Journal of American Medical Association, 279*(23), 1908-1913.

Machin, M., & De Souza, J. (2004). Predicting health outcomes and safety behaviour in taxi drivers. *Transportation Research, Part F, 7*, 257-270.

Malhotra, A., & White, D. (2002). Pathogenesis of obstructive sleep apnea syndrome. In W. McNicolas & E. Phillipson (Eds.), *Breathing disorders in sleep*. London: W.B. Saunders.

Marin, J., Gascon, J., Carrizo, S., & Gispert, J. (1997). Prevalence of sleep apnoea syndrome in the Spanish adult population. *International Journal of Epidemiology, 26*(2), 381-386.

Marshall, N., Barnes, M., Travier, N., Campbell, A., Pierce, R. J., McEvoy, R., et al. (2006). Continuous positive airway pressure reduces daytime sleepiness in mild-moderate obstructive sleep apnoea: meta-analysis. *Thorax*.

Marshall, N., Bolger, W., & Gander, P. (2004). Abnormal sleep duration and motor vehicle crash risk. *Journal of Sleep Research, 13*, 177-178.

Marshall, N., Gander, P., & Neill, A. (2003). Obstructive sleep apnoea and risk of motor vehicle accident: a perspective. *The New Zealand Medical Journal, 116*(1176).

Marshall, N., Neill, A., Campbell, A., & Sheppard, D. (2005). Randomised controlled crossover trial of humidified continuous positive airway pressure in mild obstructive sleep apnoea. *Thorax, 60*, 427-432.

Matthewson, J. (2005). Communication regarding medical check-ups and respiratory clinic patients. Wellington.

Maycock, G. (1996). Sleepiness and driving: the experience of UK car drivers. *Journal of Sleep Research, 5*, 229-237.

McArdle, N., Kingshott, R., Engleman, H., Mackay, T., & Douglas, N. (2001). Partners of patients with sleep apnoea/hypopnoea syndrome: effect of CPAP treatment on sleep quality and quality of life. *Thorax, 56*, 513-518.

McKinlay, J., Plumridge, L., & Daley, V. (1999). Methodology for studying health and society. In P. Davis & K. Dew (Eds.), *Health and society in Aotearoa New Zealand* (pp. 35-51). Auckland: Oxford University Press.

Merrit, S. (2004). Sleep-disordered breathing and the association with cardiovascular risk. *Prog Cardiovasc Nurs, 19*(1), 19-27.

Mihaere, K. (2004). *Obstructive sleep apnoea in Aotearoa/New Zealand: an objective and questionnaire-based approach to population estimation and clinical screening.* Unpublished Doctorate thesis, Massey, Wellington.

Mihaere, K., Gander, P., Neill, A., Reid, K., & Harris, R. (2005). *Prevalence of obstructive sleep apnoea in New Zealand: A comparision of Maori and non-Maori adults (unpublished paper).* Wellington: Sleep/Wake Research Centre.

Ministry of Health. (1997a). *Strengthening public health action.* Wellington: Public Health Group.

Ministry of Health. (1997b). *Strengthening public health action: the strategic direction to improve, promote, and protect public health.* Wellington: Public Health Group.

Ministry of Health. (2002a). *The New Zealand Health Monitor: a 10-year cycle of health-related surveys.* Wellington: Ministry of Health.

Ministry of Health. (2002b). *The Pacific Health and Disability Action Plan.* Wellington: Ministry of Health.

Ministry of Health. (2002c). *Reducing inequalities.* Wellington: Ministry of Health.

Ministry of Health. (2003a). *Decades of disparity: ethnic mortality trends in New Zealand 1980-1999.* Wellington: Ministry of Health.

Ministry of Health. (2003b). *Healthy eating - Healthy action: Oranga Kai Oranga Pumau.* Wellington: Ministry of Health.

Ministry of Health. (2004a). *The New Zealand Health Strategy.* Wellington: Ministry of Health.

Ministry of Health. (2004b). *Pacific Health Chart Book 2004.* Wellington: Ministry of Health.

Ministry of Health. (2004c). *A portrait of health: key results of the 2002/2003 New Zealand Health Survey.* Wellington: Ministry of Health.

Mistlberger, R., & Rusak, B. (2005). Circadian rhythms in mammals: formal properties and environmental influences. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition* (Third ed.). Philadelphia: W.B. Saunders Company.

Mitler, M., Carskadon, M., & Hirshkowitz, M. (2005). Evaluating sleepiness. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Mitler, M., Miller, J., Lipsitz, J., & al., e. (1997). The sleep of long haul truck drivers. *New England Journal of Medicine, 337*, 755-761.

Mohsenin, V. (2004). Is sleep apnea a risk factor for stroke? A critical analysis. *Minerva Medica (Abstract), 95*(4), 291-305.

Monk, T. (2005). Shift work: basic principles. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: W.B. Saunders Company.

Morgan, D. L., & Krueger, R. A. (1993). When to use focus groups and why. In D. L. Morgan (Ed.), *Successful focus groups* (pp. 3-19). Newbury Park, London, & New Delhi: Sage.

Nankano, H., Ikeda, T., Hayashi, M., Ohshima, E., & Onizuka, A. (2003). Effects of body position on snoring in apneic and non-apneic snorers. *Sleep, 26*(2), 169-172.

National Health Committee. (1998). *The social, cultural and economic determinants of health in New Zealand: action to improve health.* Wellington: National Advisory Committee on Health and Disability.

National Health Committee. (2002). *Improving Maori Health Policy.* Wellington: National Advisory Committee on Health and Disability.

Neill, A., & McEvoy, R. (1997). Obstructive sleep apnoea and other sleep breathing disorders. *Medical Journal of Australia, 167*(7), 376-381.

Neill, A., Taylor, R., & Whyte, K. (2002). *Position Paper of the New Zealand Branch of The Thoracic Society of Australia and New Zealand.* Wellington: Working party of the TSANZ New Zealand Branch.

Netzer, N. C., Hoegel, J. J., Loube, D., Netzer, C. M., Hay, B., Alvarez-Sala, R., et al. (2003). Prevalence of symptoms and risk of sleep apnea in primary care. *Chest, 124*(4), 1406-1414.

Newman, A., Foster, G., Givelber, R., Nieto, F. J., Redline, S., & Young, T. (2005). Progression and regression of sleep-disordered breathing with changes in weight: the Sleep Heart Health Study. *Arch Intern Med, 165*(20), 2408-2413.

Newman, A., Nieto, F., Guidry, U., Lind, B., Redline, S., Shahar, E., et al. (2001). Relation of sleep-disordered breathing to cardiovascular disease risk factors. *American Journal of Epidemiology, 154*(1), 50-59.

Nieto, F. J., Young, T. B., Lind, B. K., Shahar, E., Samet, J. M., Redline, S., et al. (2000). Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study. *Journal of American Medical Association, 283*(14), 1829-1836.

Nugent, A. M., Gleadhill, I., McCrum, E., Patterson, C. C., Evans, A., & MacMahon, J. (2001). Sleep complaints and risk factors for excessive daytime sleepiness in adult males in Northern Ireland. *Journal of Sleep Research, 10*, 69-74.

O'Connor, C., Thornleu, K., & Hanly, P. (2000). Gender differences in the polysomnographic features of obstructive sleep apnea. *Am J Respir Crit Care Med, 161*(5), 1465-1472.

Occupational Safety and Health Service, & Department of Labour. (2003). *A guide to the Health and Safety in Employment Act 1992.* Wellington.

Oksenberg, A., Khamayasi, I., Silverberg, D., & Tarasiuk, A. (2000). Association of body position with severity of apneic events in patients with severe non-positional obstructive sleep apnea. *Chest, 118*(4), 1018-1024.

