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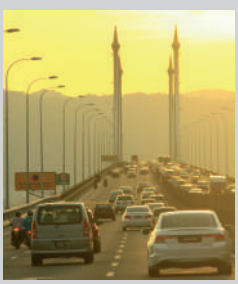

Research Report

Obstructive Sleep Apnea among Commercial Truck Drivers

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Contents

List of Tables

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Abstract

This report highlights the prevalence of high risk group of Obstructive Sleep Apnea (OSA) among commercial truck drivers based on screening using Berlin Questionnaire. Obstructive sleep apnea (OSA) has been recognised for over a decade as one of the significant risk factors for motor vehicle crashes (MVC). Many studies have shown the relationship between MVC and OSA. In Malaysia, the prevalence of OSA among commercial truck drivers is not known. Due to traffic safety concern of commercial transportation, this study was conducted to determine the prevalence of high risk of OSA and its association with motor vehicle accident. A cross sectional study involving 130 commercial truck drivers selected from a logistic company were conducted. The screening process for identifying the high risk group for OSA was done using Berlin questionnaire. Out of 130 selected drivers, all were eligible for analysis. The study revealed that 14.6% (19) of drivers were categorised as having high risk of OSA while 85.4% (111) having low risk of OSA. The study also identified that symptom of snoring and witnessed apnea as well as BMI and neck circumference was significantly associated with risk group of OSA. The results emphasise on the need to identify the group at risk of OSA among commercial truck drivers and further diagnose them for early intervention.

1. Introduction

Obstructive sleep apnoea (OSA) has been recognised for over a decade as one of the significant risk factors for motor vehicle crashes (MVC). Many studies have shown the relationship between MVC and OSA. OSA is a syndrome of sleep disordered breathing, characterised by repetitive episodes of airflow cessation (apnoea) or airflow reduction (hypopnea) that occur during sleep as a consequence of upper airway collapse (Xie et al, 2011). People with OSA stop breathing for 10 seconds or more at a regular interval whilst sleeping. Following this apnoeic episode, the person arouses him or herself and start to breathe again with resultant of hypoxemia and chronic lethargy (John H. Dirckx, 2001).

Sleep apnoea, with its repeated episodes of breathing cessation and sleep fragmentation, will produce diurnal and nocturnal symptoms. This include excessive daytime sleepiness, fatigue sleep attacks, psychomotor deficits, and disrupted night time sleep due to frequent arousal (I. Gurubhagavatula, 2004; Flemmons W. W., 2002; Kales A., 1985). Manifestation of daytime sleepiness among persons with sleep apnoea contributes to serious potential consequence. The most potential consequence is impaired performance at the wheel while driving. Sleepiness is regarded as a significant contributor to motor-vehicle crashes (Horne J., & Reyner L, 1999; Philip P. et al., 1999).

Truck driving is a hazardous occupation as large truck crashes are potentially severe due to the size, weight, and speed of these vehicles. The Federal Motor Carrier Administration's (FMCSA) Large Truck Crash Study found that half of such crashes result in fatal or incapacitating injuries. The truck driver was judged to be at fault in 87% of these crashes. In 7% of these crashes, the driver at fault admitted to falling asleep while driving (Talmage et al., 2008). Meanwhile, annual statistics of MIROS crash investigations from the year 2007 to 2011 revealed that risky driving and fatigue have been identified as the highest contributor for crashes. Fatigue accounts for 9.9% of crashes involving lorry and 7.9% bus (Ahmad Noor Syukri et al., 2012). As the nature of work of truck drivers involve driving long distances for many hours at a time and rotating

work shifts, it is more likely for this group of drivers with OSA to experience fatigue and sleepiness while driving.

Many studies had identified sleep apnoea among commercial vehicle drivers. Stoohs and co-workers (1995) found the highest prevalence of 78% in American truck drivers. However, this study was conducted at a single company, where the drivers were not randomly selected. Thus, the sample may not be representative of the broader population of drivers. Meanwhile, Moreno et al. (2004) identified that approximately 26% of the truck drivers in Brazil were found to be in the high-risk group for OSA.

In Malaysia, motor vehicle crashes involving commercial vehicles is alarming. Road accident statistics based on police data have shown an increasing number of busses and lorries involved in road crashes for a period of ten years from 2002 to 2011 (Polis DiRaja Malaysia, 2001 – 2011). In addition, the number of PSV and GDL license holders is also showing a steady and increasing trend in the last ten years (Ministry of Transport Malaysia, 2011). The increased exposure of bus and truck drivers combined with the high prevalence of OSA among this group of drivers and their nature of work increases their risk of MVC involvement. OSA has been reported as a risk factor due to sudden performance impairment in driving and could lead to accidents (Hartenbaum et al., 2006).

