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ORIGINAL ARTICLE

The relationship between driving simulation performance and obstructive sleep apnoea risk, daytime sleepiness, obesity and road traffic accident history of commercial drivers in Turkey

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Abstract
Background Driving performance is known to be very sensitive to cognitive-psychomotor impairment. The aim of the study was to determine the relationship between obesity, risk of obstructive sleep apnoea (OSA), daytime sleepiness, history of road traffic accident (RTA) and performance on a driving simulator, among commercial drivers.
Methods We examined commercial vehicle drivers admitted to Psycho-Technical Assessment System (PTAS), which is a computer-aided system that includes a driving simulator test and tests assessing psychomotor-cognitive skills required for driving. Risk of OSA and daytime sleepiness were assessed by the Berlin Questionnaire and the Epworth Sleepiness Scale (ESS), respectively.
Results A total of 282 commercial vehicle drivers were consecutively enrolled. The age range was 29–76 years. Thirty drivers were at high risk of OSA. Median ESS of the group was 2 (0–20). Forty-seven percent of the subjects at high risk of OSA failed in early reaction time test, while 28 % of the drivers with low risk of OSA failed (p=0.03). The obese drivers failed the peripheral vision test when compared with non-obese drivers (p=0.02). ESS was higher for drivers with a history of RTA when compared to those without RTA (p=0.02).
Conclusions Cognitive-psychomotor functions can be impaired in obese and high risk of OSA patients. In our opinion, requiring obese and/or high risk of OSA drivers to take PTAS tests that assess driving skills and psychomotor-cognitive functions crucial to those skills would significantly improve road traffic safety, which is of considerable importance to public health.

Keywords Obstructive sleep apnea · Berlin Questionnaire · Obesity · Daytime sleepiness · Road traffic accident · Driving performance

Introduction

Driving is a complex task that involves various perceptual, motor and cognitive processes and requires interaction with the road and the environment [1]. Findings reveal that road traffic injuries place a heavy burden on the health of the Turkish populace [2].

Falling asleep at the wheel is a significant cause of traffic accidents involving commercial drivers. Limitation of sleep leads to daytime sleepiness and impairment of psychomotor functions fundamental for drivers, such as alertness and reaction time. It was found that among Turkish public transport drivers, those with an accident in their past had significantly higher Epworth Sleepiness Scale (ESS) scores compared to those who did not [3]. Chronic sleep deprivation is one of the causes of traffic accidents and obstructive sleep apnoea

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(OSA), common among commercial drivers, is another [4, 5]. OSA is characterised by repeated complete or partial collapse of the upper airway during sleep. Micro-arousal and oxygen desaturation suffered by obstructive sleep apnoea syndrome (OSAS) patients are responsible for excessive daytime sleepiness (EDS), fatigue and lack of attention and concentration [6]. Beyond increasing the risk factor for accidents, OSAS causes deterioration of neurocognitive functions [7], which has a negative impact on driving performance. Obesity is a risk factor for OSA, as well as being an independent cause of sleepiness.

Driving simulator tests constitute a safe way of assessing driver behaviour that is both cost and time effective compared to on-road tests [8]. The purpose of this study was to identify obesity, EDS, OSA risk and road traffic accident (RTA) history among commercial vehicle drivers and investigate their relation to driving simulation performance undertaken as part of psycho-technical evaluation.

Methods

Commercial vehicle (truck, bus, minibus) drivers that consecutively applied to take a driving simulation test for psycho-technical evaluation and gave an informed consent, during a 1-year period, were included in this study. Socio-demographic data, anthropometric measurements (height, weight, neck circumference) and self-reported RTA histories were recorded. OSA risk was assessed with the Berlin Questionnaire (BQ) [9] that rates this risk according to answers given in three distinct categories, which are snoring, daytime sleepiness and/or fatigue and hypertension-obesity, while EDS was assessed with the Turkish version of the ESS [10] that consists of eight questions with a possible highest score of 24.

Psycho-technical assessment system (PTAS)

It is a computer-aided system consisting of various tests that objectively assess psychomotor and cognitive abilities necessary for driving. The system was jointly developed by TÜBİTAK (The Scientific and Technological Research Council of Turkey), Middle East Technical University (METU) and BİLTEN (Information Technologies and Electronics Research Institute) [11]. Psycho-technical assessments are made by qualified psychologists, who are employed at authorised centres formed within public or private establishments [12]. The primary reason for developing this system concerning commercial drivers was the introduction of a clause that obliges drivers whose licences were suspended due to demerit points, speeding or drunk driving to pass a computer-based psycho-technical assessment, in order to have their driving privileges reinstated. The other reason was to provide a scientific and practical contribution to the initiative to improve traffic safety and reduce traffic accidents in Turkey. Drivers involved in this study have undergone psycho-technical evaluation because in order to work in commercial vehicles for transportation of goods or people, the regulations stipulate them to obtain, every 5 years, a report documenting their physical and psycho-technical health, from an authorised medical institution.

