The Prevalence of Obstructive Sleep Apnea Among Professional Hospital Drivers

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Abstract :

Background : **Several reports have suggested that about one-fifth of car accidents are sleep-related and obstructive sleep apnea (OSA) is one of the major causes of increased daytime sleepiness. Various reports from western countries have shown that different groups of drivers, especially truck drivers have a high prevalence of OSA, which may play a part in the occurrence of car accidents.**

Objectives : **To determine the frequency of OSA and other sleep related problems in a group of professional drivers.**

Study design : **Descriptive study.**

Method : **All 21 male professional drivers at one government hospital, aged between 27-57 years old, were recruited to the study. Data were collected by clinical examination, questionnaire and overnight polysomnography. OSA was defined as a Respiratory Disturbance Index (RDI) or an apnea / hypopnea index of over 5 events per hour.**

Results : **The prevalence of OSA was 4%. Only 1 subject had severe OSA with an RDI of 102. None of them reported having car accidents but 71% reported symptoms of daytime sleepiness.**

Conclusion : **OSA was not very common among professional drivers in this study but there were other sleep related problems reported which might relate to an increased risk of car accident. Further study of sleep disorders and their association with car accidents in a larger and broader group of drivers is needed.**

เรื่องย่อ : **ภาวะหยุดหายใจขณะนอนหลับในพนักงานขับรถอาชีพของโรงพยาบาล**

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ภาวะผิดปกติของการนอนอาจมีความสัมพันธ์กับการเกิดอุบัติเหตุทางรถยนต์ เป็นข้อสังเกตที่พบจากหลายๆ รายงานในต่างประเทศ หนึ่งในภาวะผิดปกติเหล่านี้คือ ภาวะหยุดหายใจขณะนอนหลับซึ่งเป็นสาเหตุ

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ที่สำคัญสาเหตุหนึ่งที่ทำให้เกิดความรู้สึกง่วงในช่วงเวลากลางวัน ซึ่งอาจมีความสัมพันธ์กับการเกิดอุบัติเหตุจากทางรถยนต์ได้ กลุ่มพนักงานขับรถประเภทต่างๆ ต้องนั่งขับรถเป็นเวลานานทั้งกลางวันและกลางคืน มีการศึกษาเกี่ยวกับภาวะผิดปกติขณะนอนหลับรวมทั้งภาวะหยุดหายใจขณะนอนหลับในกลุ่มพนักงานขับรถในต่างประเทศ และพบว่าพนักงานขับรถบรรทุกมีปัญหาการนอนหลับมากกว่าปกติและอาจมีผลเกี่ยวเนื่องกับการเกิดอุบัติเหตุทางรถยนต์ จุดประสงค์ของการศึกษานี้ คือ เพื่อหาอุบัติการณ์ของภาวะหยุดหายใจขณะนอนหลับ และภาวะผิดปกติของการนอนหลับในกลุ่มพนักงานขับรถอาชีพของโรงพยาบาล ประชากรที่ศึกษา คือ พนักงานในขับรถอาชีพของโรงพยาบาลรัฐแห่งหนึ่งจำนวน 21 คน อายุตั้งแต่ 27-57 ปี แต่ละคนได้รับการตรวจร่างกายและถามประวัติสุขภาพโดยทั่วไป ประวัติการนอน ประวัติการขับรถ ประวัติอุบัติเหตุในอดีต และได้รับการตรวจการนอนหลับเป็นเวลา 1 คืน การวินิจฉัยภาวะหยุดหายใจขณะนอนหลับใช้เกณฑ์ คือพบการหยุดหายใจขณะหลับมากกว่า 5 ครั้ง ต่อชั่วโมง