The association between OSA and MVC has been well documented. Drivers with OSA have significantly increased risk of traffic accidents than subjects without OSA. A study conducted by J. Teran-Santos et al. (1999) revealed that patients with an apnoea–hypopnea index of 10 or higher had an odds ratio of 6.3 for having a traffic accident as compared with those without sleep apnoea. Besides, Young et al. (1997) also have reported that subjects with an apnoea/hypopnoea index (AHI) of more than 15 events have a greater risk of having a motor vehicle accident with OR of 7.3 compared to those with no sleep-disordered breathing.

It is often difficult to identify the prevalence of OSA, its associated factors as well as its burden to population. This is due to the large proportion of people with OSA remaining undetected as they are unaware that they are suffering from this disorder. Patients

often undertake their symptoms as a normal variant or a manifestation of poor lifestyle (McNicholas, 2008). Park et al. (2009) revealed that OSA often remains unrecognised or unreported by professional drivers and their employers, as well as undiagnosed by primary care clinicians. In line with this matter, some European countries including United Kingdom, Sweden, Poland, Spain, Belgium, France, Denmark, Luxembourg, Portugal, Finland and Germany as well as non-EU countries such as Australia, Canada, New Zealand and United States have implemented regulations pertaining to sleep apnoea and commercial vehicle driving. OSA has been included as one of criteria in medical screening for their commercial vehicle drivers before granting or renewing their driving license (Norlen et al., 2012).

In Malaysia, under the Road Transport Act (1987), Public Service Vehicles (Licensing and Conduct of Drivers, Conductors and Passengers) Rules 1959, the general rule indicates that a driving license should not be given or renewed to any candidate of commercial vehicle drivers who is suffering from a medical condition likely to compromise safety on the road, except if certified medically fit by a medical practitioner. However, there were no specific medical conditions or disorders mentioned in the Road Transport Act (1987). Medical fitness to drive is solely based on the professional judgement of medical practitioners who examined the patient. Based on the previous approach, for many reasons, sleep apnoea has never been considered as one of the medical condition that need to be screened. The reasons include weakness in the previous medical examination format, lack of awareness among general practitioners on sleep apnoea, and lack of health facilities equipped with sleep study test.

As an improvement of the existing system, the Road Transport Department of Malaysia in collaboration with the Ministry of Health and Malaysian Institute of Road Safety Research (MIROS) have established a medical standard, as a pre-condition for licensing, to be implemented during medical examinations. In view of the high prevalence of sleep apnoea among commercial vehicle drivers as reported by MIROS's studies, Obstructive Sleep Apnoea was included in the standard Ministry of Health (2011). Subsequently, in 2011; the Medical Examination Standard for Vocational Driver's Licensing was published by the Ministry of Health. According to the standard, any applicant not fulfilling the criteria stated will be considered as unfit for a vocational driving license.

The screening of OSA is simple and can be incorporated in the existing medical examination system for the commercial drivers. With regards to screening tools for drivers, the Berlin Questionnaire will be used as it yields a better result compared to ESS Questionnaire. This is because the Berlin Questionnaire combines subjective and objective criteria whereas ESS Questionnaire only relies on subjective measures, which is dependent on the honesty of the drivers to declare symptoms. Meanwhile, a sleep test is required to confirm that a particular driver has OSA. Sleep tests can only be conducted in designated centres which have facilities and equipment for the sleep test.

For these reasons, it would be useful to know the prevalence of the sleep-disordered breathing in truck drivers, for whom alertness is crucial. Therefore, there is a need to conduct a study to determine the prevalence of high risk for OSA and explore factors associated with it among truck drivers in a logistic trucking company transporting goods throughout the Klang Valley and Peninsular Malaysia. Identifying factors or conditions related to OSA is very important because they can be used as indicators to subject a person to a confirmatory diagnosis.

1.1 Scope and Objectives of the Study

This study was aimed to identify high risk group of obstructive sleep apnoea (OSA) among truck drivers. Specifically, this study aims to meet three objectives which are:

i. To determine prevalence of high risk group of OSA among truck drivers
ii. To identify association between associated risk factor with high risk for OSA
iii. To determine the likelihood of high risk group of OSA involved in motor vehicle accident.