Pack, A. (2006). Advances in Sleep-disordered Breathing

10.1164/rccm.200509-1478OE. *Am. J. Respir. Crit. Care Med., 173*(1), 7-15.

Pack, P. (2004). Sleep-disordered breathing. *American Journal of Respiratory Critical Care Medicine, 169*, 665-667.

Paine, S., Gander, P., Harris, R., & Reid, P. (2004). Who reports insomnia? Relationships with age, sex, ethnicity and socioeconomic deprivation. *Sleep, 27*(6), 1163-1169.

Parish, J. M., & Somers, V. K. (2004). Obstructive sleep apnea adn cardiovascular disease. *Mayo Clinic Proceedings (Abstract), 79*(8), 1036-1046.

Partinen, M., & Hublin, C. (2005). Epidemiology of sleep disorders. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition*. Philadelphia: Elsevier & Saunders.

Patel, S., Ayas, N., Malhotra, A., White, D., Schernhammer, E., Speizer, F., et al. (2004). A prospective study of sleep duration and mortality risk in women. *Sleep, 27*(3), 440-444.

Patel, S., White, D., Malhotra, A., & al., e. (2003). Continuous positive airway pressure therapy for treating sleepiness in a diverse population with obstructive sleep apnea: results of a meta-analysis. *Arch Intern Med, 163*, 565-571.

Pepin, J. L., Leger, P., Veale, D., Langevin, B., Robert, D., & Levy, P. (1995). Side effects of nasal continuous positive airway pressure in sleep apnea syndrome. Study of 193 patients in two French sleep centers. *Chest, 107*(2), 375-381.

Peppard, P., Young, T., Palta, M., & Skatrud, J. (2000). Prospective study of the association between sleep-disordered breathing and hypertension. *New England Journal of Medicine, 342*, 1378-1384.

Pepperell, J., Ramdassingh-Dow, S., Crosthwaite, N., & al., e. (2002). Ambulatory blood pressure after therapeutic and subtheraupeutic nasal continuous positive airway pressure for obstructive sleep apnoea: a randomised parallel trial. *Lancet, 359*, 204-210.

Philip, P., Sagaspe, P., Taillard, J., Valtat, C., Moore, N., Akerstedt, T., et al. (2005). Fatigue, sleepiness, and performance in simulated versus real driving conditions. *Sleep, 28*(12), 1511-1516.

Phillips, B. (2005). Sleep-disordered breathing and cardiovascular disease. *Sleep Medicine Reviews, 9*, 131-140.

Phillips, B., & Kryger, M. (2005). Management of obstructive sleep apnea-hypopnea syndrome: overview. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Pierre, P. (2005). Sleepiness of occupational drivers. *Industrial Health, 43*, 30-33.

Poceta, J. S., Timms, R. M., Jeong, D. U., Ho, S. L., Erman, M. K., & Mitler, M. M. (1992). Maintenance of wakefulness test in obstructive sleep apnea syndrome. *Chest, 101*(4), 893-897.

Powell, N., Riley, R., & Guilleminault, C. (2005). Surgical management of sleep-disordered breathing. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Punjabi, N. M., Bandeen-Roche, K., Marx, J. J., Neubauer, D. N., Smith, P. L., & Schwartz, A. R. (2002). The association between daytime sleepiness adn sleep-disordered breathing in NREM and REM sleep. *Sleep, 25*(3), 307-314.

Punjabi, N. M., Bandeen-Roche, K., & Young, T. (2003). Predictors of objective sleep tendency in the general population. *Sleep, 26*(6), 678-683.

Puvanendran, K., & Goh, K. (1999). From snoring to sleep apnea in a Singapore population. *Sleep Research Online, 2*(1), 11-14.

Qureshi, A., & Ballard, R. (2003). Obstructive sleep apnea. *Journal of Allergy and Clinical Immunology, 112*(4), 643-651.

Rahaghi, F., & Basner, R. (1999). Delayed diagnosis of obstructive sleep apnea: don't ask, don't tell. *Sleep and Breathing, 3*(4), 119-123.

Raymond, B., Clayton, R., & Chappell, M. (2003). Combined index of heart variability and oximetry in screening for the sleep apnoea/hypopnea syndrome. *Sleep Medicine Reviews, 12*, 53-61.

Reddish, T. (2003). Executive Director, The New Zealand Taxi Federation. Wellington.

Redline, S., Kapur, V., Sanders, M., Quan, S. F., Gottlieb, D., Rapoport, D. M., et al. (2000). Effects of varying approaches for identifying respiratory disturbances on sleep apnea assessment. *Am. J. Respir. Crit. Care Med., 161*, 369-374.

Redline, S., Kirchner, L., Quan, S. F., Gottlieb, D., Kapur, V., & Newman, A. B. (2004). The effects of age, sex, ethnicity, and sleep-disordered breathing on sleep architecture. *Archives of Internal Medicine, 164*(4), 406.

Redline, S., Schluchter, M., Larkin, E., & Tishler, P. (2003). Predictors of longitudinal change in sleep-disordered breathing in a nonclinic population. *Sleep, 26*(6), 703-709.

Redline, S., & Strohl, K. P. (1999). Recognition and consequences of obstructive sleep apnea hypopnea syndrome. *Otolaryngologic clinics of north america, 32*(2), 303-331.

Reid, P., Robson, B., & Jones, C. (2000). Disparities in health: common myths and uncommon truths. *Pacific Health Dialog, 7*(1), 38-47.

Reuveni, H., Tarasiuk, A., Wainstock, T., Ziv, A., Elhayany, A., & Tal, A. (2004). Awareness level of obstructive sleep apnea syndrome during routine unstructured interviews of a standardised patient by primary care physicians. *Sleep, 27*(8), 1518-1524.

Ribet, C., & Derriennic, F. (1999). Age, working conditions, and sleep disorders: a longitudinal analysis in the French cohort E.S.T.E.V. *Sleep, 22*(4), 491-504.

Rice, P. L., & Ezzy, D. (1999a). Chapter 1. Theory n qualitative research: traditions and innovations. In *Qualitative Research Methods*. Melbourne: Oxford University Press.

Rice, P. L., & Ezzy, D. (1999b). Focus groups. In *Qualitative Research Methods* (pp. 71-94). Melbourne: Oxford University Press.

Richardson, G. S., Miner, J. D., & Czeisler, C. (1989-90). Impaired driving performance in shiftworkers: the role of the circadian system in a multifactorial model. *Alcohol, Drugs, and Driving., 5-6*(4-1), 265-273.

Richman, R., Elliot, L., Burns, C., Bearpark, H., Steinbeck, K., & Caterson, I. (1994). The prevalence of obstructive sleep apnoea in an obese female population. *International Journal of Obesity, 18*, 173-177.

Riyamb, A., Rawas, A., & Hassan, O. (2000). Pathophysiology of obstructive sleep apnoea syndrome: a review. *Medical Sciences, 2*, 117-124.

Robinson, G., Warren, H., Samu, K., Wheeler, A., Matangi-Karsten, H., & Agnew, F. (2006). Pacific healthcare workers and their treatment interventions for Pacific clients with alcohol and drug issues in New Zealand. *The New Zealand Medical Journal, 119*(1228), 1809-1820.

Rodway, G., & Sanders, M. (2003). The efficacy of split-night sleep studies. *Sleep Medicine Reviews, 7*(5), 391-401.

Roehrs, T., Carskadon, M., Dement, C., & Roth, T. (2005). Daytime sleepiness and alertness. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition*. Philadelphia: Elsevier & Saunders.

