



Evaluation of Traffic Accident Risk in In-City Bus Drivers: The Use of Berlin Questionnaire

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Abstract

OBJECTIVES: Traffic accidents associated with high mortality rate may produce serious problems especially in highways. Obstructive sleep apnea (OSA) has been associated with a high risk for traffic accidents due to excessive daytime sleepiness even in in-city drivers. In the present study, it was aimed to evaluate the rate of OSA symptoms and to identify risk factors associated with traffic accidents in in-city bus drivers.

MATERIAL AND METHODS: A self-administered questionnaire including demographic and anthropometric features, sleep and work schedules, Berlin questionnaire, Epworth sleepiness score (ESS), and history of traffic accidents was used.

RESULTS: The questionnaire was conducted for 1400 male bus drivers (mean age, 38.0 ± 6.4 y, body mass index, 27.8 ± 3.9 kg/m²). A total of 1058 (75.6%) drivers had one or more accidents while driving bus. According to the Berlin questionnaire, 176 (12.6%) drivers were found to have high OSA risk and the accident rate was 83.0% in high-risk group, whereas 74.5% of low-risk drivers had accidents ($p=0.043$). The drivers with a history of traffic accident were older ($p=0.030$), had higher ESS ($p=0.019$), and were more in the high-risk OSA group according to the Berlin questionnaire ($p=0.015$). In multivariate linear regression analysis, traffic accident was associated with only Berlin questionnaire ($p=0.015$).

CONCLUSION: The present results support that city bus drivers with high OSA risk according to Berlin questionnaire have increased accident rates. Therefore, we suggest using Berlin questionnaire for screening sleep apnea not only in highway drivers but also in in-city bus drivers.

KEYWORDS: Traffic, accidents, buses, Berlin questionnaire, sleepiness

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INTRODUCTION

Obstructive sleep apnea (OSA) is characterized by instability of the upper airway during sleep resulting in reduction or elimination of airflow, oxygen desaturation, and sleep disruption. OSA affects 3.9% of women and 8.8% of men between the ages of 30 and 70 year [1]. There is an increasing evidence supporting OSA as an independent risk factor for cardiovascular and cerebrovascular disorders. In addition, OSA has some consequences for public health such as traffic and work accidents [2-4].

Since 1987, numerous studies have showed that OSA has been associated with a high risk for traffic accidents, probably the highest of all risks due to medical conditions [5-8]. A systematic review of the OSA-related risk for traffic accidents showed that individuals with OSA are clearly at higher risk for traffic accidents [9]. The mean traffic accidents ratio associated with OSA is likely to fall within the range of 1.21 to 4.89. Regardless of the presence excessive daytime sleepiness, patients suffering from OSA are at a threefold increased risk for traffic accidents during driving compared with the general population. The results of our previous study also showed that OSA patients have a twofold higher risk for traffic accidents than control subjects. Increased neck circumference and excessive daytime sleepiness are useful in predicting OSA patients at high risk of having accidents [10].

Daytime sleepiness and decrease of concentration, motor coordination, and reflexes are observed in patients with OSA. These situations cause an increase in accidents in jobs that require complex motor coordination [11,12]. Therefore, it is especially important to determine the risk for traffic accidents of public transport drivers. All the drivers may not be evaluated with polysomnography because of the long waiting lists in sleep laboratories. The

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questionnaires for the identification of subjects at high risk for OSA may overcome these limitations. The Berlin questionnaire that includes questions about snoring, daytime sleepiness, body mass index (BMI), and hypertension is a brief and validated screening tool that identifies subjects in general population who are at a high risk for OSA [13].

Traffic accidents associated with high mortality rate may produce serious problems especially in highways. OSA has been associated with a high risk for traffic accidents due to excessive daytime sleepiness even in in-city drivers. There are a great number of studies that investigate traffic accidents of highway drivers [9]. On the other hand, studies evaluating risk factors for traffic accidents in in-city bus drivers are limited. The aim of the present study was to evaluate the presence of sleep apnea symptoms in in-city bus drivers and to identify the risk factors associated with traffic accidents.

MATERIAL AND METHODS

City bus drivers working for Izmir Metropolitan Municipality were included in our cross-sectional study. The Local Ethics Committee approved the study protocol, and all subjects provided written informed consent. A self-administered questionnaire was administered to evaluate the risk for traffic accidents caused by city bus drivers. The questionnaire included demographic characteristics, social and medical information (age, gender, marital status, education, weight, height, shirt collar number for neck circumference, comorbid diseases, smoking history, alcohol consumption and sedative drug use), sleep and work schedules, driving habits and history of traffic accident (duration of driving, amount of driving in kilometers per year, total number of traffic accidents), Berlin questionnaire, and Epworth sleepiness score (ESS). The reports of traffic accidents that each driver was involved in were taken from the official records of Izmir Metropolitan Municipality for conformation.