The outcomes of this study will provide recommendations to road safety related agencies in managing fleet safety management. In addition, the findings would provide some suggestions to the fleet company in monitoring their drivers' fitness to drive on the road, and this can potentially improve their service.

1.2 Limitation of the Study

The current study has its limitation as the truck drivers are sourced from one fleet company. The findings of the study could only be generalised to the population of truck drivers within the fleet company. In this study, drivers were only screened for OSA. Due to budget constraints, the confirmatory sleep test cannot be performed in the study for those that were screened high risk for OSA.

2. Methodology

2.1 Study Design

A cross sectional study was carried out to identify the risk group of OSA among truck drivers. In this study, subjects were asked to complete questionnaires and their body weight, height, neck circumference and blood pressure was measured by trained research officers. Commercial truck drivers under a fleet setting based in the Klang Valley that travels within Peninsular Malaysia were selected to participate in this study.

2.2 Subject Recruitment

A series of meeting was arranged with the management of the logistic company to seek permission and approval for conducting the study among their drivers. All drivers employed in the company have been selected for the study to cover short and long distance journeys. None of the drivers were suffering from mental or psychiatric illness nor do they have difficulty communicating in either Malay or English. Thus, all of the drivers on duty during the data collection day were recruited for the study. Participation in this study was on a voluntary basis. All participants provided written informed consent and none of them declined to give consent. Participants were informed that any information they provide will not be disclosed to any third party.

2.3 OSA Screening Tools

Screening of OSA among subjects was carried out using Berlin questionnaire, which measures risk of having obstructive sleep apnoea. The Berlin questionnaire is a validated tool widely used for OSA screening with high sensitivity and specificity (Netzer et al.,

1999; Sharma et al., 2004). A Malay version of the Berlin questionnaire was used in the data collection. The translated Malay version has been validated by officers that are not involved in any part of this study. The questionnaire was administered to subjects by trained research assistants. The questionnaire consists of three categories related to the risk of having obstructive sleep apnoea: presence and frequency of snoring behaviour (category 1), wake time sleepiness or fatigue (category 2) and history of hypertension and/or a body mass index (BMI) of >30 kg/m^2 (category 3). Subjects can be classified as high risk or low risk based on frequency of these symptoms and the presence or absence of high blood pressure and the BMI of the person. A person with persistent symptoms (>3 – 4 times/week or everyday) on two or more questions about snoring (category 1) or persistent symptoms in either category 1 or category 2 and with the presence of at least one feature (history of high blood pressure or BMI>30) in category 3 is considered as having 'high risk' for sleep apnoea (Hartenbaum et al., 2006).

Subjects were also required to complete the Epworth sleepiness scale (ESS) questionnaire, which consists of eight questions, to assess general daytime sleepiness. They were required to subjectively rate their sleepiness by rating the chance of falling asleep whilst doing some activities such as sitting and reading, watching television and etc. (Johns, 1991). The total score for ESS will indicate whether the subjects are either having good restful sleep or likely to have excessive daytime sleepiness. The ESS score was the sum of score for eight items and can range from 0 (least sleepy) to 24 (most sleepy). A total score below 10 points is usually reported as normal (Hartenbaum et al., 2006).

Besides administration of the two questionnaires as mentioned above, physical measurement of subjects was also conducted. Their body weight and height was measured using electronic medical scale waist level model TPRO 3300, blood pressure was measured using Automatic Blood Pressure Monitor model OMRON HEM-7203 and neck circumference was measured using measuring tape by trained research assistants.

2.4 Data Collection

Data collection was conducted and completed at the depot office of the logistics company. Before departure of the first trip, the drivers were approached and explained the purpose of the study. Once they understood, written consent was obtained from them. Subjects were asked to complete a set of questionnaires consisting of demographic variables, history of motor vehicle crash, medical status and lifestyles. Once they completed the socio demographic questionnaire, they were asked to fill in the Berlin and ESS Questionnaire.

Parallel with administration of questionnaire, the subjects' body weight and height were measured to determine BMI of subjects. In addition, blood pressure and neck circumference were also measured. Physical measurements were taken by trained research officer. At the end of the survey, a token was awarded to each subject.

