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The Effect of Sleep Disorders and Fatigue on In-vehicle Traffic Accidents

Araç İçi Trafik Kazalarına Uyku Bozuklukları ve Yorgunluğun Etkisi

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ABSTRACT

Aim: Traffic accidents have been reported by the World Health Organization as a global problem affecting the whole world. Many studies have shown that the majority of traffic accidents are associated with inadequate and/or disturbed sleep. We aimed to define possible sleep disorders and chronic fatigue in people who had had an in-vehicle traffic accident with applicable scales and to take the necessary precautions.

Materials and Methods: Our study included 104 people with a suitable general condition and physical examination, who had an in-vehicle traffic accident and applied to Pamukkale University Faculty of Medicine Emergency Service. For all patients, demographic data inquiries were made, and the 'Epworth Sleepiness Scale (ESS)', 'Pittsburg Sleep Quality Index (PUKİ)', 'Berlin Questionnaire' and 'Fatigue Severity Scale' were applied.

Results: Increased daytime sleepiness was determined in 10 (9.62%) people according to the ESS, poor sleep quality in 15 (14.42%) people according to the PUKİ, high risk of Obstructive sleep apnea syndrome (OSAS) in 15 (14.42%) people according to the Berlin Questionnaire, and chronic fatigue in 30 (29.1%) people according to the Fatigue Severity Scale.

Conclusion: In our study, we showed with scales that people who had an in-vehicle traffic accident could have various sleep disorders and chronic fatigue syndrome that had not been diagnosed before. However, contrary to what is mentioned in the literature, we found the prevalence of OSAS risk to be low. Necessary measures should be taken to minimize the risk of preventable accidents while driving. In case of suspicion of respiratory disorder, which is one of the sleep disorders we frequently see, gold standard tests such as polysomnography should be used before saying that there is no respiratory disorder in sleep with scales, especially in people who will be driving as a profession.

Keywords: Traffic accident, sleep disorders, obstructive sleep apnea syndrome, daytime sleepiness, fatigue

ÖZ

Amaç: Trafik kazaları, Dünya Sağlık Örgütü tarafından tüm dünyayı etkileyen global bir problem olarak bildirilmiştir. Trafik kazalarının büyük çoğunluğunun yetersiz ve/veya bozuk uyku ile ilişkili olduğu birçok çalışmada gösterilmiştir. Biz de araç içi trafik kazası geçiren kişilerdeki olası uyku bozuklukları ve kronik yorgunluk durumunu uygulanabilir ölçeklerle tanımlamayı ve gerekli önlemeleri almayı amaçladık.

Gereç ve Yöntem: Çalışmamıza araç içi trafik kazası geçiren ve Pamukkale Üniversitesi Tıp Fakültesi Acil Servisi'ne başvuran, genel durumu ve fizik muayenesi uygun 104 kişi dahil edildi. Tüm hastalara demografik veri sorgulaması yapıldı, 'Epworth Uykululuk Ölçeği (EUÖ)', 'Pittsburg Uyku Kalitesi İndeksi (PUKİ)', 'Berlin Anketi' ve 'Yorgunluk Şiddet Ölçeği' uygulandı.

Bulgular: EUÖ'ye göre 10 (%9,62) kişide artmış gündüz uykululuğu, PUKİ'ye göre 15 (%14,42) kişide kötü uyku kalitesi, Berlin Anketi'ne göre 15 (%14,42) kişide yüksek Obstrüktif uyku apne sendromu (OUAS) riski, Yorgunluk Şiddet Ölçeği'ne göre 30 (%29,1) kişide kronik yorgunluk saptandı.

Sonuç: Çalışmamızda, araç içi trafik kazası geçirmiş kişilerde, daha önce tanı almamış olmalarına rağmen, çeşitli uyku bozukluklarının ve kronik yorgunluk sendromunun olabileceğini ölçeklerle gösterdik. Fakat literatürde bahsedilenin aksine özellikle OUAS riskinin prevalansını düşük bulduk. Araç kullanımında önlenebilir kaza riskini en aza indirmek amacıyla gerekli tedbirler alınmalıdır. Özellikle meslek olarak şoförlük yapacak kişilerde, sıklıkla gördüğümüz uyku bozukluklarından solunum bozukluğu şüphesi halinde uykuda solunum bozukluğu olmadığını ölçeklerle söylemeden önce polisomnografi gibi altın standart tetkikler kullanılmalıdır.