Ronald, J., Delaive, K., Roos, L., Manfreda, J., & Meir, K. (1998). Obstructive sleep apnea patients use more health care resources ten years prior to diagnosis. *Sleep Research Online, 1*(1), 71-74.

Rosekind, M. (2005). Managing work schedules: an alertness and safety perspective. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine, 4th Edition*. Philadelphia: Elsevier & Saunders.

Roth, T., & Roehrs, T. (2000). An overview of normal sleep and sleep disorders. *European Journal of Neurology, 7*((Suppl.4)), 3-8.

Rothman, K. (2002). *Epidemiology: An introduction*. New York: Oxford University Press.

Rouleau, I., Decary, A., Chicoine, A. J., & Montplaisir, J. (2002). Procedural skill learning in obstructive sleep apnea syndrome. *Sleep, 25*(4), 401-411.

Ryan, K. (1996). Qualitative research in medical practice. *The New Zealand Medical Journal, 109*(1018), 1-2.

Sallienen, M., Harma, M., Mutanen, P., Ranta, R., Virkkala, J., & Muller, K. (2003). Sleep-wake rhythm in an irregular shift system. *Journal of Sleep Research, 12*, 103-112.

Saunders, D. (1977). *An introduction to biological rhythms*. New York: John Wiley and Sons.

Schwab, R. J., Pasirstein, M., Pierson, R., Mackley, A., Hachadoorian, R., Arens, R., et al. (2003). Identification of Upper Airway Anatomic Risk Factors for Obstructive Sleep Apnea with Volumetric Magnetic Resonance Imaging

10.1164/rccm.200208-866OC. *Am. J. Respir. Crit. Care Med., 168*(5), 522-530.

Scrima, L., Broudy, M., Nay, K., & Cohn, M. (1982). Increased severity of obstructive sleep apnea after bedtime alcohol ingestion: diagnostic potential and proposed mechanism of action. *Sleep, 5*(4), 318-328.

Shahar, E., Whitney, C., Redline, S., & al., e. (2001). Sleep-disordered breathing and cardiovascular disease: cross-sectional results of the Sleep Heart Health Study. *Am J Respir Crit Care Med, 163*, 19-25.

Shepertycky, M., Banno, K., & Kryger, M. (2005). Differences between men and women in the clinical presentation of patients diganosed with obstructive sleep apnea syndrome. *Sleep, 28*(3), 309-314.

Siegel, J. (2005). REM Sleep. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Simard, B., Turcotte, H., Marceau, P., Biron, S., Hould, F. S., Lebel, S., et al. (2004). Asthma and sleep apnea in patients with morbid obesity: outcome after bariatric surgery. *Obes Surg, 14*(10), 1381-1388.

Soon, J. (1999a). NZ flags the way on taxis. *The Australian Financial Review.*

Soon, J. (1999b). *Taxi!! Reinvigorating competition in the taxi market.* Sydney: The Centre for Independent Studies.

Southwick, M. (2004). Personal Communication: References made to her doctoral thesis and research methods. Wellington.

Statistics New Zealand. (2004). Prioritised Ethnicity JOA4043. Wellington.

Stoohs, R., Guilleminault, C., Itoi, A., & Dement, C. (1994). Traffic accidents in commercial long-haul truck drivers: the infuence of sleep-disordered breathing and obesity. *Sleep, 17*(7), 619-623.

Stradling, J., & Davies, R. (2004). Sleep 1: obstructive sleep apnoea/hypopnoea syndrome: definitions, epidemiology, and natural history (Review series). *Thorax, 59*(1), 73-82.

Stradling, J., Pepperell. J., & Davies, R. (2001). Sleep apnoea and hypertension: proof at last? *Thorax, 56*(9), 45-60.

Strollo, P., Atwood, C., & Sanders, M. (2005). Medical therapy for obstructive sleep apnea-hypopnea syndrome. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Stutts, J. C., Wilkins, J. W., Osberg, J. S., & Vaughn, B. V. (2003). Driver risk factors for sleep-related crashes. *Accident Analysis and Prevention, 35*, 321-331.

Stutts, J. C., Wilkins, J. W., & Vaughn, B. V. (1999). *Why do people have drowsy driving crashes?* Washington: AAA Foundation for Traffic Safety.

Taheri, S., Lin, H.-M., Austin, D., Young, T., & Mignot, E. (2004). Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index. *PLOS Medicine, 1*(3), e62.

ten Brinke, A., Sterk, P. J., Masclee, A. A. M., Spinhoven, P., Schmidt, J. T., Zwinderman, A. H., et al. (2005). Risk factors of frequent exacerbations in difficult-to-treat asthma

10.1183/09031936.05.00037905. *Eur Respir J, 26*(5), 812-818.

Teran-Santos, J., Jimenez-Gomez, A., Cordero-Guevara, J., & Burgos-Santander., T. C. G. (1999). The association between sleep apnea and the risk of traffic accidents. *New England Journal of Medicine, 340*(11), 847-851.

The Canberra Taxi Proprietors Association, & Canberra Cabs. (2002). *Review: The future direction of the taxi and hire car industry*. Canberra: School of Finance & Applied Statistics, Australian National University ACT.

The New Zealand Taxi Federation Inc. (2001). *Taxi*.

Tipton, J., & Hall, L. (2001). What are the benefits of treating sleep apnea? *The Journal of Family Practice, 50*(12), 1024-1025.

Travier, N. (2005). Discussion: statistical analyses. Wellington.

Tsutsumi, W., Miyazaki, S., Itasaka, Y., & Togawa, K. (2000). Influence of alcohol on respiratory disturbance during sleep. *Psychiatry and Clinical Neurosciences, 54*, 332-333.

Tukuitonga, C., & Bindman, A. (2002). Ethnic and gender differences in the use of coronary artery revascularisation procedures in New Zealand. *New Zealand Medical Journal, 115*, 179-182.

Tukuitonga, C., & Finau, S. A. (1997). The health of pacific peoples in New Zealand up to the early 1990s. *Pacific Health Dialog, 4*(2), 59-67.

Udwadia, Z., Doshi, A., Lonkar, S., & Singh, C. (2004). Prevalence of sleep-disordered breathing and sleep apnea in middle-aged urban Indian men. *Am J Respir Crit Care Med, 169*, 168-173.

Van Dongen, H., Maislin, G., Mullington, J., & Dinges, D. (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioural function and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 26*, 117-126.

van Manen, M. (1990). Human Science. In *Researching Lived Experience* (pp. 1-34). New York: State University Press.

Verrier, R., & Mittleman, M. (2005). Sleep-related cardiac risk. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition*. Philadelphia: Elsevier Saunders.

Viner, S., Szalai, J. P., & Hoffstein, V. (1991). Are history and physical examination a good screening test for sleep apnea? *Ann Intern Med, 115*(5), 356-359.

Vitaterna, M., Pinto, L., & Turek, F. (2000). Molecular genetic basis for mammalian circadian rhythms. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and practice of sleep medicine*. Philadelphia: W.B.Saunders Company.

Wadden, T., Anderson, D., Foster, G., Bennett, A., Steinberg, C., & Sarwer, D. (2000). Obese women's perceptions of their physicians weight management attitudes and practices. *Archives of Family Medicine, 9*, 854-860.

Weaver, T. (2001). Outcome measurement in sleep medicine practice and research. Part 1: assessment of symptoms, subjective and objective daytime sleepiness, health-related quality of life and functional status. *Sleep Medicine Reviews, 5*(2), 103-128.

Weaver, T., & George, C. (2005). Cognition and performance in patients with obstructive sleep apnea. In M. Kryger, T. Roth & C. Dement (Eds.), *Principles and Practice of Sleep Medicine, 4th Edition*. Philadelphia: Elsevier Saunders.