2.5 Statistical Analysis

Data was analysed using Epi Info Software version 3.3.2 and SPSS version 17. Frequency distribution and proportion was used to describe categorical variables while mean and SD for quantitative variables. Cross-tabulation table was used to compare frequencies between groups. The percentages were compared using chi-square test, and means with independent t-test. The logistics regression analysis was performed to determine the relation between the independent variable and dependent variables. Odds ratios were adjusted for the following variables: age, BMI, neck circumference, smoking status, diabetes mellitus, hypertension, witnessed apnoea, morning headache, frequent waking while sleeping and snoring.

3. Results

A total of 130 truck drivers participated in the study. All of them were males. Their age ranged from 22 to 70 years with an average (SD) of 38.9 (10.7) years. Most of them were Malays (77.7%) and married (78.5%). The duration of driving experience ranged from 1 to 46 years with the mean (SD) of 15.7 (9.2) years.

Meanwhile, Table 1 shows distribution of characteristics and symptoms of OSA among 130 subjects. The distribution revealed that almost 45 per cent of the subjects have normal BMI index which ranged from 19 to 24. About 33 per cent of subjects were overweight while 19.2 per cent were obese. For neck circumference, almost 91% of the subjects have neck circumference less than 43 cm which indicates low risk of OSA. The other 9% of the subjects showed high risk of having OSA with neck circumference of more than 43 cm. In addition, ESS scoring shows that most of the subjects (85.4%) scored less than 10 points which indicates normal score for excessive daytime sleepiness. The other 14.6% of the subjects scored slightly higher than normal score which indicates mild daytime sleepiness.

3.1 Prevalence of High Risk Group for OSA

Screening of high risk group of OSA was carried out on all 130 subjects. Results of the screening showed that 19 subjects (14.6%) were categorised as having high risk of OSA while 111 of the subjects (85.4%) having low risk of OSA. The distribution of risk group among the subjects, which was based on the screening tool as presented in Table 2.

Table 1 Prevalence of risk factor and symptoms of OSA among subjects

Characteristic	Percentage	95% CI
ESS (Excessive Daytime Sleepiness) score		
Poor	14.6	4.3 – 14.6
Good	85.4	85.4 – 95.7
BMI		
Underweight	3.8	1.3 – 8.7
Normal	44.6	35.9 – 53.6
Overweight	32.3	24.4 – 41.1
Obese	19.2	12.8 – 27.1
Hypertension (medical history)		
Yes	7.7	3.8 – 13.7
No	92.3	86.3 – 96.2
Hypertension (blood pressure reading)		
Yes	73.8	65.4 – 81.2
No	26.2	18.8 – 34.6
Snoring		
Yes	34.6	26.5 – 43.5
No	46.2	37.4 – 55.1
Not sure	19.2	12.8 – 27.1
Frequently waking while sleeping		
Yes	6.2	2.7 –11.8
No	93.8	88.2 – 97.3
Neck circumference		
Low risk (<43 cm)	90.8	84.4 – 95.1
High risk (=> 43 cm)	9.2	4.9 - 15.6

Table 2 Classification of OSA among truck drivers based on Berlin

Classification of OSA	N	%	95% CI
Berlin (snoring, witness apnoea, fatigue, physical measurement)			
High risk	19	14.6	9.0 – 21.9
Low risk	111	85.4	78.1 – 91.0

3.2 Symptoms and Characteristics Associated with OSA

Table 3 represent a summary of occurrence of related symptoms and characteristics between high risk and low risk group of OSA. The findings revealed that snoring was significantly higher among subjects in the high risk group. In addition, the incidences of witnessed apnoea among subjects were significantly higher among high risk group of OSA. However, there was no significant difference in the occurrence of morning headache, and daytime somnolence or excessive daytime sleepiness.

With regards to risk factor, physical measurement of the subjects revealed that the BMI (Mean = 30.6 ±SD 3.8, p< 0.001) and neck circumference (Mean = 40.9 ±SD 2.4, p< 0.001) were significantly higher among high risk group of OSA. Meanwhile age, being diabetic or having hypertension shows no significant difference between the two risk groups of OSA.

Further analysis to determine variables significantly associated with the OSA was performed using multiple logistics regression analysis. The dependent variable was OSA risk group while the independent variables were age, BMI, neck circumference, smoking status, diabetes mellitus, hypertension, witness apnoea, morning headache, frequent waking while sleeping and snoring. A stepwise logistics regression was done to identify significant variables. The variables found to be significantly associated with OSA (alpha at 0.05) are age, BMI and snoring. The crude odds ratio and adjusted odds ratio as presented in Table 4.