Berlin questionnaire is composed of questions about snoring (Category 1), daytime sleepiness (Category 2), and hypertension and BMI (Category 3) [13]. The overall Berlin questionnaire score was determined, as in previous studies, from the responses to three categories: scores from the first and second categories are positive if the responses indicate frequent symptoms (>3-4 times/wk), whereas the score from the third category is positive if there is a history of hypertension or BMI >30 kg/m². Subjects are scored as being at high risk for OSA when they have a positive score on two or more categories. Other situations are scored as being at low-risk. ESS is a brief, self-administered questionnaire that provides measurement of the subject's general level of daytime sleepiness [14]. The Turkish version of ESS was validated to measure of daytime sleepiness [15]. Sleepiness was defined as a score >10.

Statistical Analysis

Statistical analysis was performed with Statistical Package for Social Sciences version 16.0 for Windows (SPSS Inc.; Chicago, IL, USA) packaged software. Numerical variables were summarized with mean±standard deviation. The significance

of differences between groups was assessed by Student t test and Mann-Whitney U test, and analysis of categorical variables was examined by the Chi-square test. A value of $p < 0.05$ was considered significant for all statistical analysis. Multiple logistic regression analysis was used to determine the relationship between the questionnaire parameters with accident risk.

RESULTS

The questionnaire was answered by 1400 male city bus drivers (mean age, 38.0 ± 6.4 y, BMI, 27.8 ± 3.9 kg/m²). The average working duration was 8.7 ± 6.1 y and daily work time was 7.9 ± 1.0 ho. It was found that there was snoring in 517 (36.9%) and witnessed apnea in 340 (24.3%) drivers. Mean ESS was 2.5 ± 2.3 and 19 drivers (1.4%) reported ESS>10. A total of 1058 drivers (75.6%) had one or more accidents while driving a bus. According to Berlin questionnaire, 176 drivers (12.6%) were found to have high risk for OSA, and the accident rate was 83.0% in high-risk group and 74.5% of low-risk drivers had accidents ($p=0.043$) (Figure 1). In addition, the high-risk drivers had an average of 1.50 ± 1.55 accidents, whereas the others had 1.25 ± 2.02 accidents in every 100,000 kilometers ($p=0.022$) (Figure 2). The drivers with a history of traffic accident were older ($p=0.030$), had higher ESS ($p=0.019$), and were in high OSA risk group according to the Berlin questionnaire ($p=0.015$) (Table 1). In multivariate linear regression analysis, traffic accident was associated with only Berlin questionnaire ($p=0.015$).

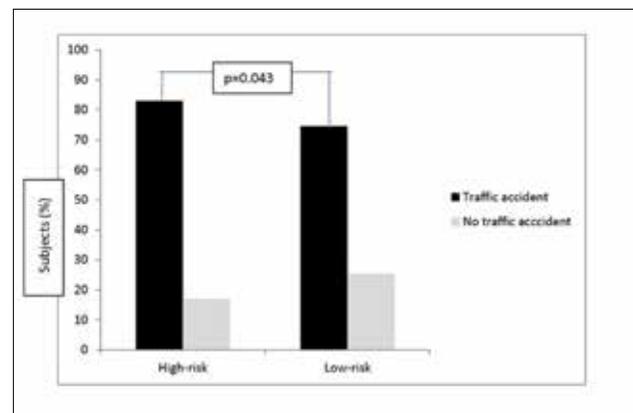


Figure 1. Accident rates of drivers at high and low risks for OSA according to Berlin questionnaire
OSA: obstructive sleep apnea

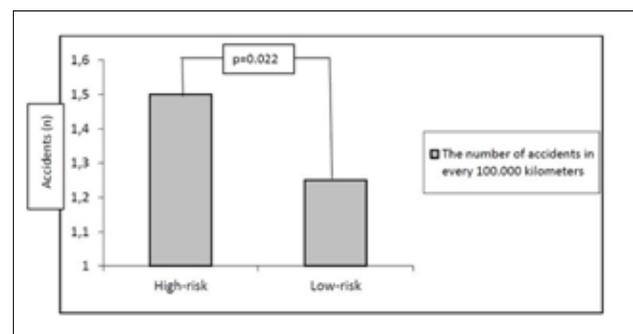


Figure 2. The number of accidents in every 100,000 kilometers in drivers at high and low risks for OSA according to Berlin questionnaire
OSA: obstructive sleep apnea

