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Original Article

Daytime sleepiness and sleep habits as risk factors of traffic accidents in a group of Turkish public transport drivers

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Abstract: Aim: To explore the association of daytime sleepiness, sleep complaints and sleep habits with self-reported car crashes among public transport drivers. Methods: A cross-sectional descriptive study was carried out on male professional public drivers in two different cities using a validated, self-administered sleep questionnaire which comprised of symptoms suggesting sleep disorders, a subjective report of daytime sleepiness and driving characteristics. The subjects (mean age±SD, 40±11 years) were divided into two groups: (1) accident group and (2) no accident group. Results: Forty nine (15.3%) of the 320 public drivers reported that they had at least one sleepiness related motor vehicle accident and/or near-missed accident (Group 1). The mean age, body mass index and annual distance driven were similar in both groups. Although Group 1 reported less sleep time per night, more witnessed apneas, abnormal sleep, alcohol use and had higher mean Epworth Sleepiness Scale scores than Group 2, multivariate analysis of risk factors revealed that only daytime sleepiness increase the risk of traffic accidents [OR: 1.32 (1.19-1.47)]. Conclusion: These results suggest that self-reported sleepiness is a predictive sign of traffic accidents due to driver sleepiness.

Keywords: Epworth Sleepiness Scale, motor vehicle accident, daytime sleepiness, obesity, obstructive sleep apnea

Introduction

Many factors affect sleep patterns and sleep disorders [1]. Also the relationship between sleep habits and daytime behavior or cognitive functioning was also shown [2]. Psychomotor functions during driving including wakefulness, quick and accurate perception, and reasoning may be impaired by sleepiness leading an increased risk of motor vehicle accidents [3, 4]. Sleepiness is characterized by a tendency to fall asleep and is the unavoidable consequence of the unsatisfied need to sleep [4]. An update systematic review reported that prevalence of obstructive sleep apnea (OSA) ranged from 3.7% to 97.3% in different populations [5]. Although subjects with OSA may complain of excessive daytime sleepiness (EDS) or insomnia, nocturia and morning headaches, some patients may be asymptomatic [6]. Sleep apnea was previously shown cause of EDS and sleepiness is an important cause of car crashes. Commercial drivers, who have severe OSA, report performance impairments and fatigue [7]. Previously published studies have suggested that fatigue or sleepiness in car drivers increases the risk of crashing [8-11].

Previously published studies revealed that traffic accidents were responsible for an important proportion of death and disability in Turkish population. Crash rate of 0.013%; injury rate of 0.003%; and fatality rate of 5.9 per 100.000 was reported [12]. A single previous study has found the rate of excessive daytime sleepiness (EDS) related traffic accidents as 21% among Turkish drivers [13]. Studies from other countries have given estimates of 4%, 6%-33% and 16% for Norway [14], Australia [15] and Britain [16, 17] respectively.

The present cross-sectional questionnaire-based study aimed explore the association of daytime sleepiness, sleep related complaints

Table 1. Risk factors according to reported sleepiness related traffic accidents and/or near missed accidents

	Accident group (n=49)	No accident group (n=271)	P^* value
Age, years	38.29 (9.7)	40.30 (11.0)	NS
Daily sleep, hours	6.86 (1.0)	7.39 (1.03)	<0.001
Driven distance, km/year	40.367.35 (19.995.5)	43.841.33 (31.574.0)	NS
Body Mass Index, kg/m^2	26.5786 (3.7)	27.4264 (4.2)	NS
ESS score	8.20 (4.8)	4.36 (3.5)	<0.001

Abbreviations: ESS, Epworth Sleepiness Scale; NS, not significant; All data are given as Means (SD). *Student's t test.

and sleep habits with self-reported car crashes in public transport drivers.

Materials and methods

Participants

The study was carried out in two border cities, Edirne from western and Antakya from south-eastern Mediterranean regions of Turkey, with a population of more than 120.000 and 200.000, respectively. There were 915 licensed commercial public drivers in Antakya and 382 in Edirne. While 211 of them drive inner city buses and the rest drive mini-buses to suburbs of Antakya, 107 of them were inner city drivers and the rest were suburban minibus drivers in Edirne. None of the subjects were long haul drivers. We aimed to reach all of the inner city drivers and randomly selected four clusters form seventeen suburban bus stations from each city. An informed consent was approved from all participants. None of them refused to participate and no questionnaires were excluded. The sample size was calculated as 252, if a level of α=0.05, β=0.2 and, daytime sleepiness rates of 15% in accident group (Group 1) versus 10% in no accident group (Group 2) were accepted.