Table 3 Differences in the occurrence of related symptoms and characteristics between high and low risk of OSA

Variables	Commercial truck driver				p-value
	High risk of OSA		Low risk of OSA		
	N (%)	Mean (SD)	N (%)	Mean (SD)	
Age (year)	-	40.2 (8.8)	-	38.7 (10.9)	0.579 [a]
BMI (kg/m2)	-	30.6 (3.8)	-	24.8 (4.6)	**<0.001** [a]
Neck circumference (cm)	-	40.9 (2.4)	-	38.2 (3.0)	**<0.001** [a]
Smokers					
Yes	9 (47.4)	-	77 (69.4)	-	0.061 [b]

No	10 (52.6)	-	34 (30.6)	-	
Diabetes					
Yes	2 (10.5)	-	5 (4.5)	-	0.283[c]
No	17 (89.5)	-	106 (95.5)	-	
Hypertension/high blood pressure					
Yes	2 (10.5)	-	32 (28.8)	-	0.093[c]
No	17 (89.5)	-	79 (71.2)	-	
Witnessed apnoea					
Yes	3 (15.8)	-	3 (2.7)	-	**0.012[c]**
No	16 (84.2)	-	108 (97.3)	-	
Morning headache					
Yes	1 (5.3)	-	5 (4.5)	-	0.884[c]
No	18 (94.7)	-	106 (95.5)	-	
Daytime somnolence					
Yes	4 (78.9)	-	15 (13.5)	-	0.390[c]
No	15 (21.1)	-	96 (86.5)	-	
Snoring					
Yes	18 (94.7)	-	27 (31.4)	-	**<0.001[b]**
No	1 (5.3)	-	59 (68.6)	-	
Frequent waking while sleeping					
Yes	0(0)	-	8 (7.2)	-	0.227[c]
No	19(100.0)	-	103 (92.8)	-	

[a] p Value of t statistics, [b] p Value of chi-square test, [c] p Value of Fisher's exact test

Table 4 Crude odds ratio and adjusted odds ratio of variables associated with OSA

	Crude OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age (year)	1.013 (0.968 –1.060)	0.576	**0.893 (0.809 – 0.986)**	**0.026**
BMI	5.542 (2.525 –12.167)	0.000	**7.574 (1.303 – 44.020)**	**0.024**
Neck circumference	1.315 (1.114 –1.553)	0.001	0.876 (0.626 – 1.226)	0.440
Smoking	2.516 (0.938 – 6.757)	0.067	3.143 (0.657 – 15.043)	0.152
Hypertension	0.425 (0.168 –1.077)	0.071	0.257 (0.060 – 1.106)	0.068
Diabetes	2.494 (0.448 –13.899)	0.297	6.227 (0.381 – 101.694)	0.199
Witnessed apnoea	0.148 (0.027 –0.798)	0.026	0.939 (0.052 – 16.997)	0.966

Morning headache	1.178 (0.130 –10.676)	0.884	4.995 (0.036 – 692.372)	0.523
Frequent waking while sleeping	0.000 (0.000)	0.999	0.000 (0.000)	0.999
Snoring	0.025 (0.003 – 0.191)	0.000	**0.020 (0.002 – 0.237)**	**0.002**

*p value of Logistics Regression statistics

3.3 Association of Motor Vehicle Accident (MVA) between High and Low Risk Group of Driver

Table 5 presents the odds ratio for history of MVC for the past three (3) years between those with high and low risk of OSA. The result shows that there was a difference in the MVC involvement between the high risk group and low risk group. High risk group of OSA were 1.5 times more likely to be involved in MVC than low risk group. However, the difference was not statistically significant. This could be due to the small sample size.

Table 5 Likelihood of risk group of OSA involved in MVA

OSA screening	N (%)	OR (95% CI)	p-value
High risk			
Involved in MVA	8	1.58 (0.52, 4.72)	0.36
Not involved in MVA	11		
Low risk			
Involved in MVA	35		
Not involved in MVA	76		

4. Discussions

The findings of this study revealed that 14.6% of commercial truck drivers were categorised as high risk group for OSA based on an internationally validated tool: Berlin Questionnaire. A similar study conducted by Moreno and his colleague (2004) identified that approximately 26% of the truck drivers in Brazil were found to be at high-risk group for OSA. Meanwhile based on a study by Fadhli et al. (2012), about 9.2% of express bus drivers in Malaysia were classified with high likelihood of having risk of OSA after being screened using the same questionnaire. Due to financial constraints, the truck drivers who have been already been screened did not undergo further confirmatory test or sleep test. Even though results of this study was not confirmed with a polysomnography sleep study, it is highly likely that the prevalence is the true prevalence as the Berlin Questionnaire is a validated tool widely used for OSA screening with high sensitivity and specificity (Netzer et al., 1999; Sharma et al., 2004). The high prevalence of high risk group of OSA highlights the necessity to conduct screening of OSA among commercial vehicle drivers.