Weaver, T., Maislin, G., Dinges, D., Younger, J., Cantor, C., McCloskey, S., et al. (2003). Self-efficacy in sleep apnea: Instrument development and patient perceptions of obstructive sleep apnea risk, treatment benefit, and volition to use continuous positive airway pressure. *Sleep, 26*(6), 727-732.

Westbrook, I., Baxter, J., & Hogan, J. (2000). Are Maori under-served for cardiac interventions? *New Zealand Medical Journal, 114*, 127-130.

White, D., Lombard, R., Cadieux, R., & Zwillich, C. (1985). Pharyngeal resistance in normal humans: influence of gender, age, and obesity. *Journal of Applied Physiology, 58*(2), 365-371.

Whittle, A. T., Finch, S. P., Mortimore, I. L., MacKay, T. W., & Douglas, N. J. (1997). Use of home sleep studies for diagnosis of the sleep apnoea/hypopnoea syndrome. *Thorax, 52*(12), 1068-1073.

Wittmann, V., & Rodenstein, D. (2004). Health care costs and the sleep apnea syndrome. *Sleep Medicine Reviews, 8*(4), 269-279.

Wu, H., & Yan-Go, F. (1996). Self-reported automobile accidents involving patients with obstructive sleep apnea. *Neurology, 46*(5), 1254-1257.

Yee, B., Campbell, A., Beasley, R., & Neill, A. (2002). Sleep disorders: a potential role in New Zealand motor vehicle accidents. *Internal Medicine Journal, 32*, 297-304.

Young, N. (2001). The pre-hospital experiences of Samoan families who have had a child admitted to hospital with pneumonia: a qualitative investigation. *Pacific Health Dialog, 8*(1), 20-28.

Young, T. (2004). *Epidemiology of obstructive sleep apnea and gender effects.* Paper presented at the Sleepless in Sydney: The 17th Annual Scientific Meeting of the Australasian Sleep Association., Sydney, Australia.

Young, T., Blustein, J., Finn, L., & Palta, M. (1997). Sleep-disordered breathing and motor vehicle accidents in a population-based sample of employed adults. *Sleep, 20*(8), 608-613.

Young, T., & Javaheri, S. (2005). Systemic and pulmonary hypertension in obstructive sleep apnea. In M. Kryger, T. Roth & W. Dement (Eds.), *Principles and Practices of Sleep Medicine, 4th Edition.* Philadelphia: Elsevier Saunders.

Young, T., Palta, M., Dempsey, J., Skatrud, J., Weber, S., & Safwan, B. (1993). The occurrence of sleep-disordered breathing among middle-aged adults. *New England Journal of Medicine, 328*(17), 1230-1235.

Young, T., & Peppard, P. (2005). Clinical presentation of OSAS: gender does matter. *Sleep, 28*(3), 293-295.

Young, T., Peppard, P., & Gottlieb, D. (2002). Epidemiology of obstructive sleep apnea: a population health perspective. *American Journal of Respiratory Critical Care Medicine, 165*, 1217-1239.

Young, T., Peppard, P., & Taheri, S. (2005). Excess weight and sleep-disordered breathing. *Journal of Applied Physiology, 99*, 1592-1599.

Young, T., Shahar, E., Nieto, F., Redline, S., Newman, A., Gottlieb, D., et al. (2002). Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study. *Arch Intern Med, 162*(8), 893-900.

Young, T., Skatrud, J., & Peppard, P. (2004). Risk factors for obstructive sleep apnea in Adults. *Journal of the American Medical Association, 291*(16), 2013-2016.

APPENDIX 1

MEDICAL ASPECTS OF FITNESS TO DRIVE

Where the guidance may appear inappropriate for an individual

It is recognised that the guidance provided may not be appropriate for all individuals given the range of manifestations of some medical conditions. The Director of Land Transport or the Director's delegate may make a decision to grant an individual a licence or renew a licence where the guidance is considered inappropriate for an individual. This may include the granting of conditional or restricted licences, such as a licence that requires the licence holder to have an annual medical review.

Where a medical practitioner considers that the advice is inappropriate for an individual they are encouraged to write to the Chief Medical Adviser outlining the individual's circumstances. As a general rule, for commercial drivers, and/or for conditions that may include the possibility of sudden loss of consciousness or sudden inability to control a vehicle, a favourable specialist report will generally be required. Where appropriate in this section, details of the type of circumstances that the Director of Land Transport Safety or the Director's delegate may consider are outlined.

Introduction

There are many medical conditions that may impair an individual's ability to drive safely. This section deals with some miscellaneous conditions that are not covered in other sections of the guidelines.

10.1 Excessive daytime sleepiness

Sleepiness can be classified as follows:

- mild sleepiness – describes infrequent sleeping during times of rest or when little attention is required
- moderate sleepiness – describes sleep episodes that occur on a regular basis during activities requiring some degree of attention. Examples of such include attending conferences, movies or the theatre, group meetings, operating machinery or watching children
- severe sleepiness – describes sleep episodes that are present daily and during activities that require sustained attention. Examples include eating, direct personal conversation, walking and physical activities, as well as operating motor vehicles.

The commonest cause of excessive sleepiness is insufficient sleep. Shiftwork, time of day (circadian factors), sedatives, and alcohol may increase sleepiness.

When driving should cease

Driving should be restricted or cease for individuals who meet the high-risk driver profile as follows:

- are suspected of having obstructive sleep apnoea syndrome where there is a high level of concern regarding the risk of excessive sleepiness while driving while the individual is waiting for the diagnosis to be confirmed by a sleep study
- complain of severe daytime sleepiness and a history of sleep-related motor vehicle crashes or equivalent level of concern
- have a sleep study that demonstrates severe obstructive sleep apnoea syndrome and either it is untreatable or the individual is unwilling or unable to accept treatment.

When driving may occur or may resume

Individuals may resume driving or can drive if their obstructive sleep apnoea syndrome is adequately treated under specialist supervision, with satisfactory control of symptoms. The Director of Land Transport Safety or the Director's delegate may impose licence conditions for regular medical assessment. Medical follow-up may be delegated to the General Practitioner.

Medical standards for individuals applying for or renewing a Class 2, 3, 4 or 5 licence and/or a P, V, I or O licence endorsement

Commercial drivers may spend long hours driving their vehicle, operate heavy vehicle or carry many passengers. An accident involving such vehicles could place many people at risk. Suspected obstructive sleep apnoea syndrome should always be investigated by a sleep study. Symptoms may be under reported given the potential implications of driving restrictions.

When driving should cease

Driving should cease for individuals who meet the high-risk driver profile as follows:

- are suspected of having obstructive sleep apnoea syndrome where there is a high level of concern regarding the risk of excessive sleepiness while driving while the individual is waiting for the diagnosis to be confirmed by a sleep study
- complain of severe daytime sleepiness and a history of sleep-related motor vehicle crashes or equivalent level of concern.
- have a sleep study that demonstrates severe obstructive sleep apnoea syndrome and either it is untreatable or the individual is unwilling or unable to accept treatment.

When driving may occur or may resume

Individuals may resume driving or can drive if their obstructive sleep apnoea syndrome is adequately treated under specialist supervision with satisfactory control of symptoms. Consideration should be given to the type of driving and hours of driving an individual undertakes. If there is any residual risk of daytime sleepiness medical practitioners should recommend a restriction in working hours or shiftwork. The Director of Land Transport Safety or the Director's delegate may impose licence conditions for regular medical assessment. Medical follow-up may be delegated to the General Practitioner.