ตรวจพบภาวะหยุดหายใจขณะหลับ 4% ในกลุ่มประชากรที่ศึกษาโดยผู้ที่มีภาวะหยุดหายใจขณะหลับนั้นมีการหยุดหายใจมากถึง 102 ครั้งต่อชั่วโมงของการนอนหลับ นอกจากนี้ยังพบปัญหาง่วงนอนระหว่างวันมากถึง 71% ในกลุ่มประชากรที่ศึกษาโดยไม่พบรายงานอุบัติเหตุทางรถยนต์เลย ภาวะหยุดหายขณะหลับพบไม่บ่อยนักในกลุ่มพนักงานขับรถอาชีพของโรงพยาบาลในการศึกษานี้ แต่พบว่าปัญหาเกี่ยวกับการนอนหลับอื่นๆ เช่น นอนหลับไม่เพียงพอ ความรู้สึกง่วงระหว่างวัน กลับพบเป็นจำนวนไม่น้อย ซึ่งปัญหาเหล่านี้อาจมีความสัมพันธ์กับการเกิดอุบัติเหตุทางรถยนต์ได้ การศึกษาเช่นนี้ในกลุ่มประชากรอื่นๆ ในขนาดกลุ่มที่ใหญ่ขึ้นน่าจะเป็นประโยชน์ในด้านของการศึกษาอุบัติการณ์ที่แท้จริงในประเทศไทย และความสัมพันธ์ของภาวะการนอนหลับที่ผิดปกติกับการเกิดอุบัติเหตุทางรถยนต์

INTRODUCTION

Sleep apnea syndrome, characterized by repetitive episodes of upper airway obstruction that occur during sleep, may be associated with oxygen desaturation, increased daytime somnolence and snoring.

It was first described using recorded sleep electrophysiology and breathing by Gastart and co-workers in 1965.[1] Subsequent records have expanded the clinical picture and the pathophysiology of sleep apnea in the last 30 years. The most common form of sleep apnea, obstructive sleep apnea (OSA), has a broad spectrum of severity. In a study by Young T, et al in 1993, 9.1% of middle-aged men and 4% of middle-aged women in the US had sleep apnea.[2] OSA is a growing public health problem since it has been associated with many disorders such as congestive heart failure, hypertension, cerebrovascular disease, obesity and may be associated with increased daytime sleepiness which may lead to an increased risk of automobile accidents . There have been many reports of increased risk of automobile accidents in patients with untreated severe OSA[3,4,5] and treatment of OSA with nasal continuous positive airway pressure (nasal CPAP) decreases the incidence of automobile accidents in this group.[6] Truck drivers are a group of interest since their working life style involves long hours of shift driving on the road. Over 20% of truck driver in one study reported sleepiness while driving but only 4% had OSA.[7] This problem may be shared by other groups of professional drivers who spend most of their time behind the wheel and have to take great responsibility for the lives of passengers as well as their own.

The objective of this study was to determine the frequency of OSA and other sleep disorders and their relationship to car accidents among hospital professional drivers whose main responsibility is driving hospital executive cars, vans or buses.

MATERIALS AND METHODS

Twenty-one professional drivers working at one government hospital were recruited to the study during the period of January 1996 to December 1996. After obtaining informed consent for the study, all of

them had a physical examination, a sleep questionnaire given by a single trained interviewer, followed by spirometry and full night polysomnography.

Physical examinations:

All subjects had a general physical examination including blood pressure measurement and body mass index (BMI) calculated by using weight in kilogram divided by (height in meter)^2. Neck circumference was measured in centimeter at the level of cricothyroid membrane.

Questionnaires:

All subjects completed a general health questionnaire (personal demographics, use of regular medication, previous medical history, alcohol consumption, smoking history), a specific work questionnaire (number of year driving, number of hours driving each day, distance driven in a day, previous car accident) and a general sleep questionnaire adapted partly from Epworth Sleepiness Scale (usual sleep pattern, daytime sleepiness, morning headache, sleepiness while driving).

Pulmonary function study:

Spirometry was performed on each subject to screen for an obstructive airway disease using a rolling sealed type, Sensor Medics Pulmonary Function Test (PFT) Horizon system, USA. Measurements included forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC), and FEV_1/ FVC ratio.