Anahtar Kelimeler: Trafik kazası, uyku bozuklukları, obstrüktif uyku apne sendromu, gün içi uykululuk, yorgunluk

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INTRODUCTION

Motor vehicle accidents are expected to be the fourth leading cause of death in the world by 2030[1]. Driving a motor vehicle is a skill that requires the integration of complex functions such as higher cortical function, alertness, concentration and eye-hand coordination. Considering the causes of traffic accidents, it has been seen that they may be caused by human errors, bad weather conditions, bad road conditions and mechanical problems related to the vehicle. It has been reported that up to 20% of traffic accidents are due to driver fatigue and sleepiness[2]. Sleep disorders are one of the leading causes of traffic accidents and can lead to serious injuries and high mortality[3]. Falling asleep while driving has become an important international public health problem due to the heavy cost of traffic-related morbidity and mortality[4]. Between 10 and 30 percent of fatal accidents are associated with falling asleep while driving[5]. In the studies of Masa et al.[6] and Lloberes et al.[7], it was shown that perceived sleepiness at the wheel before a collision was significantly associated with accident risk. In a study by Connor et al.[8], it was reported that approximately 20% of fatal accidents were associated with driver fatigue. It was also shown in another study that sleepiness at the wheel increased the risk of an accident by 2 times[5]. It has been stated by the National Sleep Foundation that 100,000 traffic accidents occur every year due to tired drivers, and long-distance drivers are at a higher risk of having an accident due to fatigue and sleepiness[9]. In many previous studies, it has been shown that sleepiness-related traffic accidents are caused by many sleep-related diseases such as Obstructive sleep apnea syndrome (OSAS). The predictors of driver sleepiness with largest evidence to date are younger age, male gender, duration of driving, increased daytime sleepiness (EDS) and increased risk of obstructive sleep apnea. In addition, underlying diseases also significantly affect EDS[10]. In our study, we aimed to examine the relationship between traffic accidents and sleep quality, sleep disorders and fatigue in people who applied to the emergency department due to a traffic accident, and to determine that the treatment of people's known sleep disorders is an important step in preventing traffic accidents.

MATERIALS AND METHODS

Our study included 104 conscious patients over the age of 18 years, who applied to the Emergency Department of Pamukkale University Medical Faculty and had an in-vehicle traffic accident as a driver. Motorcycle and other non-vehicle traffic accidents were not included in the study. After the necessary initial examinations and evaluations of the patients were made, questions including demographic data, year of driving, number of accidents, time of accident, alcohol use in the accident, traffic accidents had in the last 6 months and the presence of someone with them during the accident were asked. The 'Epworth Sleepiness Scale' (ESS)[6] measuring daytime sleepiness, 'Pittsburgh Sleep Quality Index' (PSQI)[7] measuring sleep quality, 'Berlin Questionnaire' used for screening in the diagnosis of OSAS and 'Fatigue Severity Scale'[8] assessing fatigue severity, Turkish reliability and validity of which were proven, were applied. The time interval of the accident was analyzed as 00:01-06:00, 06:01-12:00, 12:01-18:00, 18:01-24:00 by dividing 24 hours into 4.

Those who scored 10 or higher on the ESS were evaluated as 'increased daytime sleepiness'. PSQI was examined in 7 categories, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disorders, use of sleeping pills, and daytime functions, and poor sleep quality was determined for those with a total score of 5 and above. The Berlin Questionnaire was examined in 3 categories within itself, and a high risk of OSAS was determined for those who scored 2 points or more. Finally, the Fatigue Severity Scale consisted of 9 questions, and those with a score above 6.1, obtained by dividing the total score by 9, were diagnosed with chronic fatigue syndrome.

Written consent forms were obtained from all participants stating that they volunteered for the study, and the study was carried out in line with the decision of the Medical Ethics Committee of Pamukkale University no. 60116787-020/34134 (date: 09.06.2020).

Statistical Analysis

Data were analyzed with Statistical Package for the Social Sciences (SPSS) 25.0 [IBM SPSS Statistics 25 software (Armonk, NY:IBM Corp.)] package program. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as numbers and percentages. The conformity of the data to the normal distribution was examined using the Shapiro-Wilk test. The Mann-Whitney U test was used to analyze the independent group differences. The Spearman's correlation analysis was used to examine the relationships between continuous variables. A p value of <0.05 was considered statistically significant in all analyses.