Screening and diagnosis of OSA especially among commercial vehicle drivers is important as undiagnosed and untreated OSA may lead to increased risk of vehicle accidents. People with sleep apnoea remain undetected since they are unaware that they have this problem and often undertake their symptoms as normal variant or a manifestation of poor lifestyle (McNicholas, 2008). Park et al. (2009) revealed that OSA often remains unrecognised or unreported by professional drivers and their employers, as well as undiagnosed by primary care clinicians. Due to the importance in screening and diagnosing OSA, some European countries such as Norway, Switzerland (J. Krieger, 2007), and the United States (US Department of Transportation FMCSA, 2009) have implemented regulations pertaining to sleep apnoea and commercial vehicle driving. OSA has been included as one of criteria in medical screening for their commercial vehicle drivers before being granted or renewed driving license. In Malaysia, the Road

Transport Department of Malaysia (JPJ) collaborated with the Ministry of Health (MOH) and Malaysian Institute of Road Safety Research (MIROS) to establish a medical standard, as a pre-condition for licensing, to be implemented during medical examinations. In 2011, the Medical Examination Standard for Vocational Driver's Licensing was published by the Ministry of Health. According to the standard, any applicant not fulfilling the criteria stated, including having OSA, will be considered as unfit for a vocational driving license.

Comparison on risk factor as well as symptoms of OSA between high risk and low risk group of OSA was conducted among the study subjects. Snoring and witnessed apnoea are significant symptoms of OSA in this study. Of 19 subjects having high risk of OSA, 18 (94.7%) reported snoring while 3 (15.8%) recorded witnessed apnoea. In this study, snoring is statistically significant associated with OSA even after considering the effects of other variables in multiple logistics regression. The finding is similar with other reported studies (Fadhli et al., 2012; Hui et al., 2002; Deegan & McNicholas, 1995). Among OSA patient, snoring reflects the basic pathophysiology which is due to the narrowing of upper airway (Deegan & McNicholas, 1995).

Compared to those with low risk of OSA, the subjects with high risk of OSA recorded higher BMI (Mean = 30.6 ±SD 3.8, $p < 0.001$). The high BMI indicates obesity. In the multiple logistics regression analysis, BMI is statistically significant in predicting OSA risk group in this study. Subjects with high risk of OSA were 7.6 times likely to have higher BMI. The finding is consistent with a study conducted by Hui and his colleague (2002) that identified the relation of OSA and higher BMI among bus drivers in Hong Kong (Hui et al., 2002). In addition, other studies also had proven a clearly established relation of BMI and OSA (Hoffstein & Szalai, 1993; Deegan & McNicholas, 1995; Rollheim, Osnes & Miljeteig, 1997). Several studies have reported that the relative risk of OSA was more than 10 times higher in persons with body mass index (BMI) > 29 kg/m (Gami et al., 2003 and Schafer et al., 2002). In fact, BMI was included in the Berlin Questionnaire as one of the indicators to identify the risk of having OSA (Netzer et al., 1999).

In addition, subjects with high risk of OSA also recorded larger neck circumference (Mean = 40.9 ±SD 2.4, $p < 0.001$) compared to those with low risk of OSA. Downey et al.

(2009) stated that a neck circumference of 40 cm or greater had a sensitivity of 61 per cent and specificity of 93 per cent for having OSA. However, in the multivariate analysis, with the presence of information on BMI, neck circumference became less important and statistically insignificant in identifying the OSA risk group. Meanwhile, comparison between low and high risk group of OSA revealed that age is insignificant as a risk factor. However, further analysis by multiple logistics regression shows that age is statistically significant associated with OSA risk group. Age is an important consideration of risk for OSA. Young and his colleague (2004) stated that the prevalence of OSA increases with age with a 2 to 3 fold higher elderly ($\geq$ 65 years) among compared to those in middle age (30 to 64 years).