APPENDIX 2
PILOT STUDY

This report describes the 2003 pilot study on the prevalence of OSAS symptoms among taxi drivers in the wider Wellington region. The pilot study utilised the same questionnaire and research procedures from Harris (2003). Ethical approval from the Massey University Human Ethics Committee (WTG protocol 03/124).

Aims

The first aim of the pilot study was to assess the feasibility of this research approach in gaining access to taxi drivers.

The second aim was to check the feasibility of the additional questions employed in the survey questionnaire.

Methods and Procedures

The target population for this study was all listed taxi drivers/drivers from the electoral roll from the Wellington region, aged 30-60 years.

The study package (included a cover letter, an information sheet about the study, the questionnaire, a paper tape measure, and a consent form for the focus group study) was sent out to 699 taxi drivers on 1 October 2003. Each driver who completed the questionnaire was offered the option of a free one month gym membership sponsored by Bodyworks Gym. Non-responders received two further postal reminders. Data was double-entered in Epi Info6 and analysed in SAS v.8.

Results

Of the 699 taxi drivers, 10 were incorrectly classified, 22 were no longer driving, 5 had declined, and 20 study packages were returned (RTS). Therefore the final total sample was 642. There were a total of 255 respondents yielding a response rate of 39.7%.

The proportion of respondents that were male was 88.2%, and 11.8% were female. Of the respondents defined by ethnicity, Māori made up 13% (n=33), Pacific drivers made up 16% (n=40) and drivers of "other" ethnicities amounted to 71% (n=180). The mean age reported was 52.9 years (sd=9.4 years).

General sleep habits

Table 12.1 Prevalence of never/rarely get enough sleep

	never/rarely		*often/always*		*χ^2p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	50	27.8	130	72.2		1.00		
Māori	11	33.3	22	66.7		1.30	0.59-2.87	0.517
Pacific	19	47.5	21	52.5	0.051	**2.35**	**1.17-4.74**	**0.017**

Drivers of Pacific ethnicity were 2.3 times more likely to significantly report 'never' or 'rarely' getting enough sleep compared to drivers of "other" ethnicities.

Table 12.2 Prevalence of never/rarely waking feeling refreshed

	never/rarely		*often/always*		*χ^2p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	59	33.3	118	66.7		1.00		
Māori	11	33.3	22	66.7		1.00	0.46-2.20	1.000
Pacific	15	39.5	23	60.5	0.763	1.30	0.63-2.68	0.471

There were no statistical significant differences between ethnic groups for reporting 'never' or 'rarely' waking feeling refreshed.

OSAS symptoms

Table 12.3 Prevalence of snoring

	never/rarely		*often/always*		*χ^2p-value*	*OR*	*95%CI*	*p-value*
	n	**%**	**n**	**%**				
Other	92	53.8	79	46.2		1.00		
Māori	18	56.3	14	43.7		1.10	0.52-2.36	0.799
Pacific	20	51.3	19	48.7	0.916	0.90	0.45-1.81	0.776

For reporting 'often' or 'always' snoring, there were no significant differences between ethnic groups.

Table 12.4 Prevalence of observed apnoeas

variable	*yes*		*no*		χ^2*p-value*	*OR*	*95%CI*	*p-value*
	n	%	n	%				
Other	35	19.6	144	80.4		1.00		
Māori	9	28.1	23	71.9		1.61	0.68-3.78	0.275
Pacific	8	20.0	32	80.0	0.541	1.03	0.44-2.43	0.949

There were no significant differences between ethnic groups for reporting observed apnoeas.

Table 12.5 Excessive daytime sleepiness, by ethnicity and sex

variable	*ESS≤10*		*ESS>10*		*Chi*^{2}	*OR*	*95%CI*	*p-value*
	n	*%*	*n*	*%*	*p-value*			
<u>Sex:</u>								
men	168	80.8	40	19.2		1.00		
women	26	89.7	3	10.3	0.245	0.48	0.14-1.65	0.242
<u>Ethnicity:</u>								
Other	141	83.4	28	16.6		1.00		
Māori	24	80.0	6	20.0		1.26	0.47-3.36	0.646
Pacific	27	73.0	10	27.0	0.328	1.87	0.81-4.28	0.142

For reporting excessive daytime sleepiness, there were no significant differences between sexes, or between ethnic groups.

Table 12.6 Neck size (interquartile groups), ethnicity

variable	*Q1*		*Q2*		*Q 3*		*Q4*	
	n	%	n	%	n	n	n	%
Māori	4	16.0	4	16.0	2	8.0	15	60.0
Other	35	22.3	37	23.6	44	28.0	41	26.1
Pacific	4	14.3	3	10.7	2	7.1	19	67.9

Pacific drivers had larger neck sizes compared to Māori and people of "other" ethnicities.

Additional questions

Some questions were omitted from the original national OSA survey to make room for occupational-based questions. These included: (1) a question of 'perceived' sleep problems, (2) whether drivers accessed care, (3) an indication of other work, and (4) an indication of working nights. The responses to these questions indicated 'ambiguity', thus wording was changed to ensure the right responses were obtained. For instance, the question regarding 'other types of work', acquired responses such as 'unpaid' work like house-hold chores, or administrative work like completing the log-book. The responses intended were for other 'paid' employment.

Summary

For most of the results, statistical significance was not found. Moreover, the pilot study results were mixed, with Māori more likely to report observed apnoeas, and snoring 'often' or always'. Pacific peoples were significantly more likely to 'never' or 'rarely' get enough sleep, score ESS>10, and have larger neck sizes, although these were not statistically significant. Despite this, the pilot results provide some support indicating a trend similar to previous studies showing Pacific peoples and Māori were more likely to report OSAS symptoms, compared to people of "other" ethnicities. The low response rate limited the ability of the pilot study to provide accurate estimates, or provide estimates of differences. Nevertheless, as indicated from the low response rate, and the difficulty in occupational labelling, the pilot study demonstrated that the electoral roll was not the best sampling frame to use in order to gain adequate access and support from taxi drivers. Thus, another sample frame was considered for the study.

APPENDIX 3
SLEEP QUESTIONNAIRE

APPENDIX 4
STUDY PACK: COVER LETTER

Dear Sir/Madam,

You may have remembered a sleep questionnaire that was sent out earlier this month from the Sleep/Wake Research Centre, Research School of Public Health, Massey University, Wellington. **Please ignore this letter if you have received it already.**

We would like to find out how many taxi drivers are at risk of a sleep disorder called obstructive sleep apnoea syndrome, and whether drivers have tried to get help for this problem.

We are administering a questionnaire to all taxi drivers who work for Wellington Combined Taxis and Hutt and City Taxis. We would greatly appreciate your help in answering the questionnaire. **Please fill out the questionnaire even if you don't think you have this sleep problem.**

The questionnaire will only take about 5 minutes. Please fill in your questionnaire and send it back to us in the enclosed post-paid reply envelope, or you can give us your answers by calling our number **0800 SLEEPING (0800 75 33 74)** (weekdays).

This research is funded by the Health Research Council of New Zealand. Ethical approval has been given by the Massey University Campus Human Ethics Committee, Wellington.

If you have any concerns about the questionnaire or the research study, please contact: **Riz Firestone, telephone: 04 801 5799 extension 6081**, or **John Matthewson on extension 6080.** Thank you for your time.

Yours sincerely,

Riz Firestone	**Prof. Philippa Gander**
Researcher/PhD Student	Director of Sleep/Wake Research Centre & Supervisor

APPENDIX 5
STUDY PACK: INFORMATION SHEET

Introduction:

We are seeking your help for a research study to investigate:

1. **How many taxi drivers may be at risk for obstructive sleep apnoea?**
2. **What are the possible barriers that taxi drivers experience if they want to seek treatment for obstructive sleep apnoea?**

Obstructive Sleep Apnoea Syndrome (OSAS) is a common sleep disorder. People who have this problem have regular breathing pauses while they are asleep. OSAS can also make you very sleepy during the day. If left untreated, it can lead to other significant problems. There is evidence to suggest that Māori and Pacific Island people may be at higher risk for OSAS for a variety of reasons. There are a variety of successful treatments for OSAS. This study is part of the Riz Firestone's doctoral thesis in Public Health.