RESULTS

One hundred four patients who were conscious and in good general condition after having had an in-vehicle traffic accident were included in our study. The mean age of the patients was 38.97±13.69 years, and 15 (14.4%) were female and 89 (84.6%) were male. It was determined that 4 of the patients (3.8%) did not have a driver's license. The average driving time of the individuals was calculated as 15.52±11.68 years. Considering the type of vehicle in the accidents, 90 (86.5%) were cars, 8 (7.7%) were pickup trucks, 4 (3.8%) were trucks, and 2 (1.9%) lorries. When the education levels of the individuals were

examined, it was determined that 43 (42.6%) were primary school graduates, 32 (31.7%) were high school graduates and 26 (25.7%) were university graduates. It was determined that 18 of the patients (17.3%) had a previously known chronic disease, and 5 (4.8%) of the patients were drunk at the time of the accident. Considering the time interval of the accidents, it was seen that 44 (45.4%) of them were between 06:01 and 12:00. When the histories of previous traffic accidents were examined, it was determined that 5 people (4.8%) had at least one in-vehicle traffic accident in the last 6 months. It was learned that 51 (49.1%) people were with at least one person at the time of the accident (Table 1).

The mean score of the ESS was 3.66±4.01 and EDS was detected in 10 (9.62%) people. The mean of the PSQI was 3.46±2.64, and 15 (14.42%) people showed poor sleep quality. The mean of the Berlin Questionnaire was 1.55±1.83, and the risk of OSAS was considered high in 15 (14.42%) individuals. The mean of the Fatigue Severity Scale was 18.2±14.48, and chronic fatigue was found in 30 (29.1%) individuals (Table 2).

The mean body mass index (BMI) of the subjects was 26.25±4.54, and a statistically significant negative correlation was found between education level and BMI (r=-0.200, p<0.05).

When the ESS was compared with the Berlin Questionnaire (r=0.519, p<0.001), the Fatigue Severity Scale (r=0.420, p<0.001) and the PSQI (r=0.374, p<0.005), a statistically significant positive correlation was observed between them (Table 3).

There was a statistically significant positive correlation between the Berlin Questionnaire and the Fatigue Severity

Table 1. Demographic characteristics of people who had an in-vehicle traffic accident

	Patient (n=104)
Age, mean±SD, y	38.97±13.69
Gender Female (%) Male (%)	15 (14.4%) 89 (84.6%)
Duration of driving Mean±SD, y	15.52±11.68
BMI, Mean±SD	26.25±4.54
Vehicle type Otomobile Truck Pickup truck Lorry	90 (86.5%) 4 (3.8%) 8 (7.7%) 2 (1.9%)
Educational level Primary school High school University	43 (42.6%) 32 (31.7%) 26 (25.7%)
Period of education Mean±SD, y	10.75±2.82
Time of accident 06:01-12:00 12:01-18:00 18:01-24:00 00:01-06:00	44 (45.4%) 28 (28.9%) 16 (16.5%) 9 (9.3%)
ESS Mean±SD	3.66±4.01
Berlin Questionnaire Mean±SD	1.55±1.83
FSS Mean±SD	18.2±14.48
PSQI total Mean±SD	3.46±2.64

BMI: Body mass index, ESS: Epworth Sleepiness Scale, FSS: Fatigue Severity Scale, PSQI: Pittsburgh Sleep Quality Index, SD: Standard deviation

Table 2. The clinical status of the patients according to the results of the scales

Fatigue Severity Scale	Fatigue	
	+	30 (29.1%)
	-	73 (70.9%)
Epworth Sleepiness Scale	Day sleepiness	
	+	10 (9.6%)
	-	94 (90.4%)
Berlin Questionnaire	OSAS high risk	15 (14.4%)
PSQI	Poor sleep quality	15 (14.4%)

OSAS: Obstructive sleep apnea syndrome, PSQI: Pittsburgh Sleep Quality Index

Table 3. Correlation of Epworth Sleepiness Scale with other scales

Epworth Sleepiness Scale		
	p	**r**
Berlin Questionnaire	<0.001*	0.519
Fatigue Severity Scale	<0.001*	0.420
PSQI	<0.05*	0.374