Within this framework, drivers were tested in an approximately 60-min long driving simulation that employs a modular, computer-aided simulator of 160×97×190 cm dimensions (length × width × depth), weighing 120 kg. Before starting, each test was explained to the driver through the earpiece and a practice trial was made. The real test began once the trial was successfully completed and the driver was informed via the earpiece that the real test was starting. The purpose of this was to make sure that the participant had a clear understanding of the test.

PTAS tests

In PTAS, after each test, the number and ratio of correct, false and skipped answers were calculated and the points acquired were compared with the standards that vary according to age and level of education, resulting in an automatic assessment of good or poor performance.

First group of tests

Failing two or more of the tests described below, which were designed to assess cognitive abilities, is considered to indicate cognitive dysfunction.

Sustained attention test In this test that takes about 2.5 min, participants were asked to find a target shape that exists more than once in every row and to mark these from left to right. The numbers and ratios of correct, false and skipped answers were calculated to assess good or poor performance (Fig. 1).

General index of visual perception and memory test During this test, after being shown some images for 75 s, drivers were asked to mark with their pens the matching images they saw on the screen, within 15 s.

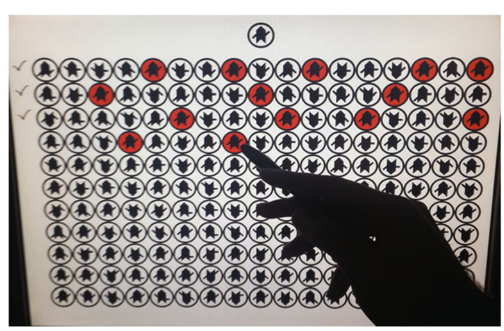

Fig. 1 Sustained attention test

Reasoning test In this test prepared like a puzzle, participants were asked to determine the rule in the presented example and apply that rule to find which shape would follow (Fig. 2).

Second group of tests

Tests below, which were designed to measure psychomotor abilities, consist of nine indices. Failure in four or more indices is assessed as a deficiency of psychomotor abilities.

Coordination test Drivers were asked to drive the vehicle on a narrow road, staying on the right lane throughout the test. This test concerns the total time spent off road in both high and low speeds and the number of off-road events. For high and low speeds and easy and difficult segments of the road, the amount of time the vehicle spent outside its designated lane, total time of lane variation, the number of times it took a dead-ending fork in the road and the number of times it went off lane to the right or to the left were assessed.

Speed-distance estimation test An arrow that moved with a fixed speed disappeared from the screen after a certain amount of time had passed. The driver was asked to press the button on the screen at the exact moment he thought that the arrow should have reached its destination. This test involved two components: the mean early reaction time and the mean late reaction time. For the assessment, points taken from the number of early and late reactions, as well as the means of early and late reaction times, were automatically calculated.

Reaction rate test In this test, whenever they saw a green circle on the screen, participants were asked to press a button on the corresponding side (left or right) of the steering wheel. Similarly they were asked to press either the left or the right side pedal whenever they saw a green square in a corresponding side of the screen. They were told to do nothing when they saw a red circle or a square. Average reaction rates were calculated separately for hands and feet, revealing whether these reflexes were poor or good.

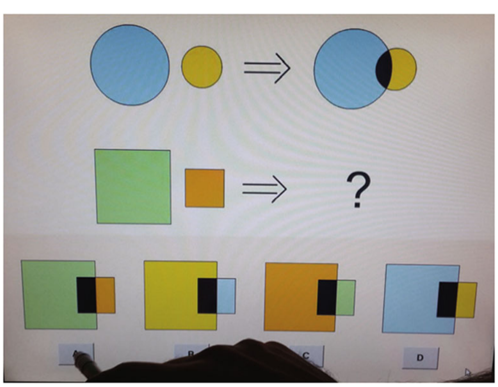

Fig. 2 Reasoning test

Peripheral vision test It consists of two components: number of correct answers on the panels and the main screen/panel index. Participants were required to do two tests simultaneously. In the first test, four squares at the centre of the screen became activated according to a predetermined order and the participants were asked to find the triangle that had the same colour as the activated square and mark it with their pen or by touching it. At the same time, they were asked to respond to arrows appearing on the side panels of the simulator by pressing either the left or the right pedal that corresponded to the panel on which the arrow appeared. The screen and the side panels acted independently of each other. The panels were arranged to allow for 140° field of vision and drivers were asked to stare only at their screens through this test.