Research Procedures:

Our study will be conducted in the Wellington region, and it is separated into two stages.

- Stage one requires **all drivers to fill out the questionnaire**.
- Stage two is **optional** for you to participate in a taxi driver's group discussion.

Stage 1: Sleep Questionnaire:

- The information collected will remain confidential. **You cannot be personally identified.**
- This questionnaire will enable us to determine whether taxi drivers are at risk of OSAS, **so it is important that you answer the questionnaire even if you think you do not have a problem.**

Stage 2: Focus Groups

- This will involve three ethnic groups of taxi drivers: Māori, Pacific Island people, other ethnicities.
- Each group will take part in up to 3 confidential discussions ("Focus Groups") lead by Riz Firestone and an assistant.
- Group sessions will be taped to ensure that information is accurately recorded. **The participants will not give their names, or any other identifying information during the sessions.**
- Focus groups will help us to explore how much people know about treatment services for OSAS, and why they may, or may not choose to use them.

Results from the study will be presented in a brochure to all participating taxi companies and to the New Zealand Taxi Federation.

Participant's Rights:

At any stage of the study you have the right to:

- decline to participate;
- withdraw from the study at any time;
- ask any questions about the study at any time;
- completion and return of the questionnaire implies consent, therefore, you have the right to decline to answer any particular question;
- if you participate in stage two of the study, you have the right to ask for the audio/video tape to be turned off at any time.

If you are willing to be in a focus group session, please complete and return the enclosed Focus Group Consent Form.

Committee Approval Statement:

This project has been reviewed and approved by the Massey University Human Ethics Committee, WGTN Protocol 03/124. If you have any concerns about the conduct of this research, please contact:

Mr Jeremy Hubbard, Acting Chair
Massey University Campus Human Ethics Committee Wellington
Private Box 756
Wellington

Telephone: 04 801 2794 extension 6358
Email: J.JHubbard@massey.ac.nz

If you have any questions about the study please call:
Riz: (04) 801 5799 extension 6081 (afternoons only) or
John: (04) 801 5799 extension 6080

To answer the Sleep Questionnaire over the phone call **0800 SLEEPING (0800 75 33 74)**. Thank you for your help.

Riz Firestone (MPH)
PhD Student
Tel: 801 5799, ext 6081

Prof Philippa Gander (Ph.D)
Director
Sleep/Wake Research Centre Supervisor
Tel: 801 5799, ext 6033

APPENDIX 6
STUDY PACK: FOCUS GROUP CONSENT FORM

'Access to treatment for obstructive sleep apnoea among professional taxi drivers.'

The focus group will include about 7 people, a facilitator and an assistant. You will be asked to discuss, as a group, issues around obstructive sleep apnoea syndrome and accessing treatment for it. You will be asked to participate in up to 3 sessions each lasting up to 1.5 hours. These groups will be held in 2004 in Wellington, and you would be provided with $50 petrol vouchers for participation in each session.

The focus groups will be video-taped and audio-taped. This is to ensure that what you say is accurately recorded. The tape recording will be transcribed. Any names or personal references will be coded. Once the recordings have been transcribed, the tapes will be destroyed. The researchers are the only people who will have access to the tapes and the transcriptions. Some quotes from the focus groups may be included to set the research context, but no names will be included with the quotes.

Any information shared in the focus group will remain confidential. This study has been approved by the Massey University Human Ethics Committee, Wellington. If you have any questions contact Riz Firestone (tel: 801 5799, extension 6081).Please sign below and provide a contact telephone number if you are willing to be involved in a focus group.

- I have read the Information Sheet and have had the opportunity to discuss this study, and I understand that I may ask further questions at any time.
- I consent to participating in a focus group session.
- I understand the session will be recorded and transcribed.
- I agree that any information and opinions shared in this session, as well as personal dignity and individual rights will be respected and remain confidential.

Signature:	**Date:**
Name (printed):	**Telephone Number:**

APPENDIX 7
POSTCARD REMINDER

(TEXT ON OPPOSITE SIDE OF POSTCARD)

SLEEP QUESTIONNAIRE

This is just a reminder to please send us back your questionnaire as soon as possible or phone us on: 0800 SLEEPY (0800 75 33 74)

Please ignore this reminder if you have replied.

Thank-you

Riz Firestone	Professor Philippa Gander
Researcher/Ph.d Student	**Director/Supervisor**
Sleep/Wake Research Centre	**Sleep/Wake Research Centre**

APPENDIX 8
RULES FOR DATA ENTRY

Field Description	Number of Characters	Key Options	Comments
ID Number	4	2001-2540 3001-3166	• Taxi company 1 • Taxi company 2
Q1	1	1 or 2	9 if no answer
Q2	8	dd/mm/yyyy	• If no day is given key in as the first of the month. • If no date at all, data will later need to be checked, as Epi-Info seems to record this as a "20". • Change to 'not specificified' box
Q3	1	1	• 9 if missing • If NZ Māori or Pacific Island ethnicity is noted, other ethnicities will not be included. • If no ethnicity is given, then this is recorded as "Not Specified" in the final text, but not as category "k".
Q4		text	• Answers will be entered as written. All qualifications will be noted, including tertiary and vocational training.
Q5	4	##.#	• Any ranges are given as the average. • Where average of range results in _.25 or _.75 – round to _.5 • Very unusual entries will be left blank. • If this section is not answered or written remarks like 'don't know', this will be left blank.
Q6	1	0, 1, 2, 3	• 9 if missing • Double entries or ticks b/w boxes: (0,1) key as 1 (1,2) key as 2 (2,3) key as 2 • Double tick or tick b/w boxes but indicate preference, key in preference.
Q7	1	0, 1, 2, 3	• Same as Q6 • 'Mostly; key as 2 • 'Sometimes' and 'Occasionally' key as 1.

Q8	1	0, 1, 2, 3	• 9 if missing. • Double tick or tick b/w boxes: (0,1) key as 1 (1,2) key as 1 (2,3) key as 2 • Triple tick, key in middle answer. • 'Sometimes' key as 1. • 'Sometime during every night' key as 3. 'don't know', 'no idea' '?' 'not known', key as 7.
Q9	4	##.#	• Leave blank if missing, or unusual answer. • Convert inches to cms • Average39-40cm, key as 39.5cm.
Q10	1	0, 1, 2, 3	• 9 if line box is missing • Double tick or tick b/w boxes: (0,1) key as 1 (1,2) key as 1 (2,3) key as 2 • Ticked all boxes, treat as missing and key in 9. • Triple tick, key middle answer.
Q11	1	0,1	• 9 if missing • 7 if don't know
Q12	6	##	• Answers will only be taken from the largest denomination. (eg if years are given, months and weeks are ignored, if months are given, weeks are ignored) • Expressions in fractions will be rounded down. • Leave blank if no answer.
Q13	2	##	• Leave blank is missing. • 'NA', 'Nil', or dash key as 0.
Q14	2	##	• Leave blank is missing. • Ranges will be given as averages.
Q15	1	0, 1, 2 SPECIFY	• Assume 0 for no if line not answered. • 'NA', 'Nil' key as 0 • If comments given, key Y. Otherwise, leave blank.
Q16	1	0, 1	• No = 0, Yes = 1 • Text replies under "specify" should be identical with what the respondent has written, without any interpretation.