*Statistically significant.
PSQI: Pittsburgh Sleep Quality Index

Table 4. Correlation of the Berlin Questionnaire with scales, age and duration of education

Berlin Questionnaire		
	p	**r**
Fatigue Severity Scale	<0.001*	0.343
PSQI	<0.05*	0.341
Age	<0.05*	0.210
Duration of education	<0.05*	-0.201

*Statistically significant.
PSQI: Pittsburgh Sleep Quality Index

Scale (r=0.343, p<0.001) and the PSQI (r=0.341, p<0.05). While a statistically significant positive correlation (r=0.210, p<0.05) was found between the Berlin Questionnaire and age, a negative correlation was observed with education level (r=-0.201, p<0.05) (Table 4).

According to the results of the Berlin Questionnaire, the ESS, Fatigue Severity Scale, and PSQI scores were found to be statistically significantly higher in those with a high risk of OSAS (p=0.021, p=0.0001, p=0.009) (Table 5).

There was a statistically significant positive correlation between the Fatigue Severity Scale and the PSQI (r=0.308, p<0.05). A statistically significant positive correlation was demonstrated between the PSQI and the number of accidents related to absent-mindedness (r=0.340, p<0.05). A statistically significant negative correlation was observed between the training periods and the number of accidents due to absent-mindedness (r=-0.232, p<0.05) (Table 6).

Table 5. Relationship between the results of Berlin Questionnaire and other scales

Berlin Questionnaire	OSAS low risk (n=89)	OSAS high risk (n=15)	
	Mean±SD	Mean±SD	p
Epworth Sleepiness Scale	3.35±3.95	5.53±3.98	0.021* (z=2.302)
Fatigue Severity Scale	15.9±13.19	31.73±14.71	0.0001*(z=3.626)
PSQI	3.05±2.31	6.11±3.26	0.009* (z=-2.608)

*Statistically significant; z: Mann-Whitney U test.

OSAS: Obstructive sleep apnea syndrome, PSQI: Pittsburgh Sleep Quality Index, SD: Standard deviation

Table 6. Other statistically significant correlations

		(A)	(B)	(C)	(D)	(E)
PSQI (A)	r					
	p					
FSS (B)	r	0.308				
	p	0.011*				
Number of accidents due to absent-mindedness (C)	r	0.340	-0.031			
	p	0.005*	0.756			
Duration of education (D)	r	-0.039	0.107	-0.232		
	p	0.759	0.289	0.020*		
BMI (E)	r	0.729	-0.035	0.169	-0.200	-
	p	0.146	0.729	0.090	0.046*	

*Statistically significant.

PSQI: Pittsburgh Sleep Quality Index, FSS: Fatigue Severity Scale, BMI: Body mass index

DISCUSSION

Injuries caused by traffic accidents are an important global and public health problem affecting societies. It is known that an important part of this situation is due to driver fatigue and sleepiness[2]. According to the National Transportation Safety Board in the United States (USA), sleep deprivation is the most common cause of sleepiness[11]. Sleep deprivation affects attention, performance, concentration and motor coordination along with neurobiological functions, especially psychomotor and neurocognitive functions. All these lead to an increased risk of accidents while driving[12].

Young age, male gender, EDS, and increased risk of OSAS are known risk factors for driver's sleepiness[10], and in our study, there was a middle aged male predominance. In a study by Filomeno et al.[13], as in our study, it was reported that EDS was more common in the middle-aged group compared to the young-aged group, and this might be associated with higher alcohol consumption in the middle-aged group than in the younger age group.

Traffic accidents are also a hot topic in our country due to the loss of life, and it is thought that the accidents are often related to drowsy driving due to daytime sleepiness[14]. While daytime sleepiness was found to be increased by 9.62% in our study, the increased prevalence of EDS in traffic accidents was found to be 3% in the USA, 10% in France, and 33% in New Zealand in previous studies[15]. It has been stated that these differences in studies may be related to differences according to ethnic populations. An example of this is the correlation between increased BMI and daytime sleepiness, and a similar risk ratio in Asian people with normal BMI, regardless of BMI[16]. We also did not find any correlation between BMI and increased EDS in our study, but we found a negative correlation between education level and BMI. We thought that this might be related to the increase in awareness about healthy nutrition as the level of education increased.