Through the findings, the employers could promote a healthy lifestyle among their workers in order to minimise the occurrence of high BMI and large neck circumference which could trigger OSA.

OSA has been well documented to have an association with MVC. Those with OSA are 2 to 7 times more likely to be involved in MVC compared to those without OSA, depending on its severity (Ruth et al., 2006; Teran-Santos et al., 1999; Young 1997). However, in this study we were unable to establish the significant association between both. A possible explanation for this result is that the history of MVC obtained through questionnaire was subjected to reporting bias. In addition, the study design used was not the best method in determining the association of OSA and MVC. The more appropriate study design would be a case control or a cohort study. However, due to time and budget constraints, a cohort study would not be possible as it requires a longer follow up time and a big group of drivers. In contrast, difficulty in identifying the case of drivers limits the possibility of conducting a case control study. Moreover, current status of OSA based on the Berlin Questionnaire may not reflect the situation in the past three (3) years.

5. Conclusion and Recommendations

In summary, this study has shown a high prevalence of OSA based on screening using Berlin questionnaire among the subjects in a group of commercial truck drivers. Based on the findings, snoring, witnessed apnoea, BMI and neck circumference could be positive predictors to screen drivers with OSA. Based on the results of the study, the importance of screening for the features and the risk of OSA among commercial vehicle drivers in Malaysia as part of a medical assessment for either initial licensing or renewal of a commercial vehicle driving licence have been emphasised. Ultimately, subsequent treatment of drivers with OSA may improve road traffic safety. Health promotion and education are urgently needed to increase public awareness on the effect of OSA on driving among medical professionals, legislators, licensing authorities, operators of commercial vehicle and drivers in order to improve road safety. Moreover, inter agencies collaboration and full implementation of existing efforts as well as initiatives to address OSA and driver fatigue in road crashes should be realised by the relevant authorities.

References

Ahmad Noor Syukri Z. A., Siti Atiqah M. F., Fauziana L., & Abdul Rahmat, A. M. (2012). *MIROS crash investigation and reconstruction annual statistical report 2007 – 2011* (MRR 05/2012). Kajang: Malaysian Institute of Road Safety Research.

Deegan P. C., & McNicholas W. T. (1995). Pathophysiology of obstructive sleep apnea. *Eur Respir J. 1995; 8, 2,* 230 – 2237.

Downey R., Gold P. M., & Wickramasinghe H. (2009). Obstructive sleep apnea. Available at http://emedicine.medscape.com/article/295807overview. Accessed May 18, 2013.

Flemmons W. W. (2002). Clinical practice. Obstructive sleep apnea. *N Engl J Med. 2002*; *34,* 498 – 504.

Gami, A. S., Caples, S. M., & Somers, V. K. (2003). Obesity and obstructive sleep apnea. *Endocrinol Metab Clin North Am*, *32,* 869 – 894.

Hartenbaum, N. Collop, N., Rosen, I. M., Phillips, B. George, C. F. P., Rowley, J. A. Freedman, N. Weaver, T. E. Gurubhagavatula, I. Strohl, K. Leaman, H. M. Moffitt, G. L., & Rosekind, M. R. (2006). Sleep apnea and commercial motor vehicle operators: Statement from the joint task force of the American college of occupational and environmental medicine, and the national sleep foundation. *J Occup Environ Med*, *48*(6), S5 – S37.

Hoffstein V., & Szalai J. P. (1993). Predictive value of clinical features in diagnosing OSA. *Sleep, 1993, 16,* 118 – 122.

Horne J., & Reyner L. (1999). Vehicle accidents related to sleep: A review. *Occup Environ Med, 1999; 56,* 289 – 294.

Hui D. S. C., Chan J. K. W., Ko F. W. S, Choy D. K. L, Li T. S. T., Chan A. T., Wong K. K. , & Lai C. K. W. (2002). Prevalence of snoring and sleep-disordered breathing in a group of commercial bus drivers in Hong Kong. *Internal Medicine Journal, Vol 32 Issue 4*, 149 – 157.

Indira Gurubhagavatula, Greg Maislin, Jonathan E. Nkwuo, & Allan I. Pack. (2004). Occupational screening for obstructive sleep apnea in commercial drivers. *American Journal of Respiratory and Critical Care Medicine,* 2004, Volume 170.

J. Krieger. (2007). Sleep apnea and driving: How can this be dealt with? *Eur Respir Rev December 1, 2007 vol. 16 no. 106*; 189 – 195.

