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Evaluation of subjective sleepiness and prevalence of obstructive sleep apnoea and sleep-disordered breathing in a population of commercial drivers

Key Messages

1. Sleepiness at work was reported by 61% of the bus drivers in this study, with estimated minimum prevalence rates of sleep-disordered breathing (SDB) and obstructive sleep apnoea syndrome (OSAS) of 8% and 5%, respectively.
2. Body mass index, neck circumference, and snoring intensity are the positive independent predictors of respiratory disturbance index values, whereas neither self-reported nor subjective sleepiness identified SDB. Bus drivers who snore loudly during sleep (especially those overweight) are strongly advised to seek medical attention for investigation and treatment of OSAS.
3. Home continuous positive airway pressure acceptance is low, but there was significant improvement of subjective sleepiness and cognitive function among bus drivers who did take up such treatment.
4. To improve road safety, health education and promotion are urgently needed to increase awareness of OSAS among medical professionals, legislators, licensing authorities, drivers, and the public.

Hong Kong Med J 2007;13(Suppl 3):S36-9

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HCPF project number: 216023

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Introduction

Obstructive sleep apnoea syndrome (OSAS) is a common form of sleep-disordered breathing (SDB) characterised by repetitive episodes of partial or complete upper airway obstruction causing sleep fragmentation, disabling daytime sleepiness, impaired cognitive function, poor quality of life, and an increased risk of road traffic accident (RTA). We have previously estimated a minimum prevalence of OSAS of 4.6% in a study of a small group of commercial bus drivers (n=216), and reported that neither self-reported nor subjective sleepiness could identify subjects with SDB.[1]

Aims and objectives

In a larger group of commercial bus drivers at a different bus depot in Hong Kong, we further evaluated the prevalence of SDB, OSAS, and its related symptoms and factors that might predict their presence. In addition, we assessed nasal continuous positive airway pressure (CPAP) acceptance and compliance among those confirmed to have OSAS, and relevant outcomes 3 months after such treatment.[2]

Methods

Study subjects

This study was conducted from October 2001 to August 2004. Our research assistants interviewed the commercial bus drivers who agreed to take part in the sleep questionnaire survey. Interviews ensued over a period of 24 months at the regional bus depot during the drivers' tea breaks, or before or after shift work. Apart from the usual demographic data, the Sleep and Health Questionnaire (SHQ[3]) and the Epworth sleepiness scale (ESS[4]) questionnaire were administered to the bus drivers as in our previous study.[1]

Symptom measurement

The SHQ was previously validated by characterising symptom distribution in population surveys of sleep apnoea,[3] whereas the ESS is specific to symptoms of daytime sleepiness and the subjects were asked to score the likelihood of falling asleep in eight different situations with different levels of stimulation, adding up to a total score of 0 to 24.[4]

Sleep monitoring

Bus drivers who completed the sleep questionnaire and consented for sleep study were randomly selected to have a home sleep study with the MESAM IV device (Madaus Medizin-Elektronik, Freiburg, German), which monitored four variables. The latter included: snoring, heart rate, oxygen saturation (SpO_2), and body position. The respiratory disturbance index (RDI) values obtained using the MESAM IV correlated well with the apnoea-hypopnoea index (AHI) using standard polysomnography (PSG) and the validity of the device has been confirmed previously in the Hong Kong Chinese population.[5]

Table 1. Responses to selected questions from the Sleep and Health Questionnaire[2,3] (n=1016)

Response	Mild	Moderate	Severe
Impaired performance ability	24.4%	2.4%	0.4%
Sleepiness interfered with daily tasks	10.5%	2.5%	2.0%
Impaired energy level	33.2%	2.7%	0.1%
Daytime sleepiness or sleepiness during normal working hours	52.4%	4.0%	4.5%
Snoring intensity (past month)	46.9%	15.0%	7.4%
Snoring frequency (past month)	43.9%	6.2%	17.7%
Observed awakenings	4.0%	0.4%	0.4%
Observed choking	1.4%	0.2%	0.2%
Observed apnoea	3.0%	0.4%	0.3%
Frequent awakenings	35.4%	3.5%	2.4%
Difficulty in falling asleep	27.8%	3.8%	2.9%

Table 2. Correlation of variables versus respiratory disturbance index (RDI) and objective snoring[2] (n=211)