Questionnaire

Data were collected in the year 2004 in Edirne and 2011 in Antakya by means of an anonymous, self-administered sleep questionnaire which comprised multiple-choice and likert type items, including demographic characteristics, nocturnal sleep habits and symptoms suggesting sleep disorders (un-refreshing sleep, sleep disordered breathing, insomnia), and a subjective report of daytime sleepiness. Validated Turkish version of The Epworth Sleepiness Scale was used to assess sleepiness (18-22). The drivers were informed that their answers could not have any influences on their driving licenses or employment. Questionnaires were administered to drivers in stations.

Statistical analyses

Demographic variables, which were normally distributed, are described as mean and standard deviation with comparison between groups made with Student's *t* test. Mann-Whitney U test was used to compare the groups about sleep habits and symptoms rated using likert type scale and described as median and minimum-maximum.

A factor analysis and linear regression was used to extract the items in the questionnaire in relation to sleep habits and symptoms such as loud snoring, witnessed apnea, and etc. to see the association between the constructs and Epworth Sleepiness Scale.

Multivariate logistic regression analysis was performed to see the association between motor vehicle accidents and/or near-miss accidents and age, body mass index, ESS scores, kilometers driven per year, daily sleep hours, and constructs obtained from factor analysis. All variables were continuously analyzed (unit per unit). Two-tailed *p* values of 0.05 or less were deemed to be statistically significant. All analyses were performed using the SPSS statistical software package (SPSS, v.13.0, Inc., Chicago, Illinois).

Results

Forty nine (15.3%) of the 320 public drivers reported that they had at least one sleepiness related motor vehicle accident and/or near-miss accident (Group 1). Ages ranged from 19 to 74 years (mean: 39.99; SD: 10.85). The mean age, body mass index and annual mile-

Table 2. Comparison of sleep habits between drivers who had sleepiness related accidents and drivers who reported no accident

	Accident group (n=49)	No accident group (n=271)	*p** value
Loud Snoring	2 (1-5)	2 (1-5)	NS
Witnessed apnea	1 (1-3)	1 (1-5)	<0.05
Sweating	1 (1-5)	1 (1-5)	NS
Abnormal sleep	2 (1-5)	1 (1-5)	<0.05
Daytime sleepiness	1 (1-5)	1 (1-5)	NS
Alcohol use	1 (1-5)	1 (1-4)	<0.001
Sleep medication use	1 (1-2)	1 (1-5)	NS
Various bed time	3 (1-5)	2 (1-5)	0.056
Unrest awakening	2 (1-5)	1 (1-5)	NS
Nocturia	1 (1-5)	1 (1-5)	NS

Abbreviations: NS, not significant; *Mann-Whitney U test, Data are given as Median (Range**) **Likert type.

Table 3. Rotated component matrix of factor analysis of items about sleep habits

	Factor I	Factor II	Factor III
Variable bed time	0.736	0.144	-0.035
Alcohol consumption	0.709	-0.194	0.215
Unrest awakening	0.697	0.341	0.110
Abnormal sleep	0.475	0.473	0.035
Sweating	0.369	0.304	-0.090
Loud Snoring	-0.018	0.711	0.012
Daytime sleepiness	0.157	0.673	0.186
Nocturia	0.305	0.420	-0.016
Sleep medication use	0.086	-0.136	0.832
Witnessed apnea	-0.025	0.410	0.663

Extraction Method: Principal Component Analysis. Rotation Method: Equamax with Kaiser Normalization. Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.754. Bartlett's Test of Sphericity: 0.001 (chi-square: 422.8).

Table 4. Linear regression model analyzing the relationship between the constructs of sleep habits and Epworth Sleepiness Scale

	Unstandardized Coefficients		Standardized Coefficients	T	p
	B	SE	Beta		
Constant	4.950	0.195		25.402	<0.001
Factor I	1.279	0.195	0.322	6.555	<0.001
Factor II	1.351	0.195	0.340	6.923	<0.001
Factor III	.579	0.195	0.145	2.966	0.003

Dependent Variable: Epworth Sleepiness Scale score.

age were similar in both groups. Mean Epworth Sleepiness Scale scores of Group 1 were higher than Group 2 (p<0.001), and also drivers in Group 1 reported less sleep time per night than Group 2 (p<0.001). **Table 1** shows univariate analyses of risk factors according to reported sleepiness related traffic accidents and/or near missed accidents.

Drivers in Group 1 rated more witnessed apnea, abnormal sleep and, alcohol use while both groups were similar in regard to other sleep habits such as loud snoring, sweating, daytime sleepiness, sleep medication use, various bed time, unrest awakening, and nocturia. **Table 2** shows sleep habits according to sleepiness related traffic accidents and/or near missed accidents.

A factor analysis of sleep habits revealed three constructs. **Table 3** shows rotated component matrix of factor analysis of items about sleep habits. First one comprised of going to bed at variable times, alcohol use, and unrest awakening. Second one comprised of loud snoring and daytime sleepiness. The third one comprised of sleep medication use and witnessed apnea. The lineer regression model showed the significant relationship between these three constructs and Epworth Sleepiness Scale scores (**Table 4**).

