TITLE

Sleep Apnea and Driving in NSW Transport Drivers

AUTHORS

Anup Desai[1], Jim Newcombe[1], Delwyn Bartlett[1], David Joffe[2], Ron Grunstein[1]

Sleep Research Group, Institute of Respiratory Medicine, Royal Prince Alfred Hospital, Sydney[1]
Sleep Research Group, Institute of Respiratory Medicine, Royal North Shore Hospital, Sydney[2]

SUMMARY

We have performed a pilot study to assess obstructive sleep apnea (OSA), work and life-style factors as causes of driver fatigue in transport drivers. This study is part of a larger national study of sleep disordered breathing in transport drivers. A group of NSW transport drivers completed a survey designed to assess an individual's level of daytime sleepiness and their likelihood of having OSA. Questions were also asked about motor vehicle accident history, sleep and work habits. The transport drivers sampled exhibited a high prevalence of OSA, which was found to be a primary cause of excessive daytime sleepiness in this group. Management strategies for this population must be developed which target OSA as an important cause of driver fatigue.

INTRODUCTION

Driver fatigue or sleepiness is a widespread, serious and common problem within our society. Fifteen to twenty-five percent of all road accidents are believed to be sleep related (1). Furthermore, NSW Statistics attribute 18% of all fatal accidents (2) and 30% of fatal accidents in rural areas to driver fatigue (3). Twenty to sixty percent of truck accidents are sleep related (4). The problem of driver fatigue of course moves far beyond just road vehicles to all modes of transportation, being an important factor in rail, sea and air accidents as well. The Exxon Valdez oil spill and the destruction of the Space Shuttle Challenger are both examples of fatigue related disasters that have had devastating consequences (5;6)

Driver fatigue commonly causes “fall asleep” motor vehicle accidents. These tend to be more severe or fatal compared with other road accidents. This is because they often involve a single vehicle running off the road at high speed, they tend to occur on higher-speed roadways, and braking or other preventative measures may be absent (1). If truck drivers are involved, the potential to cause death or serious injury to other road users is greatly increased.

Important causes of driver fatigue include the circadian timing of driving, the length of driving without rest, insufficient sleep hours (sleep loss/deprivation), drugs (especially alcohol), and sleep disorders. Each of these factors has in turn been shown to impair driving performance(7-11). Importantly, these factors can be additive or perhaps even multiplicative in the one individual to create a very dangerous sleep propensity. Many truck drivers, for example, are required to drive continuously for many hours at night, oftentimes with prior sleep deprivation, and are possibly further impaired by sleep disorders such as obstructive sleep apnea and the use of drugs. There may also be other indirect effects of these factors contributing to sleep related accidents. For example, both sleep deprivation and alcohol have been shown to increase risk-taking behaviour (12).

Obstructive Sleep Apnea (OSA) is the most common and important sleep disorder to cause driver fatigue. OSA is widespread, affecting approximately 25% of middle-aged men (13;14). It is characterised by pauses in breathing during sleep due to upper airway narrowing or closure. This results in repetitive, intermittent hypoxaemia and sleep fragmented by frequent arousals (15). Due to these disruptions to normal sleep patterns, patients with OSA tend to suffer from excessive daytime sleepiness. There is also increasing recognition that OSA has other important consequences, leading to impaired quality of life (16) and decrements in attention and cognitive performance (17), and there is increasing evidence of a link to hypertension and vascular disease(18;19). Of particular importance to driving and road safety, many studies have now also demonstrated an increased motor vehicle accident risk in patients with OSA when compared with the general population (20-24). In a very large study involving nearly 1000 subjects and using objective government records, Young et al. (22) showed that the odds ratio for having had any recent road

traffic accident was approximately doubled in subjects with OSA compared with those without, while the odds ratio for multiple road traffic accidents averaged 4.6. At more severe levels of OSA, the likelihood of having had multiple road traffic accidents increased by a factor of 7.3. It is important to realise that even this objective data may underestimate the frequency of road traffic accidents in this population because OSA patients are prone to single-vehicle accidents, which may go unreported.