In our study, according to the Berlin Questionnaire applied to people who applied with a traffic accident, 14,42% had the risk of OSAS, and this rate was found to be lower than expected. There are many studies proving the relationship between OSAS and traffic accident risk. This relationship has been clearly demonstrated in polysomnography (PSG) studies[17]. However, in studies conducted in our country with the questioning of OSAS symptoms, results showing that the risk of accident with OSAS symptoms are low or unrelated have been obtained. This situation has been thought to be related to the OSAS symptoms' being personal and/or the person's lack of awareness or their being hidden due to professional concerns in drivers[14]. Since the relationship between OSAS and accident is a proven fact, routine PSG application is one of the

topics discussed in order to reveal this risk in people who will be driving as a profession[17].

In our study, a positive correlation was found in the results of the ESS and the Berlin Questionnaire evaluating the risk of OSAS. This result, which supports that OSAS affects daytime sleepiness, was not supported in some studies. It was thought that this was mostly due to the lack of motivation of people and their inability to evaluate themselves and the disease[18]. However, daytime sleepiness is an inevitable consequence as a result of sleep interruptions during night, autonomic dysfunction and hypoxia due to OSAS. In addition, another important cause of EDS is impaired sleep quality[19]. In our study, we also found a statistically significant positive correlation between ESS and PSQI. In addition, considering the patients with a history of in-vehicle traffic accident in the last 6 months, it was shown that the sleep quality was worse in these individuals, although there was no statistically significant difference compared to those without a history of traffic accidents. It was thought that this was actually an important finding, but that statistical differences could not be shown due to the inadequacy of the numbers.

Although fatigue and daytime sleepiness are different definitions, in clinical practice these two conditions cannot be distinguished from each other[19]. In our study results, a significant positive correlation was found between ESS and fatigue severity scale. In the studies, fatigue was defined in drivers while driving, and Mayor et al.[20] determined the fatigue rate of drivers as 32% while driving. Similarly, we found chronic fatigue syndrome in 29.1% of drivers in our study.

When PSG results are examined in people with OSAS, it is seen that the time spent in stage 1 and in wakefulness increase, which is thought to be associated with impaired sleep quality[18]. In our study, we found poor sleep quality in people at high risk of OSAS. It is inevitable to have a chronic fatigue process related to reasons such as poor sleep quality and deterioration of oxygenation during the night caused by OSAS. In relation to this, in our study, we found that the Fatigue Scale scores were high in people with high OSAS risk.

In a study examining age and sleep disorders in traffic accident victims, it was seen that sporadic causes such as alcohol and drug use are more common in young and middle ages, and more chronic causes such as respiratory disorders at sleep in older ages[5]. In our study, we found a significant positive correlation between the increased risk of OSAS and age in those who had a traffic accident.

Studies examining the relationship between education level and traffic accidents have shown that low education level leads to more fatal accidents[21,22]. In our study, a negative correlation was found between the duration of education and the number of accidents due to absent-mindedness, and a positive correlation with the risk of OSAS. We thought that this was associated with greater attention and awareness as the duration of education increased, as well as a lower risk of OSAS and a lower risk of traffic accidents caused by it.

Finally, the effect of sleep disorders on traffic accidents is a fact that has been researched and revealed by the whole world. In some studies on the solution, it has been shown that some measures to be taken against sleepiness (stopping and taking a short walk, listening to music, opening the window, consuming coffee) reduce the risk of accidents in drivers[23].

CONCLUSION

The relationship between in-vehicle traffic accidents and daytime sleepiness, OSAS risk, chronic fatigue, and poor sleep quality has been demonstrated, and both loss of life and property can be largely prevented by recognizing these, even with easy-to-apply scales, and taking the necessary precautions.

However, the relationship between the risk of OSAS obtained by questioning the risk of OSAS, which is a common cause of sleep disorder, and having an accident was observed at a low rate. PSG examinations should be recommended in cases of clinical suspicion and in occupational groups such as professional driving, and traffic accidents should be prevented by using continuous positive airway pressure if OSAS is detected.

Ethics

Ethics Committee Approval: The study was carried out in line with the decision of the Medical Ethics Committee of Pamukkale University no. 60116787-020/34134 (date: 09.06.2020).

Informed Consent: Written consent forms were obtained from all participants stating that they volunteered for the study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.S., Design: S.T., Data Collection or Processing: M.S., Analysis or Interpretation: S.T., Literature Search: M.S., Writing: S.T.

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