Logistic regression analysis of risk factors including age, body mass index, daily sleep time, driven distance per year, daytime sleepiness and, constructs of sleep habits revealed that only daytime sleepiness increase the risk of traffic accidents (OR: 1.32, **Table 5**).

Discussion

The results of our study show that drivers who reported accidents had a significantly higher ESS scores compared with others and also self-

Table 5. Logistic regression analysis of risk factors in subjects reported sleepiness related traffic accidents and/or near missed accidents or not

	B	S.E.	Wald	p	OR (95% CI)
Body Mass Index	-0.046	0.044	1.081	0.298	0.96 (0.88-1.04)
Age	-0.002	0.017	0.014	0.907	0.99 (0.97-1.03)
Daily sleep (hours)	-0.317	0.166	3.660	0.056	0.73 (0.53-1.01)
Driven distance (kms/year)	0.000	0.000	0.798	0.372	1.000 (1.00-1.00)
ESS score	0.276	0.053	27.553	<0.001	1.32 (1.19-1.47)
Factor I	-0.050	0.177	0.081	0.776	0.95 (0.76-1.35)
Factor II	-0.369	0.198	3.468	0.063	0.69 (0.47-1.02)
Factor III	-0.320	0.226	2.008	0.156	0.73 (0.47-1.13)
Constant	0.486	1.677	0.084	0.772	

ESS: Epworth Sleepiness Scale.

reported sleepiness was found to be associated with a high risk for traffic accidents [OR: 1.32 (1.19-1.47)]. Other significant variables including daytime sleepiness, witnessed apnea and alcohol use failed in multivariate model. The present study shows the association between sleepiness while driving and the risk of traffic accidents in Turkish drivers. Driver fatigue or sleepiness is major determinants of traffic accidents. Thus we evaluated the role of sleep durations and sleep apnea in subjective sleepiness in commercial drivers.

In the study group, drivers who reported accidents or near missed accidents have less mean daily sleep hours than others. Also Ozturk L et al., in a previously published study, found that drivers who reported five hours or less of average sleep duration for a night had significantly more traffic accidents compared with those who had more than five hours of sleep [13]. The average sleep duration per night plays an important role in sleep related traffic accidents. It is well-known that psychomotor performance is impaired if sleep is limited to five hours for two or more consecutive nights [23]. Among the causes of sleepiness, sleep related breathing disorders appear to play a major role in accidents due to their high prevalence [24]. In our sample self-reported sleepiness was found quite common, because a high proportion of subjects (15.0%) had an Epworth Sleepiness Scale score. Beside this those factors not found to be associated with an increase in risk included miles driven per year, age, obesity, alcohol consumption, and daily sleep time, although the result with respect to alcohol use was unexpected [25].

Although previous studies showed the association among sleep apnea, visceral obesity, insulin resistance and hypercytokinemia, the drivers in our sample were similar in respect to body mass index [26].

Snoring was more prevalent in people reporting excessive daytime sleepiness (EDS) at work than the general population [27], and the risk of having any motor vehicle accident is higher in snorers than non-snorers [28]. In present study a relationship was found between ESS and reported loud snoring but unfortunately multivariate analyses failed to demonstrate the relationship between accidents and the construct including snoring.

Screening, early diagnosis and effective treatment of drivers with sleep apnea may decrease daytime sleepiness related motor vehicle accidents because a group of patients that often remains underdiagnosed and undertreated despite the evidence of progressive nature of both diseases. Physicians need to question patients about sleepiness and advise them about driving. Driving regulations in many countries state that patients with sleep apnea and hypersomnolence should not drive.

This study had several limitations. Our samples consisted of bus and minibus drivers who were driving on the urban and suburban roads and streets. These results may therefore not be generalizable to other driver populations such as long-haul truck drivers. These results should be better accepted as initial documentation of sleepiness and sleep related traffic accidents in Turkish commercial public transport drivers. We used a self-administered questionnaire so

the data were depended on the recalling capacity of patients. An objective measurement about sleep patterns and sleep disorders supporting subjects' self-reports might have prevented an overestimation and verified the results. On the other hand, drivers with sleep apnea may under report accidents and symptoms [29]. While this is a limitation, police and insurers may also underestimate the problem due to regulations and under reporting. Despite these study limitations, this cross-sectional descriptive study has evaluated a number of factors that appear to increase a driver's risk for involvement in a sleep-related motor vehicle crash.

Conclusions

These results suggest that self-reported sleepiness while driving is a predictive sign of traffic accidents. We have to implement strategies to reduce sleepiness such as screening daytime sleepiness to identify sleep apnea during license evaluations.

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Disclosure of conflict of interest

None declared.

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