Polysomnography (sleep study):

Full standard polysomnography, using a Sensor medics 4100 series system USA, was performed on each subject. Variables measured included arterial oxygen saturation (Sat O_2) or pulse oxymetry, electrocardiogram (EKG), oronasal airflow (using a thermister), thoracic and abdominal movements, body position, electroencephalogram, electromyogram, electrooculogram, snoring sound (microphone) and leg movements.

Diagnostic criteria of OSA:

An *obstructive apnea* was defined as a cessation of airflow for at least 10 seconds despite ongoing respiratory effort.

A *central apnea* was defined as a cessation of airflow and respiratory effort for at least 10 seconds.

Mixed apnea was defined as a combination of the obstructive and central apnea that lasted for at least 10 seconds.

A *hypopnea* was defined as a greater than 50% reduction in the amplitude of two out of three of these measurements (oronasal airflow, thoracic effort, abdominal effort) for at least 10 seconds.

Sleep disorder breathing was determined by calculating a **Respiratory Disturbance Index (RDI)** which was the total number of respiratory events (apneas plus hypopneas) divided by number of hours of sleep.

OSA was defined as an RDI of > 5 per hour.

Statistical analysis :

Data were entered into a computer database, analyzed using SPSS for windows (version 10.0) software and presented as mean, standard deviation and proportion. Chi-square test was used to determine significant difference of the proportions between groups (the group with and without daytime sleepiness). A p-value lower than 0.05 was considered as statistically significant.

RESULTS

The demographic data of all the subjects is listed in Table 1.

Our subjects were middle-aged. All were males who had over 10 year- experience of driving. The average BMI was 26.2 ± 5.0. Average number of hours driving per week per person was 33.7 hours (± 24.6). The usual number of hours per day per person spent asleep was 6.7 (± 1.1). The average driving distance in a day was 68.3 kilometers (± 42.1).

Subject sleep characteristics and RDI results are shown in Table 2.1 and 2.2

Table 1. Demographic data of the subjects.

Demographic data	Mean ± SD (N = 21)
Age (years)	41.7 ± 6.6
Neck circumference(cm)	38.9 ± 4.9
BMI (kg /m^2)	26.2 ± 5.0
Mean arterial blood pressure (mmHg)	94.4 ± 10.3
Number of hours driving/week	33.7 ± 24.6
Number of sleep-hours/day	6.7 ± 1.1
Number of years driving	17.9 ± 7.8

Table 2.1. Subject sleep characteristics and RDI results.

Patient Number	BMI (kg/m^2)	Neck circumference (cm)	Daytime sleepiness	RDI (events/hour)	Average O_2 saturation (%)	Lowest O_2 saturation (%)	HTN*	DM**
1	39.5	49.5	-	102***	85	66	-	-
2	25.6	49.5	+	0	97	95	-	-
3	29.0	42	-	1.2	95	91	-	-
4	20.8	34.5	+	0	97	95	-	-
5	29.8	37.5	-	0	96	84	-	-
6	21.8	34	-	0	97	81	-	-
7	25.3	38	+	0	95	89	-	-
8	24.8	38.5	-	1	97	94	-	-
9	30.9	42	+	0.6	97	92	+	-
10	30.4	45	+	1.6	95	89	-	-
11	30.2	34	+	0	95	90	-	-
12	21.5	34	-	0.2	95	88	-	-
13	30.9	44	-	0	96	90	+	-
14	19.1	34.5	+	0.2	96	94	-	-
15	25.3	36	-	0	95	82	-	-
16	28.4	39	+	0	97	95	-	-
17	30.1	42	+	0.2	95	91	-	+
18	25.4	38	+	0	95	94	-	-
19	20.6	34.5	+	0	96	94	-	-
20	21.7	36	+	0	97	95	-	-
21	20.2	35	+	0	96	93	-	-

* HTN=Hypertension, ** DM=Diabetes mellitus
*** RDI of 102 times/hour (all are obstructive apnea)

Table 2.2. Subject sleep characteristics and other associated symptoms.