Variable	RDI		% Objective snoring	
	Pearson correlation (r)	P value (2-tailed)	Pearson correlation (r)	P value (2-tailed)
Age	0.09	0.20	0.01	0.86
Neck circumference	0.34	<0.01	0.24	<0.01
Body mass index	0.43	<0.01	0.36	<0.01
Epworth sleepiness scale (0-24)	0.06	0.38	0.09	0.21
Sleepiness at work*	0.00	0.95	-0.06	0.37
Snoring intensity past month*	0.25	<0.01	0.32	<0.01
Witnessed apnoea*	0.10	0.15	0.07	0.35
Impaired performance ability (Likert scale 1-6)	0.07	0.33	-0.14	0.05
Alcohol intake	-0.02	0.86	0.03	0.80

* 5-point frequency scale

All bus drivers with an RDI of ≥5/h on home sleep study were invited to undergo hospital-based PSG for confirmation of their obstructive sleep apnoea status. Those found to have AHI scores of >10/h were offered attended, overnight, home CPAP titration. Drivers who agreed, were prescribed nasal CPAP units with time clocks to assess objective compliance (machine run time). The ESS and cognitive function tests including trail-making, digit-symbol, digit-span, and stroop colour testing were performed at baseline and 3 months after starting CPAP treatment.

Results and discussion

Altogether 1016 (971 males) of 1477 subjects in the regional bus depot completed the questionnaire survey. The demographic characteristics of the whole group, expressed as means and standard deviations (SDs), were as follows: age 45.3 (7.4) years, body mass index (BMI) 24.9 (3.6) kg/m^2, and neck circumference 38.9 (3.1) cm. The mean extent of self-reported sleep duration over the past 3 months was 7.0 (1.2) h/night; for ESS scores, corresponding figures were 4.8 (4.0).

Sleep and Health Questionnaire

A total of 304 (30%) subjects reported snoring loud enough to disturb others. There were 334 (33%) who reported that their driving was affected by sleepiness, whereas 244 (24%) reported having fallen asleep during driving in the past with the following frequency: only once (16%), 2-5 times (56%), 6-20 times (18%), 21-100 times (6%), >100 times (3%), and "Don't know" (2%). Six (1%) subjects reported having had an RTA due to sleepiness at work. Other results from the SHQ are shown in Table 1.

Home sleep study

Following the questionnaire survey, 300 eligible subjects were randomly selected to have home sleep study with the MESAM IV device, of whom 211 (207 males) agreed to participate. The mean (SD) RDI value for these subjects was 9 (13)/h and the minimum SpO_2 during sleep was 82% (11%). Based on their sleep studies, 85 (40%), 55 (26%), 37 (18%), and 19 (9%) of the subjects had RDI values of ≥5, ≥10, ≥15, and ≥30/hour of sleep, respectively. The 95% confidence intervals for the frequency of bus drivers in these four RDI categories were 16-23%, 22-30%, 27-38%, and 39-51%, respectively. Fifty-five (26%) subjects had RDI values of ≥5 and had self-reported sleepiness at work, whereas 17 (8%) had RDI values of ≥5 and ESS scores of >10.

Factors correlating with respiratory disturbance index

Using Pearson correlation analysis, there were significant correlations between BMI, neck circumference, snoring intensity, snoring frequency, and relevant parameters such as (i) RDI, and (ii) percentage of subjects with objective snoring (Table 2). Using RDI as the dependent variable, multiple regression analysis revealed that the predictor variables accounted for 50% of the variance ($F_{3,185}$=20.87, P<0.01). Body mass index (P<0.001), snoring intensity (P=0.038), and neck circumference (P=0.046) yielded independent, statistically significant positive associations

Table 3. Comparison of relevant variables among drivers who accepted and refused home continuous positive airway pressure (CPAP) treatment[2]

Variables	Mean (interquartile range)		P value*
	CPAP users (n=9)	Refused CPAP (n=13)	
Age	46.0 (7.0)	50.0 (8.5)	0.64
Body mass index	27.3 (3.2)	27.8 (4.4)	0.87
Neck circumference	40.5 (2.3)	41.0 (2.3)	0.59
Apnoea-hypopnoea index	53.5 (24.0)	35.9 (22.2)	0.01
Arousal index	44.6 (27.6)	24.7 (17.7)	<0.01
Min oxygen saturation (SpO_2)	72.0 (24.0)	73.5 (12.8)	0.43
Mean SpO_2	94.0 (5.5)	95.0 (2.1)	0.08
CPAP pressure titrated	12.0 (3.0)	11.0 (2.8)	0.29
Epworth sleepiness scale	13.0 (11.0)	6.0 (9.5)	0.18

* Mann-Whitney *U* test

with the RDI values, whereas snoring frequency did not.