Specific data on the prevalence and accident risk with respect to OSA in commercial drivers is very limited. They are thought to constitute a high-risk group for OSA, being predominantly male, and often middle aged and overweight - 3 important risk factors for OSA (25;26). Stoohs et al. (27) used portable screening devices to investigate the prevalence of sleep apnea in a sample of professional truck drivers in the USA. They found that 46% of the 159 truck drivers studied had 10 or more oxygen desaturation events per hour of sleep, an indicator of OSA. This alarmingly high statistic led to the US Department of Transportation to fund a further study of sleep apnea prevalence in commercial drivers. Pack et al (28) from the Uni. Of Pennsylvania have recently completed and presented in abstract form their results. They found 28% of the 408 commercial drivers who had overnight sleep studies had OSA (defined as a respiratory disturbance index of greater than 5/hour). This is much lower than Stoohs' prevalence, but still higher than the general population figures. Shortfalls of this study include a limited response rate and a low percentage of long distance drivers (approximately 11%). One study has reported on accident rates in community-sampled truck drivers with OSA, finding them double those who did not have OSA (29).

OSA can be effectively treated with nasal continuous positive airway pressure (CPAP) (30). This device, placed by the patient's bedside, generates air pressure and delivers it through a nasal mask, thus splinting open the upper airway during sleep. Regular use of CPAP markedly improves self-reported accident risk (31-34) and there is early work to show it improves objective accident risk (35).

METHODS

The subjects in this study were all NSW transport drivers (truck drivers) attending a yearly delegates meeting of the NSW Transport Workers Union. They were asked to complete a survey, which included questions to assess their likelihood of having OSA and any excessive daytime sleepiness they might be experiencing. The questions used were from the Multivariate Apnea Prediction Questionnaire (36) and the Epworth Sleepiness Scale (37) respectively. Questions were also asked about their general medical health, motor vehicle accident history, sleep and work habits. Simple physical characteristics such as height and weight were measured. The questionnaire was administered first with subjects taking 10 - 20 minutes to complete it. Subjects were then taken to the measurement areas to have their heights and weights recorded. All subjects gave written informed consent to participate in the study and participation was entirely voluntary. Subject consent forms were separated from the rest of the questionnaires by the subjects and placed in separate sealed boxes to ensure subject anonymity and confidentiality. The Ethics Review Committee (RPAH Zone) of the Central Sydney Area Health Service approved the study.

RESULTS

206 surveys were returned, representing over 85% of potential respondents at this one meeting. However, only 158 of the 206 surveys returned were completed fully and able to be analysed. Data was analysed using Microsoft Excel 97 and Analyse-It (version 1.44), a statistical analysis add-in program for Microsoft Excel. Chi-squared tests (X^2) were used to test associations.

All respondents were male, with an average age of 44.8 +/- 8.3 years and an average body mass index of 30.0 +/- 5.6 kg/m^2 (ideal range 20 -25). The prevalence of OSA, as assessed by the Multivariate Apnea Prediction Questionnaire, was 60.8%. This questionnaire predicts the likelihood of having OSA with an average apnea/hypopnea score of greater than 10 per hour of sleep (positive and negative predictive values of 0.75 and 0.74 for OSA) (36). 34% of the drivers had an Epworth Sleepiness Scale of at least 10, indicating excessive daytime sleepiness. These drivers were more likely to have OSA (X^2, $p<0.001$), but did not show an increased self-reported accident risk. There was no significant relationship between having an accident in the last 3 years, and having OSA, driving more than 10 hours per day and sleeping less than 6 hours per night on workdays. However, drivers with a longest work shift duration of at least 14 hours showed a trend for higher accidents (X^2, $p = 0.10$) and were more likely to have OSA (X^2, $p = 0.01$).

CONCLUSIONS

The transport drivers sampled exhibited a high prevalence of OSA. The prevalence value we found is greater than the prevalence values previously reported by Stoohs, et al (27) and Pack, et al (28). However, it should be stressed that we used different methodologies to these two authors to assess for OSA. Our results also represent only an early report, describing preliminary work from a much larger study, which has been properly designed and powered to give Australia wide prevalence data for OSA in transport drivers. Nonetheless, this paper adds to the evidence suggesting that OSA is more prevalent in commercial drivers than in the general population. As a group, commercial drivers tend to be predominantly male, and are often middle-aged and overweight - 3 important risk factors for OSA. The demographic data we have reported above is consistent with this. So, it is not surprising that OSA is more prevalent amongst them compared with the general population.

Our study failed to show an association between OSA in commercial drivers and an increased risk of motor vehicle accidents. However, there was also no significant relationship between having an accident in the last 3 years, and being excessively sleepy during the day, driving more than 10 hours per day and sleeping less than 6 hours per night on workdays. It is likely that subjects under-reported their motor vehicle accident history, a common unavoidable problem with self-report surveys such as this. Despite assurances of confidentiality, subjects may not have felt comfortable reporting accidents where they were potentially at fault. Large studies looking at the association between OSA in commercial drivers and objective crash records (government agencies, company files) are needed to more accurately address this issue in the future.