Table 1. Comparison of the drivers with and without traffic accidents

	Drivers with traffic accidents (n=1058)	Drivers without traffic accidents (n=342)	p
Age (yrs)	38.2±6.3	37.4±6.5	0.030
Weight (kg)	86.7±13.8	87.4±12.7	0.42
Body mass index (kg/m ²)	27.8±3.9	27.7±3.9	0.82
Neck circumference ≥43 cm*, n (%)	336 (31.8)	122 (35.7)	0.21
Current smokers, n (%)	558 (52.7)	169 (49.4)	0.56
Alcohol consumption, n (%)	156 (14.7)	42 (12.9)	0.26
Sedative drug use, n (%)	10 (1.0)	2 (0.5)	0.53
Comorbid diseases, n (%)	189 (17.9)	40 (11.7)	0.23
Epworth sleepiness score	2.6±2.3	2.3±2.4	0.019
High OSA risk **, n (%)	146 (13.8)	30 (8.8)	0.015

* Shirt collar number

** High OSA risk was assessed by Berlin questionnaire

OSA: obstructive sleep apnea

Data are expressed as mean±SD, unless otherwise stated.

DISCUSSION

There are a great number of studies that investigate traffic accidents of highway drivers [9]. However, studies evaluating risk factors for traffic accidents in in-city bus drivers are limited. In the present study, it was observed that city bus drivers had high risk (75.6 %) for one or more accidents while driving bus. The risk for traffic accidents was found to be related to older age, daytime sleepiness assessed by ESS, and being at high risk for OSA by the Berlin questionnaire. In multivariate linear regression analysis, traffic accident risk was independently associated with only Berlin questionnaire in in-city bus drivers.

Professional drivers are at a high risk for traffic accidents due to shift work and sleep disorders. In a study from Turkey, traffic accident history was found in 259 (49.7%) of in-city bus drivers [16]. In our study, a total of 1058 (73.4%) drivers had one or more accidents while driving a bus. Unlike in-city bus drivers, inter-city express bus drivers have lower risk for traffic accidents. Vennelle et al. [17] evaluated 456 commercial bus drivers and they found that 7% of drivers had traffic accident history. The high rate of traffic accidents in in-city bus drivers may depend on increased in-city traffic density.

In a study from Malaysia, 128 of 289 (44.3 %) randomly selected express bus drivers were diagnosed as OSA [18]. The results supported that the rate of OSA in bus drivers was high. Therefore, identification of in in-city bus drivers who have high risk for OSA is especially important. The Berlin questionnaire is a brief and validated screening tool that identifies subjects who are at high risk for OSA [13]. The Berlin questionnaire was also used to evaluate OSA symptoms and sleepiness in drivers and to assess the predictors of traffic accidents. The relationship between traffic accidents and high-

risk Berlin questionnaire of OSA was demonstrated in previous studies [19,20]. In the present study, traffic accident rate was higher in drivers who were considered as high risk for OSA according to Berlin questionnaire (83.0% in high-risk and 74.5% in low-risk drivers). In addition, high-risk drivers had an average of 1.50±1.55 accidents, whereas the others had 1.25±2.02 accidents in every 100,000 kilometers.

The risk factors associated with traffic accidents were evaluated in many studies. Akkoyunlu et al. [16] assessed the relationship between OSA symptoms and traffic accidents, and they found that only daytime sleepiness was significantly correlated with accidents. Howard et al. [21] evaluated the prevalence of excessive sleepiness, sleep-disordered breathing, and accident risk factors in 2342 commercial vehicle drivers. They showed that increasing sleepiness was related to an increased risk of traffic accident. In a study from Iran, high-risk Berlin questionnaire, larger neck circumference, and a history of witnessed apnea were the most important predictors of motor vehicle accidents [19]. In our study, the risk of traffic accidents was found to be related to older age, daytime sleepiness assessed by ESS, and being at high-risk for OSA by the Berlin questionnaire. In multivariate linear regression analysis, traffic accident risk was independently associated with only Berlin questionnaire. Therefore, we suggest that Berlin questionnaire may be used for the identification of city bus drivers at high risk of having traffic accidents.

The relationship between anthropometric characteristics and risk for accidents in drivers was not found in most of the study. In only one study, the relationship between neck circumference and accident risk was determined [19]. Since the relationship between anthropometric characteristics of in-city bus drivers and the accident risk was not demonstrated, the results of our study were also consistent with the literature.

To the best of our knowledge, this is the largest study evaluating traffic accident risk for in-city bus drivers based on official records. On the other hand, the present study has potential limitations. The first limitation was that the study was based only on self-report questionnaires. However, the drivers were aware that we would obtain official accident records from the workplace. Second, polysomnography could not be performed in the drivers because of long waiting list of subjects in our sleep laboratory. However, we are planning to perform sleep test within the shortest possible time.

In conclusion, the present results support that in-city bus drivers with high risk for OSA according to Berlin questionnaire have increased accident rates. Therefore, we suggest using Berlin questionnaire for screening sleep apnea in in-city bus drivers.