Statistical analysis

Statistical analyses were performed on SPSS 22.0 statistical package program for Windows. Shapiro-Wilk test was used in order to test the normality of variables. Mann-Whitney *U* test was used to compare two groups. Categorical variables were compared using Pearson's chi-squared test, Fisher's exact test and Fisher-Freeman-Halton test. Logistic regression analysis was used to define risk factors for OSA and road traffic accidents (RTA). Significance level is defined as α=0.05.

Results

A total of 282 commercial vehicle drivers were consecutively enrolled. All of them were men, the age range was 29–76 years and 79 % of them had primary school education. Median duration of working as a commercial driver was 15 years. Mean body mass index (BMI) was 27.65±3.9 kg/m^2 and 28 % of participants had a BMI ≥30 kg/m^2, while the median neck circumference was 41 cm. Median ESS score was found to be 2 (0–20) for the drivers. According to the BQ that classifies OSA risk as high or low, 11 % were found to have high OSA risk. Of the 274 drivers for whom accident histories were obtained, 26 % were involved in traffic accidents (Table 1).

Compared to the other group, the group classified as high OSA risk was found to contain individuals who had worked as a commercial driver for a longer length of time, with higher BMIs, larger neck circumferences and higher ESS scores (p= 0.011, p<0.001, p<0.001, p=0.003, respectively) (Table 2). When the relationship between the PTAS parameters and the OSA risk was examined, it was found that the ratio of those with poor reaction times was 46.7 % for those with high OSA risk, while it was 28.1 % for those with low OSA risk [OR 2.23, 95 % CI (25–75: 1.03–4.02), p<0.03]. For high OSA risk drivers, the risk of failing the reaction time test was 2.23 times higher (Table 3). Multiple logistic regression analysis

Table 1 Characteristics of the drivers

Age [med (min–max)]		45 (29–76)
Gender		All men (n=282)
Education status	Primary school	79 %
	High school	18 %
	University	3 %
Driving experience duration (year)		15 (2–50)
Comorbidities	None	98 % (n=276)
	Diabetes mellitus	0.4 % (n=1)
	Hypertension	1.6 % (n=5)
Neck circumference med (min–max)		41 (34–50)
ESS score med (min–max)		2 (0–20)
BMI (mean, kg/m^2)		27.65±3.9
BMI	<30 kg/m^2 (n, %)	200, 72 %
	≥30 kg/m^2 (n, %)	78, 28 %
BQ	High risk (n, %)	30, 11 %
	Low risk (n, %)	250, 89 %
Past self-reported RTA	(+) (n, %)	72, 26 %
	(−) (n, %)	202, 74 %

ESS Epworth Sleepiness Scale, *BMI* body mass index, *RTA* road traffic accident, *BQ* Berlin Questionnaire

was performed in order to identify the independent determinants of OSA risk. Significant associations were found between OSA risk and obesity, ESS score and poor performance in reaction time test. These parameters were identified as independent determinants for high OSA risk (Table 4).

In the group with self-reported RTA, the median age and duration of working as a driver were found to be lower, compared to those with no accidents [41 (30–67) vs. 46 (29–76), p=0.003 for age; 14 (2–37) vs. 15 (2–50), p=0.005 for driving experience duration]. Neck circumference and ESS score were found to be significantly higher for drivers involved in accidents compared to those who were not [41 (35–47) vs. 41 (34–50), p=0.04 for neck circumference; 2 (0–19) vs. 2 (0–20), p=0.02 for ESS] (Table 2). Examining the correlation between PTAS performance and RTA history revealed that drivers without a past self-reported RTA performed poorer in speed-distance estimation test than those with a past accident [OR 2.50, 95 % CI (25–75: 1.34–4.68), p=0.003] (Table 5). The multivariate analysis indicated no significant relation between RTA history and speed-distance estimation test of the simulator. The ESS score was significantly higher for drivers with self-reported RTA in multivariate analysis. This association was found independent of high OSA risk, obesity, age, neck circumference, driving experience duration and failure of two of the PTAS tests (late reaction time, speed-distance estimation test) (Table 6). Seventy-two drivers had RTA history but no significant relationship existed between a past RTA and OSA risk (p=0.197).

It was found that obese drivers (BMI ≥30 kg/m^2) are older, have larger neck circumferences and have a longer duration of experience as commercial drivers when compared to non-obese drivers (BMI <30 kg/m^2) (p=0.001, p<0.001, p<0.001, respectively). No significant difference was observed among the obese and non-obese drivers, in terms of their ESS scores (p=0.918) (Table 2). Obese drivers were observed to have a significantly higher rate of failure in the peripheral vision test compared to those who were not obese [OR 2.78, 95 % CI (25–75: 1.1–6.9), p=0.02] (Table 5).