We found that drivers with a longest work shift duration of at least 14 hours showed a trend for higher accidents and were more likely to have OSA. This last finding is interesting in view of published reports which suggest that sleep deprivation worsens OSA (38;39). The degree of additional deterioration in driving performance in subjects with OSA who are then sleep deprived has not been assessed in the literature to date, but has important implications for the many truck drivers who drive sleep deprived (40).

We found that one third of drivers had an Epworth Sleepiness Scale of at least 10, indicating pathological daytime sleepiness. These drivers were more likely to have OSA, suggesting that OSA is an important treatable cause of driver sleepiness in this population. Screening and management strategies for transport drivers must be developed which target this very important cause of driver fatigue.

ACKNOWLEDGEMENTS:

This project was funded by the NSW Road Transport Authority

REFERENCES

(1) Horne JA, Reyner LA. Sleep related vehicle accidents. BMJ 1995; 310(6979):565-567.

(2) Motor Accidents Authority of NSW. Driver Fatigue. Motor Accidents Authority of NSW Web Page. 1997. http://www.maa.nsw.gov.au/road_safety/fatigue/

(3) Road Safety Bureau NSW. Problem Definition and Countermeasure Summary: Fatigue. Road Safety Bureau NSW Report 1993.

(4) Traffic Accident Commission Victoria. Road Safety Progress. Traffic Accident Commission Victoria Report, Appendix 1. 1994.

(5) Coren S. Daylight savings time and traffic accidents [letter]. New England Journal of Medicine 1996; 334(14):924.

(6) Mitler MM, Carskadon MA, Czeisler CA, Dement WC, Dinges DF, Graeber RC. Catastrophes, sleep, and public policy: consensus report. [Review]. Sleep 1988; 11(1):100-109.

(7) Lenne MG, Triggs TJ, Redman JR. Time of day variations in driving performance. Accident Analysis & Prevention 1997; 29(4):431-437.

(8) Philip P, Taillard J, Quera-Salva MA, Bioulac B, Akerstedt T. Simple reaction time, duration of driving and sleep deprivation in young versus old automobile drivers. Journal of Sleep Research 1999; 8(1):9-14.

(9) Lenne MG, Triggs TJ, Redman JR. Interactive effects of sleep deprivation, time of day, and driving experience on a driving task. Sleep 1998; 21(1):38-44.

(10) Fairclough SH, Graham R. Impairment of driving performance caused by sleep deprivation or alcohol: a comparative study. Human Factors 1999; 41(1):118-128.

(11) Juniper M, Hack MA, George CF, Davies RJ, Stradling JR. Steering simulation performance in patients with obstructive sleep apnoea and matched control subjects. European Respiratory Journal 2000; 15(3):590-595.

(12) 14th Congress of the European Sleep Research Society. Madrid, Spain, 9-12 September 1998. Abstracts. Journal of Sleep Research 1998; 7(sup 2):113-113.

(13) Bearpark H, Elliott L, Grunstein R, Cullen S, Schneider, H et al. Snoring and sleep apnea. A population study in Australian men. American Journal of Respiratory & Critical Care Medicine 1995; 151(5):1459-1465.

(14) Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr et al. The occurrence of sleep-disordered breathing among middle-aged adults. New England Journal of Medicine 1993; 328(17):1230-1235.

(15) Guilleminault C. Clinical features and evaluation of obstructive sleep apnea. In: Kryger MH, Roth T, Dement WC, editors. Principles and practice of sleep medicine. Philadelphia: W.B. Saunders, 1989: 552-558.

(16) Grunstein RR, Stenlof K, Hedner JA, Sjostrom L. Impact of self-reported sleep-breathing disturbances on psychosocial performance in the Swedish Obese Subjects (SOS) Study. Sleep 1995; 18(8):635-643.

(17) Engleman H, Joffe D. Neuropsychological function in obstructive sleep apnoea. Sleep Medicine Reviews 1999; 3(1):59-78.

(18) Peppard P, Young T, Palta M, Skatrud J. Prospective Study of the association between sleep-disordered breathing and hypertension. New England Journal of Medicine 2000; 342(19):1378-1384.

(19) Skomro RP, Kryger MH. Clinical presentations of obstructive sleep apnea syndrome. [Review]. Progress in Cardiovascular Diseases 1999; 41(5):331-340.