Ethics Committee Approval: The permission was obtained from İzmir Metropolitan Municipality for this questionnaire (Approval No: 68726049-(641-3-3)-292-1910).

Informed Consent: Written informed consent was obtained from each participant.

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REFERENCES

1. Peppard PE, Young T, Barnett JH, et al. Increased prevalence of sleep-disordered breathing in adults. *Am J Epidemiol* 2013;177:1006-14. [\[CrossRef\]](#)
2. Gordon P, Sanders MH. Positive airway pressure therapy for obstructive sleep apnoea/hypopnoea syndrome. *Thorax* 2005;60:68-75. [\[CrossRef\]](#)
3. Jennum P, Riha RL. Epidemiology of sleep apnoea/hypopnoea syndrome and sleep disordered breathing. *Eur Respir J* 2009;33:907-14. [\[CrossRef\]](#)
4. Yaggi HK, Strohl KP. Adult obstructive sleep apnea/hypopnea syndrome: definitions, risk factors, and pathogenesis. *Clin Chest Med* 2010;31:179-86. [\[CrossRef\]](#)
5. George CF, Nickerson PW, Hanly PJ, et al. Sleep apnea patients have more automobile accidents. *Lancet* 1987; 22:447. [\[CrossRef\]](#)
6. Findley LJ, Unverzagt ME, Suratt PM. Automobile accidents involving patients with obstructive sleep apnea. *Am Rev Respir Dis* 1988;138:337-40. [\[CrossRef\]](#)
7. Barbé F, Pericás J, Munoz A, et al. Automobile accidents in patients with sleep apnea syndrome. An epidemiological and mechanistic study. *Am J Respir Crit Care Med* 1998;158:18-22. [\[CrossRef\]](#)
8. Komada Y, Nishida Y, Namba K, et al. Elevated risk of motor vehicle accident for male drivers with obstructive sleep apnea syndrome in the Tokyo metropolitan area. *Tohoku J Exp Med* 2009;219:11-6. [\[CrossRef\]](#)
9. Tregear S, Reston J, Schoelles K, et al. Obstructive sleep apnea and risk of motor vehicle crash: systematic review and meta-analysis. *J Clin Sleep Med* 2009;5:573-81.
10. Basoglu OK, Tasbakan MS. Elevated risk of sleepiness-related motor vehicle accidents in patients with obstructive sleep apnea syndrome: a case-control study. *Traffic Inj Prev* 2014;15:470-6. [\[CrossRef\]](#)
11. George CF. Sleep. 5: Driving and automobile crashes in patients with obstructive sleep apnoea/hipopnoea syndrome. *Thorax* 2004;59:804-7. [\[CrossRef\]](#)
12. George CF. Sleepiness, sleep apnea, and driving: still miles to go before we safely sleep. *Am J Respir Crit Care Med* 2004;170:927-8. [\[CrossRef\]](#)
13. Netzer NC, Stoohs RA, Netzer CM, et al. Using the Berlin questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med* 1999;131:485-91. [\[CrossRef\]](#)
14. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep* 1991;14:540-5. [\[CrossRef\]](#)
15. Izci B, Ardic S, Firat H, et al. Reliability and validity studies of the Turkish version of the Epworth Sleepiness Scale. *Sleep Breath* 2008;12:161-8. [\[CrossRef\]](#)
16. Akkoyunlu ME, Kart L, Uludağ M, et al. Relationship between symptoms of obstructive sleep apnea syndrome and traffic accidents in the city drivers. *Tuberk Toraks* 2013;61:33-7. [\[CrossRef\]](#)
17. Vennelle M, Engleman HM, Douglas NJ. Sleepiness and sleep-related accidents in commercial bus drivers. *Sleep Breath* 2010;14:39-42. [\[CrossRef\]](#)
18. Yusoff MF, Baki MM, Mohamed N, et al. Obstructive sleep apnea among express bus drivers in Malaysia: important indicators for screening. *Traffic Inj Prev* 2010;11:594-9. [\[CrossRef\]](#)
19. Amra B, Dorali R, Mortazavi S, et al. Sleep apnea symptoms and accident risk factors in Persian commercial vehicle drivers. *Sleep Breath* 2012;16:187-91. [\[CrossRef\]](#)
20. Catarino R, Spratley J, Catarino I, et al. Sleepiness and sleep-disordered breathing in truck drivers: risk analysis of road accidents. *Sleep Breath* 2014;18:59-68. [\[CrossRef\]](#)
21. Howard ME, Desai AV, Grunstein RR, et al. Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. *Am J Respir Crit Care Med* 2004;170:1014-21. [\[CrossRef\]](#)