Q17 **Q17a** **Q17b**	1 1 4	0, 1 0,1 ##.#	• No=0, Yes=1 (for all of Q17) • Ambiguous text answers will be recorded as No, Key 0. • Q17b will not be considered/entered unless Q17a has been answered as 'Yes'. • If a range is given, then the average will be recorded. If this is a fraction, then this will be rounded down to the integer.
Q18 **SPECIFY**	1 4	0, 1 ##.#	• No=0, Yes=1 • If 'non-work' is given – do not record. • Key in if supplied. • Provide average if range given.
Q19	1	1, 9	• Yes=1, No Answer=9 (as opposed to 'No')s

APPENDIX 9
LETTER INFORMING GPS

Dear Sir/Madam,

You may recall filling out a blue or yellow questionnaire about your sleeping habits and tiredness during the day. Part of the study was to check how sleepy taxi drivers are, and also to find out how many taxi drivers are at risk of a sleep problem called Obstructive Sleep Apnoea.

A person who has **Obstructive Sleep Apnoea** stops breathing repeatedly while they are asleep. When they are able to breathe, they probably snore loudly. All this disturbs their sleep and leads to feeling more sleepy when they are awake. It is quite possible to have this problem without knowing it, although the pattern of snoring and breathing pauses often disturbs other people in the household.

Obstructive sleep apnoea can also make other medical problems worse if left untreated, but the good news is that it can usually be easily treated.

The answers you gave on the questionnaire suggest that you may be at moderate or high risk of having obstructive sleep apnoea. **It is impossible to know for certain from the questionnaire** whether you have it, but your answers indicate that it would be a good idea to talk to your doctor. You could make an appointment to see your GP about this, or bring it up next time you see them for another reason.

There may be something simple that can be done to help you feel less tired during the day. However, if your doctor thinks there is reason to check things out further, they may refer you to a sleep medicine specialist.

I you would like, we can send a letter for you to give to your doctor to help explain things. Please call free on **0800 SLEEPING (0800 75 33 74)** if you would like a letter for your GP, or if you have any questions or queries.

Thank you once again for participating in this study.

Kind regards

Riz Firestone	**Prof. Philippa Gander**	**Dr John Matthewson**
PhD Student/Researcher	Director	Research Assistant
Sleep Wake Research Centre		

APPENDIX 10
MUHE LETTER OF APPROVAL

Human Ethics Committee: Wellington

16 September 2003
Ridvan Tua Firestone
C/O Sleep/Wake Research Centre
Massey University
WELLINGTON

Dear Ridvan

Re: MUHEC: WGTN Protocol - 03/124

Improving Access to Treatment for Obstructive Sleep Apnoea Among Professional Taxi Drivers

Thank you for your letter of 28 August 2003 in response to the issues raised by the Massey University Wellington Human Ethics Committee.

I am pleased to advise that following consideration of the information supplied by you, the ethics of your protocol are now approved. Approval is for three years. If this project has not been completed within three years from the date of this letter, a new application must be submitted at that time.

Any departure from the approved protocol will require the researcher to return this project to the Massey University Human Ethics Committee for further consideration and approval. A reminder to include the following statement on all public documents: "This project has been reviewed and approved by the Massey University Human Ethics Committee, WGTN Protocol 03/124. If you have any concerns about the conduct of this research, please contact Mr Jeremy Hubbard, Acting Chair, Massey University Wellington Human Ethics Committee, telephone 04 801 2794 ext 6358, email J.J.HUBBARD@MASSEY.AC.NZ."

Yours sincerely

Jeremy Hubbard (Acting Chair)

Massey University Human Ethics Committee: Wellington

Cc: Professor Philippa Gander, Sleep/Wake Research Centre

APPENDIX 11
LIST OF SLEEP CLINICS/SERVICE PROVIDERS

New Zealand Sleep Services

Auckland

Auckland Physiology
PO Box 99354
New Market
Auckland

Dr Andy Veale, Nicola Mills, Gwen Gumbley
tel: (09) 638 9965
fax: (09) 638 9967
email: nicolam@aucklandphysiology.co.nz

Green Lane Hospital Sleep Centre
PO Box 92189
Auckland 1030

Dr Kenneth Whyte, Louise Mafile'o
tel: (09) 630 9943, ext 8050
fax: (09) 630 9899
email: lmafileo@adhb.govt.nz

Starship Children's Hospital
Private Bag 92024
Auckland

Cathy Douglas
tel: (09) 307 4949 ext 6483

Hamilton

Anglesea Sleep
Anglesea Clinic
PO Box 228
Hamilton

Dr Noel Karalus, Adelle Veen
tel: (07) 858 0777
fax: (07) 858 0779

Waikato Hospital Sleep Laboratory
Health Waikato
Private Bag 3200
Hamilton

Dr John McLachlan, Merrhis Majurey, Jo Askew
tel: (07) 839 8899 ext. 6609
fax: (07) 858 0935
email: majureym@waikatodhb.co.nz

Tauranga

Pacific Health
Tauranga Hospital
Private Bag 12024
Cameron Road
Tauranga

Dr Neil Graham, Leigh Grenfell
tel: (07) 579 8000
fax: (07) 579 8524
email: leighg@bopdhb.govt.nz

Hastings

Health Care Hawkes Bay Respiratory Laboratory Villa 2, Regional Hospital Omahu Road Hastings	Dr Robin Armstrong, Dee McFadyen tel: (06) 878 8109 ext. 6606 fax: (06) 878 1613 email: Dee.McFadyen@hawkesbaydhb.govt.nz

Palmerston North

Respiratory Services Palmerston North Hospital PO Box 2056 Palmerston North	Dr Alistair Watson, Jane Overtoun tel: (06) 350 8618 fax: (06) 350 8647 email: respserv@midcentral.co.nz

Wellington

Wellington Hospital Sleep Clinic Respiratory Medicine Private Bag 7902 Wellington South	Dr David Jones, Penny Fairbrother tel: (04) 385 5867 fax: (04) 385 5550 email: Penelope.Fairbrother@ccdhb.org.nz
WellSleep Bowen Hospital Crofton Downs Wellington	Dr Alister Neill, Dr Angela Campbell tel: (04) 920 8819 fax: (04) 920 8861 email: wellsleep@wnmeds.ac.nz

Blenheim

Wairau Hospital PO Box 46 Blenheim	Dr John Hedley, Marian Vercoe tel: (03) 577 6987

Nelson

Nelson Hospital Medical Outpatients Private Bag 18 Nelson	Dr Steve Delany Lynda Stewart tel: (03) 546 1800 fax: (03) 546 1288 email: lynda.stewart-samson@nmhs.govt.nz

Christchurch

Christchurch Hospital – Paediatrics Private Bag 4710 Christchurch	Janine Larkin tel: (03) 364 0194 fax: (03) 364 0919 email: janine.larkin@cdhb.govt.nz
Christchurch Hospital Sleep Unit Private Bag 4710 Christchurch	Dr C Drennan, Dr L Beckert, Bryn Sparks tel: (03) 364 1089 fax: (03) 364 1089 email: sleep@cdhb.govt.nz
Southern Sleep Services 479 Durham Street North Christchurch	Dr Chris Drennan, Yvonne Epton tel: (03) 366 3479 fax: (03) 366 2479 email: sleep@xtra.co.nz

Dunedin

Dunedin Hospital – Paediatrics Department of Paediatrics PO Box 913 Dunedin	Prof Barry Taylor, Rachel Sayers tel: (03) 474 7644 fax: (03) 474 7817 email: rachel.sayers@stonebow.otago.ac.nz
Tom McKendrick Sleep Laboratory Dunedin Hospital Private Bag Dunedin	Dr Robyn Taylor, Dave Jones tel: (03) 474 0999, ext 8781 fax: (03) 474 7883 email: davej@healthotago.co.nz

Invercargill

Southland Hospital Medical Unit Southland Hospital Invercargill	Dr Charles Renner, Michelle Klenner tel: (03) 214 5775 fax: (03) 214 6317 email: michelle.klenner@sdhb.govt.nz

APPENDIX 12
FOCUS GROUP CONFIRMATION LETTER

<dd/mm/yyyy>

Dear Sir/Madam,

Thank you for volunteering your time to participate in a focus group. There are four groups in total. You have been assigned according to the ethnic group as noted on your sleep questionnaire, or because you have indicated that you have tried to get help for a sleeping problem in the past. Being selected does not mean that *you have* a sleeping problem.