(20) Teran-Santos J, Jimenez-Gomez A, Cordero-Guevara J. The association between sleep apnea and the risk of traffic accidents. Cooperative Group Burgos-Santander [see comments]. New England Journal of Medicine 1999; 340(11):847-851.

(21) Barbe, Pericas J, Munoz A, Findley L, Anto JM, Agusti AG. Automobile accidents in patients with sleep apnea syndrome. An epidemiological and mechanistic study. American Journal of Respiratory & Critical Care Medicine 1998; 158(1):18-22.

(22) Young T, Blustein J, Finn L, Palta M. Sleep-disordered breathing and motor vehicle accidents in a population-based sample of employed adults. Sleep 1997; 20(8):608-613.

(23) Wu H, Yan-Go F. Self-reported automobile accidents involving patients with obstructive sleep apnea. Neurology 1996; 46(5):1254-1257.

(24) Findley LJ, Levinson MP, Bonnie RJ. Driving performance and automobile accidents in patients with sleep apnea. [Review]. Clinics in Chest Medicine 1992; 13(3):427-435.

(25) Redline S, Kump K, Tishler PV, Browner I, Ferrette V. Gender differences in sleep disordered breathing in a community-based sample. American Journal of Respiratory & Critical Care Medicine 1994; 149(3:Pt 1):6.

(26) Dealberto MJ, Ferber C, Garma L, Lemoine P, Alperovitch A. Factors related to sleep apnea syndrome in sleep clinic patients. Chest 1994; 105(6):1753-1758.

(27) Stoohs RA, Bingham LA, Itoi A, Guilleminault C, Dement WC. Sleep and sleep-disordered breathing in commercial long-haul truck drivers. Chest 1995; 107(5):1275-1282.

(28) Pack A, Maislin G, Staley B, Pack FM, Dinges DF. Obstructive Sleep Apnea in Commercial Drivers. American Journal of Respiratory & Critical Care Medicine 2000; 161:A714.

(29) Stoohs RA, Guilleminault C, Itoi A, Dement WC. Traffic accidents in commercial long-haul truck drivers: the influence of sleep-disordered breathing and obesity. Sleep 1994; 17(7):619-623.

(30) Sullivan CE, Issa FG, Berthon-Jones M, Eves L. Reversal of obstructive sleep apnoea by continuous positive airway pressure applied through the nares. Lancet 1981; 1(8225):862-865.

(31) Cassel W, Ploch T, Becker C, Dugnus D, Peter JH, von Wichert P. Risk of traffic accidents in patients with sleep-disordered breathing: reduction with nasal CPAP. European Respiratory Journal 1996; 9(12):2606-2611.

(32) Krieger J, Meslier N, Lebrun T, Levy P, Phillip-Joet F, Sailly JC et al. Accidents in obstructive sleep apnea patients treated with nasal continuous positive airway pressure: a prospective study. The Working Group ANTADIR, Paris and CRESGE, Lille, France. Association Nationale de Traitement a Domicile des Insuffisants Respiratoires. Chest 1997; 112(6):1561-1566.

(33) Engleman HM, Asgari-Jirhandeh N, McLeod AL, Ramsay CF, Deary IJ, Douglas NJ. Self-reported use of CPAP and benefits of CPAP therapy: a patient survey. Chest 1996; 109(6):1470-1476.

(34) Yamamoto H, Akashiba T, Kosaka N, Ito D, Horie T. Long-term effects nasal continuous positive airway pressure on daytime sleepiness, mood and traffic accidents in patients with obstructive sleep apnoea. Respiratory Medicine 2000; 94(1):87-90.

(35) Findley L, Smith C, Hooper J, Dineen M, Suratt PM. Treatment with nasal CPAP decreases automobile accidents in patients with sleep apnea. American Journal of Respiratory & Critical Care Medicine 2000; 161(3:Pt 1):9-9.

(36) Maislin G, Pack AI, Kribbs NB, Smith PL, Schwartz AR, Kline LR et al. A survey screen for prediction of apnea. Sleep 1995; 18(3):158-166.

(37) Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991; 14(6):540-545.

(38) Persson HE, Svanborg E. Sleep deprivation worsens obstructive sleep apnea. Comparison between diurnal and nocturnal polysomnography. Chest 1996; 109(3):645-650.

(39) Stoohs RA, Dement WC. Snoring and sleep-related breathing abnormality during partial sleep deprivation [letter]. New England Journal of Medicine 1993; 328(17):1279.

(40) Mitler MM, Miller JC, Lipsitz JJ, Walsh JK, Wylie CD. The sleep of long-haul truck drivers. New England Journal of Medicine 1997; 337(11):755-761.