John, H. Dirckx. (2007). Stedmann's concise medical dictionary for the health professions: Illustrated- 4th edition, Lippincott Williams & Wilkins, USA, 2001.

Johns, M. V. (1991). A new method for measuring daytime sleepiness. *Sleep, 14*(6), 540 – 545.

Kales A., Cadieux R. J., & Bixler E. O., et al. (1985). Severe obstructive sleep apnea — I: onset, clinical course, and characteristics. *J Chronic Dis. 1985; 38,* 419 – 425.

McNicholas W. T. (2008). Diagnosis of obstructive sleep apnoea in adults. *Proc Am Thorac Soc*., *2008*(5), 154 – 160.

M. Fadhli Mohd Yusoff, Marina Mat Baki, Norlen Mohamed, A. Sani Mohamed, M. Razif Mohamad Yunus, Mazita Ami, Ilhamah Othman, & Azlan I. Ishak. (2010). Obstructive sleep apnea among express bus drivers in Malaysia: Important indicators for screening. *Traffic Injury Prevention, 11*(6), 594 – 59.

Ministry of Health. (2011). Medical examination standards for vocational driver's licensing.

Netzer N. C., Stoohs R. A., & Netzer C. M. (1999). Using the Berlin questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med*; 131; 488.

Philip D., Parks, Gerardo Durand, Antonios J., Tsismenakis, Antonio Vela-Bueno, & Stefanos N. Kales. (2009). Screening for obstructive sleep apnea during commercial driver medical examinations. *JOEM 2009; 51*(3), 275 – 282.

Philip P., Taillard J., Guilleminault C., Salva M. A. Q., Bioulac B., & Ohayon M. Long distance driving and self-induced sleep deprivation among automobile drivers. *Sleep, 1999*; 22, 475 – 480.

Polis DiRaja Malaysia, Cawangan Trafik Bukit Aman, Perangkaan Kemalangan Jalan Raya Malaysia, 2001 – 2011.

R. C. Moreno, F. A. Carvalho, C. Lorenzi, L. S. Matuzaki, S. Prezotti, P. Bighetti, F. M. Louzada, & G. Lorenzi-Filho. (2004). High risk for obstructive sleep apnea in truck drivers estimated by the Berlin questionnaire. *Prevalence and associated factors chronobiology international, 2004, 21*(6), 871 – 879.

Rollheim J., Osnes T., & Miljeteig H. (1997) The relationship between obstructive sleep apnoea and body mass index. *Clin Otolaryngol, 1997;* 22, 419 – 442.

Ruth L. B. Ellen, Shawn C., Marshall, & Mark Palayew et al. (2006). Systematic review of motor vehicle crash risk in persons with sleep apnea. *Journal of Clinical Sleep Medicine, Volume 2*(2), 193 – 200.

Schafer, H., Pauleit, D., Sudhop, T., Gouni-Berthold, I., Ewig, S, & Berthold, H. K. (2002). Body fat distribution, serum leptin, and cardiovascular risk factors in men with obstructive sleep apnea. *Chest*, *122,* 829 – 839.

Talmage, J. B., Hudson, T. B., Hegmann, K. T., & Thiese, M. S. (2008). Consensus criteria for screening commercial drivers for obstructive sleep apnea: Evidence of efficacy. *Journal of Occupational Environmental Medicine, 50*(3), 324 – 329.

Terán-Santos, A. Jiménez -Gómez, J. C. Ordero-Guevara & The Cooperative Group Burgos–Santander. (1999). The Association between sleep apnea and the risk of traffic accidents. *The New England Journal of Medicine 1999*, *340*(1), 847 – 851.

Transport Statistics Malaysia, Ministry of Transport Malaysia 2011.

US Department of Transportation FMCSA. (2009). Access through http://www.fmcsa.dot.gov/safety-security/sleep-apnea/industry/Commercial-Drivers.aspx

Xie, W., Chakrabarty, S., Levine, R., Johnson, R., & Talmage, J. B. (2011). Factors associated with obstructive sleep apnoea among commercial motor vehicle drivers. *Journal of Occupational Environmental Medicine, 53*(2), 169 – 173.

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, 1997*; *20,* 608 – 613.

Young, T., Skatrud J., & Peppard, P. E. (2004). Risk factors for obstructive sleep apnea in adults. *Journal of American Medical Association*, 291, 2013 – 2016.

Research Report

Obstructive Sleep Apnea among Commercial Truck Drivers

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