What are Focus Groups?

A focus group is a way of collecting information from a diverse group of people. The information gathered will be taken from the ***'group discussion'***, not from individuals. It is not an interview.

What is the 'purpose' of the group discussion?

The aim of the focus group is to discuss the sleep disorder "Obstructive Sleep Apnea Syndrome" (OSAS), and to ***'identify'*** the *issues* that taxi drivers may *face and experience* if, and when trying to get help for this sleep disorder. A definition of OSAS is given over the page.

Group Considerations:

- Focus groups can take up to 2 hours, and therefore, you need to be ***'absolutely clear'*** that you are able to attend on the date and time noted below.
- To avoid disruption of the group discussion cell phones are not permitted to be switched on.
- No one will be personally identified in the 'write-up'. Therefore, confidentiality of the discussion remains within the group.
- The group discussion will be taped so opinions/perspectives are not missed.
- You have the option of reading the transcript to 'authenticate' what you have said.

Your Focus Group Appointment:

Date:

Time:

Place: **Seminar Room, Level 2, 'No Names' Building, 102 Adelaide Road, Newtown, Wellington.**

Please telephone John to confirm your place or if you have any questions, on 0800 SLEEPING (0800 75 3374), or 801-5799, ext 6081.

Your input into this study will be valuable. Upon request you will receive a summary of the discussion analysis. Light refreshments and beverages are provided. A $50 petrol voucher will be given in return for your participation. We look forward to meeting you then.

Riz Firestone
Researcher/Facilitator

John Matthewson
Research Assistant/Assistant Facilitator

(PAGE 2)

What is Obstructive Sleep Apnea Syndrome (OSAS)?

OSAS is characterised by:

Repeated periods when breathing stops for at least 10 seconds or more (*apnoea*), or restricted airflow during sleep (*hypopnoea*). OSAS is easily treatable.

Symptoms:

- Breathing pauses during sleep
- Snoring
- Day time sleepiness

Who is at risk?

- Middle-aged people (30-60 years)
- Over-weight people
- Men
- Māori and Pacific Island Peoples

APPENDIX 13
'FIT AND PROPER PERSON' CHECK LIST

'Fit and proper person' check

Your application will be sent to the nearest Land Transport New Zealand regional office for a 'fit and proper person' check to be undertaken. The person who carries out the check considers any:

- transport-related offences, especially relating to safety
- history of mental health or behavioural problems
- past complaints about a transport service you may have operated
- history of persistent failure to pay fines for transport-related offences
- criminal convictions (in New Zealand or overseas), including charges or convictions relating to violent or sexual offences, drug or firearms offences, or offences involving organised criminal activity
- serious convictions. From 16 January 2006, persons convicted of specified serious offences on, before or after that date will be prohibited from holding or applying for a passenger endorsement. The specified serious offences are
  - murder
  - a sexual crime under Part VII of the *Crimes Act 1961* that is punishable by seven or more years' imprisonment, including sections 144A and 144C
  - crimes under any of the following sections of the *Crimes Act 1961*: 173, 174, 175, 176, 188, 189(1), 191, 198, 199, 200(1), 201, 208, 209, 210, 234, 235 and 236
  - any offence committed outside New Zealand that, if committed within New Zealand, would constitute one of the above offences.

Read a detailed list of offences in section 29A of the Land Transport Amendment Act 2005 (on the Knowledge Basket website).

Read a detailed list of offences under sections 144A and 144C of the *Crimes Act 1961* (on the Knowledge Basket website).

APPENDIX 14
LEGISLATION

The Health and Safety in Employment Act 1992

Under the Health and Safety in Employment Act 1992, employers are responsible for the safety of their employees at work. This includes employees who are driving as part of their work – whether they are the driver, or a passenger, whether they drive regularly or occasionally, and whether the vehicle is owned, leased or rented by your company.

Under the Act, employers must take all practicable steps to:

- provide and maintain a safe and healthy working environment
- provide and maintain necessary facilities for employee safety and health
- ensure that vehicles are arranged, designed, made and maintained so that they are safe for the employee to use
- ensure that employees are not exposed to hazards (including hazards arising from the way that work is organised, such as driving schedules)
- develop procedures for dealing with emergencies that can arise while employees are at work.

Employers must also:

- identify, assess and control significant hazards
- ensure that every employee is given information about emergency procedures and all identified hazards
- provide appropriate training and supervision
- involve employees in the development of health and safety procedures.

An accident register must be kept and cases of serious harm to employees at work must be registered with the Department of Labour's Occupational Safety and Health Service (OSH).

If you employ contractors, you must take all practicable steps to ensure that individual contractors, and individual sub-contractors or employees of contractors, are not harmed by the work they are engaged to do, or by hazards in their place of work.

The central requirement is that "all practicable steps" are taken. This depends on what can reasonably be done in the particular circumstances, taking into account:

- the possible nature and severity of potential harm
- the existing knowledge about the likelihood and severity of that potential harm
- the existing knowledge about the effectiveness of possible safeguarding measures
- the availability and cost of each of those measures.

ACC and employer responsibilities under the Injury Prevention, Rehabilitation and Compensation Act 2001

From 1 April 2002, the Injury Prevention, Rehabilitation and Compensation Act 2001 requires employers to pay the first week of compensation, at a rate of 80 percent of earnings lost by an employee as a result of a motor vehicle injury that is both a motor vehicle injury and a work-related personal injury.

A motor vehicle injury that happens in a work context will be categorised as a work-related personal injury if:

- it happens while an employee is a passenger in an employer's vehicle at the beginning or at the end of the day; and
- that vehicle is provided by the employer for the purpose of transporting employees.

The injury will also be a work-related personal injury if it happens while the employee is travelling between his or her place of employment and another place, in order to get treatment for another work-related personal injury. The treatment being sought has to be necessary for the other work-related personal injury and be treatment of a sort the employee is entitled to under the Act.

Workplace injuries can result in significant costs to individuals, businesses and the community. ACC's primary function is injury prevention. Consequently ACC encourages employers to work with their employees to reduce the number and severity of injuries in the workplace. ACC provides a range of injury prevention programmes and assistance to employers and industry groups including:

- regular regional injury prevention seminars
- advice on setting up workplace health and safety systems
- Occupational Overuse Syndrome (OOS) prevention information
- back injury prevention/back pain management programme.

The range of injury prevention and injury management publications available free of charge includes:

- How to set up and support workplace health and safety
- How to implement safer workplace practices
- Down with speed: a review of the literature and the impact of speed on New Zealanders
- Code of practice for manual handling
- Manual handling equipment list
- Manual handling hazard control card
- How to develop a workplace back plan
- Acute low back pain management
- Active and working: managing acute low back pain in the workplace.

Contact ACC ThinkSafe on 0800 844 657 to order any of these publications. For further information about ACC's injury prevention resources, visit the ACC website at **www.acc.co.nz/injury-prevention**