Patient Number	BMI (kg/m²/)	Daytime sleepiness	AM** headache	Sleepiness while driving	Alcohol use	Smoking* (pack-year)	Decreased libido
1	39.5	-	-	-	+	E 10 yr (2.5)	-
2	25.6	+	-	+	+	C (2.5)	-
3	29.0	-	-	+	+	C (10)	-
4	20.8	+	+	-	-	C (3.75)	-
5	29.8	-	-	+	+	E 1 yr (19)	+
6	21.8	-	-	-	-	N	+
7	25.3	+	+	-	+	C (20)	+
8	24.8	-	-	-	+	C (1.5)	+
9	30.9	+	+	+	-	C (35.5)	+
10	30.4	+	-	+	+	N	+
11	30.2	+	-	-	+	E 1 yr (25)	+
12	21.5	-	-	-	+	C (15)	+
13	30.9	+	-	-	-	N	-
14	19.1	+	-	-	-	C (22)	-
15	25.3	+	-	-	+	C (15)	+
16	28.4	+	-	+	+	E 5 yr (9)	-
17	30.1	+	+	+	+	E 7 yr (11)	+
18	25.4	+	+	-	+	C (15)	+
19	20.6	+	+	-	+	C (25)	+
20	21.7	+	-	-	-	N	+
21	20.2	+	-	-	+	N	+

* Smoking history: E = ex-smoker, the number of years followed letter "E" denoted the number of years subject quitted smoking, C = current smoker, N = non-smoker

** AM headache = morning headache

Notes: None of them use stimulants.

Nearly thirty percent of the subjects (6/21) complained of headache when they woke up in the morning. About seventy percent (15/21) reported daytime sleepiness. One-third (7/21) reported feeling sleepy while driving and none used stimulants while driving. None of them had had car accidents related to sleepiness while driving. Over one-half of these subjects had a history of alcohol use and complained of decreased sexual drive. Whereas, up to 76% (16/21) of them felt that they did not have enough sleep.

Pulmonary function test results of each individual subject are shown in Table 3.

Almost all of the subjects had normal spirometry except one had mild obstructive disease (subject no.14) with FEV_1/FVC of 66% and was currently smoking (22 pack-years). The subject who had OSA (subject no. 1) also had normal spirometry.

Comparing the groups of subjects with and without symptoms of daytime sleepiness, the group who had daytime sleepiness seemed to have more complaints of morning headache. However, there were no statistically significant differences when symptoms such as sleepiness while driving, decreased libido, morning headache and history of alcohol consumption were compared between the 2 groups (Figure 1).

Table 3. Pulmonary function test results of all the subjects.

Patient number	FEV_1* (L) and % predicted	FVC** (L) and % predicted	FEV_1/FVC ratio (%)
1	2.96 (91)	3.34 (84)	89
2	2.74 (85)	3.64 (91)	75
3	3.73 (103)	4.29 (95)	87
4	4.40 (130)	4.60 (112)	95
5	3.22 (100)	3.63 (93)	89
6	3.14 (102)	3.83 (102)	82
7	2.62 (94)	3.30 (95)	79
8	3.04 (117)	3.51 (107)	87
9	2.28 (75)	2.89 (77)	79
10	3.71 (105)	4.23 (100)	88
11	2.43 (71)	3.14 (75)	77
12	2.75 (90)	2.96 (80)	93
13	3.24 (102)	3.49 (92)	93
14	1.89 (68)	2.86 (84)	66
15	2.33 (81)	2.90 (81)	80
16	4.28 (118)	5.30 (124)	81
17	4.1 (128)	5.05 (129)	81
18	2.44 (90)	2.91 (89)	84
19	2.59 (84)	3.48 (93)	74
20	2.88 (98)	3.54 (99)	81
21	3.40 (101)	4.56 (113)	75