Polysomnography results and continuous positive airway pressure treatment outcome

Drivers who had RDI values of ≥5/h (n=85) during home sleep study were invited to undergo full PSG in our hospital for confirmation of OSAS but only 25 (29%) agreed. Most refused to participate because of the major outbreak of severe acute respiratory syndrome in our hospital at that time. Others either did not feel that they had significant symptoms warranting further tests and treatment, or were not available. These 25 subjects had a mean (SD) age of 48 (5) years, BMI of 27 (3) kg/m^2, ESS score of 9 (6), AHI value on PSG of 38 (21)/h, SpO_2 value of 92% (7%), and minimum SpO_2 of 73% (12%). Twenty-two subjects had AHI values of >10/h and were offered attended overnight CPAP titration. Their mean titrated CPAP pressure was 12 (2.0) cm H_2O. Only nine drivers accepted home CPAP treatment with a mean (SD) objective CPAP compliance (run time) of 5 (1) h/night whereas corresponding ESS values decreased from 11 (6) at baseline to 5 (3) at 3 months (P=0.028).

Comparisons between those who accepted home CPAP (n=9) and those who refused (n=13) are shown in Table 3. Users of CPAP had significantly more severe SDB, as reflected by a higher AHI and a higher arousal index on PSG, but there was no significant difference in baseline ESS values. The results of cognitive function tests completed by CPAP users at baseline and at 3 months thereafter are shown in Table 4. There was significant improvement of short-term memory and concentration, as reflected by changes in digit span and trail B, respectively, but there was no significant change in digit symbol, trail A, and stroop colour assessment.

Table 4. Changes in cognitive function tests among continuous positive airway pressure (CPAP) users[2] (n=9)*

Test	Mean (interquartile range)		P value
	Baseline	3 months	
Digit span†	12.0 (6.5)	12.5 (7.3)	0.02
Digit symbol†	13.0 (2.5)	11.5 (8.0)	0.11
Trail A‡	31.0 (23.8)	28.5 (16.8)	0.22
Trail B‡	47.0 (51.0)	45.5 (35.8)	0.04
Stroop colour§	81.0 (48.5)	93.5 (10.0)	0.35

* Wilcoxon signed ranks test was used to compare changes from baseline to 3 months

† The digit symbol and span tests involved the immediate memory and recall of number sequences

‡ The trail-making test estimated the minimum time required to connect a structured number sequence; the lower the score, the better the performance

§ The stroop colour test evaluated the correct matching of colour and their corresponding characters; for the stroop colour, digit symbol, and span tests, a higher score indicated superior performance

Conclusions

This study has shown minimum prevalence rates of SDB and OSAS of 8% and 5%, respectively in a group of commercial bus drivers in Hong Kong. The corresponding prevalence rates in a community study of middle-aged male office workers in Hong Kong were 9% and 4%.[6] Body mass index, neck circumference, and snoring intensity were the positive independent predictors of the RDI, whereas neither self-reported nor subjective sleepiness (ESS values) could identify our subjects with SDB. Home CPAP acceptance was low but conferred significant improvement in terms of subjective sleepiness and aspects of cognitive function among those who received it. To improve road safety, suitable health education and promotion are urgently needed to increase awareness of OSAS among the medical professionals, legislators, vehicle licensing authorities, drivers, and the general public.

Acknowledgements

This study was supported by the Health Care and Promotion Fund (#216023). I am also most grateful to the medical, nursing, and research staff at the Division of Respiratory Medicine, the Chinese University of Hong Kong, Prince of Wales Hospital, for their technical and clerical support for this project.

Results of this study were first published in the *Respirology*: Hui DS, Ko FW, Chan JK, et al. Sleep-disordered breathing and continuous positive airway pressure compliance in a group of commercial bus drivers in Hong Kong. Respirology 2006;11:723-30.

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