* FEV_1 = Forced expiratory volume in 1 second
** FVC= Forced vital capacity
Notes:
1. Normal % predicted value of FEV_1 and FVC are from the reference spirometric values for healthy nonsmokers in Thailand reported by Dejsomritrutai W, et al.[8]
2. Airflow obstruction determined by American Thoracic Society (ATS) criteria using FEV_1/FVC less than 70%.[9]

Polysomnographic results:

Only one subject (subject no. 1) was found to have an RDI of 102, which met the diagnostic criteria for severe OSA. His average O_2 saturation during sleep was 85% and lowest O_2 saturation was 66%. No EKG abnormalities were found. This subject had a BMI of 39.5 and he denied having daytime sleepiness or car accidents. None of the polysomnographic results suggested the diagnosis of other sleep disorders such as upper airway resistance syndrome, periodic breathing or narcolepsy. The average total sleep time was 347.1 ± 47.8 minutes. Average sleep efficiency was 77.8 ± 7.3% and average arousal index was 12.9 ± 19.1.

DISCUSSION

Sleepiness is a common cause of car accidents.[3] Sleep disorders especially sleep apnea are common causes of excessive daytime sleepiness which may be related to an increased risk of car accidents. Many studies have reported an increased risk of accidents in patients with severe OSA[3] but the

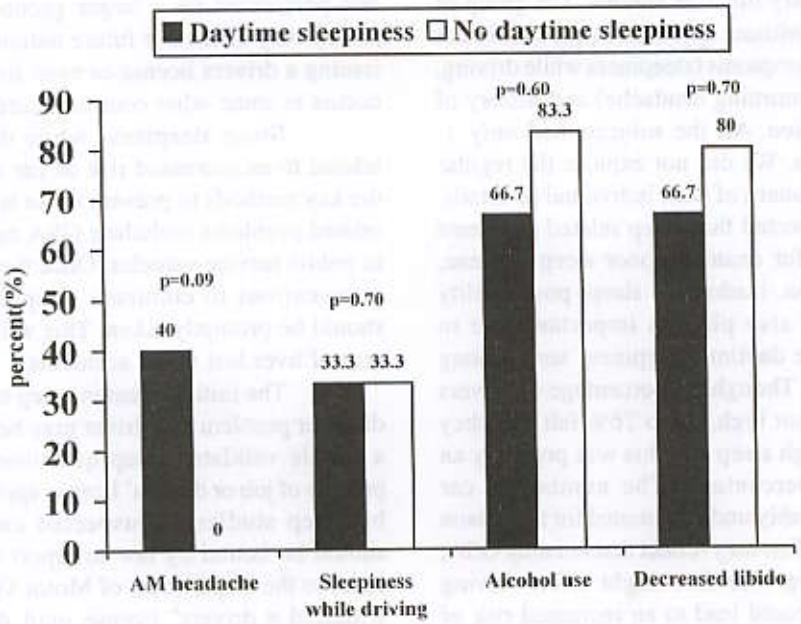

Figure 1. Percentage of symptoms and history of alcohol use between the group with and without daytime sleepiness.

same conclusion did not apply to those with mild or moderate OSA. Acute sleepiness in car drivers also significantly increased the risk of a crash in which a car occupant was injured or killed.[10]

Different studies of sleep disorders in drivers have reported a varying prevalence of OSA in various groups of drivers.[7,11,12,13] A large study in Finland by Hakkanen and colleagues reported a prevalence of OSA of 4% in 184 long-haul truck drivers[7] whereas Yee et al reported a prevalence of 36% (14 of 40) in a group of drivers injured in car accidents in New Zealand.[13] In this study, 4% of subjects who were professional drivers had OSA using the definition of a RDI of >5 events/ hour. The difference in frequency of OSA might be explained by the difference in study populations among studies. The study by Yee et al[13] looked at a specific group of drivers who had already had car accidents and found they tended to have a higher prevalence of sleep disorders. On the other hand, Hakkanen, screening a large group of truck drivers in Finland produces a prevalence figure for OSA in truck drivers in general.[7] Our study was performed on another group of drivers, hospital professional drivers, who usually work during the daytime and rarely work overnight. They may drive either short or long distances and they work in shifts.

Despite our much smaller study group, we demonstrated a similar prevalence of OSA in hospital professional drivers. However, we could not demonstrate a relationship between the severity of OSA and the incidence of car accidents since there was only one driver with severe OSA (RDI of 102) who denied a history of car accidents or symptoms of daytime sleepiness. This subject refused the offer of CPAP treatment but on follow up of his symptoms a year later, he reported no new symptoms or car accidents. We suspect that a higher percentage of subjects might have sleep related symptoms but they might not report all their symptoms due to a fear of the effects on their job evaluation which may lead to the interventions such as forcing leave of absence or a change in job once the results were reported to their superior or the effects on their car and health insurance. Moreover, about 33% of the subjects reported "feeling not fresh" or "sleepy" while driving and 71% reported daytime sleepiness despite normal

sleep and pulmonary function studies. The group of subjects with and without daytime sleepiness did not differ in terms of symptoms (sleepiness while driving, decreased libido, morning headache) and history of alcohol consumption. All the subjects had only 1-night sleep studies. We did not explore the regular sleep hygiene or pattern of each individual in details. However, we suspected that sleep related problems other than OSA (for example, poor sleep hygiene, sleep fragmentation, inadequate sleep, poor quality sleep, etc) might also play an important role in contributing to the daytime sleepiness seen among our all the subject. Though the percentage of drivers who had OSA is not high, up to 76% felt that they did not have enough sleep and this was probably an underestimated percentage. The number of car accidents was probably underestimated for the reason mentioned above. This may reflect that not only OSA, but also other sleep disorders might affect driving performance that could lead to an increased risk of car accidents. OSA only contributed to parts of it. This same observation was seen in the group of habitually sleepy drivers.[14]

This study was limited by small sample size, gender preference (all subjects were male.) and some subjective data such as symptoms of daytime sleepiness, and the number of car accidents etc. might be underestimated. Nevertheless, this study did confirm the existence of OSA, and sleep related problems such as inadequate sleep, difficulty of sleeping etc. among this population group. Long term follow up and repeated sleep studies should be carried out on this study group as well as offering treatment. Developing a validated simple screening tool for sleeping disorders such as a sleep questionnaire, and a portable and quick sleep study test are also essential. The study should be expanded and performed on a larger group of drivers. The results may affect our future national guidelines for issuing a drivers license or even license renewal, as occurs in some other countries currently.[15,16]

Since sleepiness while driving might be related to an increased risk of car accidents, one of the key methods to prevent those is to identify sleep related problems including OSA causing sleepiness in public service vehicles. Once these are identified, interventions to eliminate sleep related problems should be promptly taken. This will help reduce the cost of lives lost in car accidents.

The initial screening step to identify a sleep disorder problem in a driver may be started by using a simple validated sleep questionnaire during the process of job or drivers' license application followed by sleep studies in suspected cases. Physicians should be bound by law to report newly identified cases to the Department of Motor Vehicle (DMV) to withhold a drivers' license until those cases have received appropriate treatment. Effective treatment of these treatable causes would significantly diminish the incidence of car accidents and in addition prevent loss of life from those accidents.

CONCLUSION

Sleep related problems are related to an increased risk of car accidents. OSA is also considered to increase the risk of car accidents. Our study confirms the existence of OSA and sleep related problems in hospital professional drivers as others have demonstrated among different groups of drivers. This problem deserves to be explored more extensively as it could have been an important future public health problem since the number of car accidents is increasing, leading to loss of lives and resources as a result.

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