Discussion

In this study concerning commercial vehicle drivers in Turkey, by employing the BQ, a subjective yet well-accepted test, we have determined that 11 % of drivers had high OSA risk. Drivers with high risk of OSA and a traffic accident history were found to have significantly higher ESS scores compared to drivers with low OSA risk and those who had no past accidents, respectively. Yet, no significant correlation was found to exist between OSA risk and past RTA. In early reaction time test of the driving simulation, the failure rate was significantly higher for subjects with high OSA risk and this association was manifest in the multiple regression analysis as well. Although BMI was found to be higher for high OSA risk drivers, no relationship was observed between obesity and

Table 2 Comparison of RTA, OSA risk and obesity with driver characteristics

	RTA (+) n=72	RTA (−) n=202	p	BQ-HR n=30	BQ-LR n=250	p	BMI ≥30 n=78	BMI <30 n=200	p
Age	41 (30–67)	46 (29–76)	0.003	46 (32–76)	45 (29–68)	0.131	48 (33–68)	43 (29–76)	0.001
Driving experience duration	14 (2–37)	15 (2–50)	0.005	20 (3–40)	15 (2–50)	0.011	18 (5–50)	14 (2–40)	<0.001
Neck circumference	41 (35–47)	41 (34–50)	0.040	43 (37–50)	41 (34–49)	<0.001	43.5 (40–50)	40 (34–47)	<0.001
ESS score	2 (0–19)	2 (0–20)	0.022	3 (0–20)	2 (0–19)	0.003	2 (0–19)	3 (0–20)	0.918
BMI (kg/m^2)	26.8 (19–36)	27.6 (19–40)	0.224	32 (23–39)	26.8 (19–40)	<0.001	–	–	–

Data are given as median (min–max)

BQ-HR Berlin Questionnaire-high risk of OSA, *RTA* road traffic accident, *BQ-LR* Berlin Questionnaire-low risk of OSA, *BMI* body mass index

Table 3 Risk of OSA and driving simulation performance

	BQ-HR (*n*=30)	BQ-LR (*n*=280)	*p*	OR (95 % CI)
Sustained attention test failed	2 (6.7 %)	16 (6.4 %)	1	–
General index (GI) of visual perception and memory test failed	23 (76.7 %)	159 (63.9 %)	0.16	–
Reasoning test failed	5 (16.7 %)	64 (25.9 %)	0.26	–
Coordination test failed	2 (6.7 %)	21 (8.4 %)	1	–
Early reaction time test failed (one component of speed-distance estimation test)	70 (28.1 %)	14 (46.7 %)	0.03	2.23 (1.03–4.82)
Reaction rate test failed	9 (30 %)	75 (30.1 %)	0.98	–
Peripheral vision test failed	3 (10 %)	16 (6.4 %)	0.44	–
Total test failed	4 (13.3 %)	30 (12.1 %)	0.77	–

BQ-HR Berlin Questionnaire-high risk of OSA, *BQ-LR* Berlin Questionnaire-low risk of OSA

RTA history. However, in the peripheral vision test of the simulator obese drivers' performance was found to be significantly poorer. In the multivariate analysis that included age as a variable, no association was found between RTA and simulation parameters.

Two separate studies that took 500 truck drivers as their subjects found 22 and 56 % of drivers to have high OSA risk according to the BQ [13, 14]. Numerous studies have also identified a relationship between EDS, whatever its cause might be, and increased risk for RTA [15–18]. In the Edinburgh study [19], 20 % of 677 bus drivers were found to have ESS >10. Of the drivers taking part in that study, 80 % reported falling asleep at the wheel in the preceding month, and 7 % reported that they were involved in an accident. However, other studies exist which found no relation between high ESS scores and increased RTA risk [20–22].

The multivariate analysis made in our study revealed that for high OSA risk drivers, ESS score increased by a factor of 1.29. In this study, a correlation was found between self-reported RTA and ESS for commercial drivers; multivariate analysis has also shown a relationship between accident history and EDS. Ozoh et al. [7] have found OSA risk score to be positively correlated with the ESS for 500 commercial drivers. The said study has found high risk for sleep apnoea in half of the drivers and of those one fourth also had EDS. Akkoyunlu et al. [23] have determined that for subjects who drove within the city, those with a RTA history had a significantly higher level of EDS than those without.

Table 4 Determinants of OSA risk with multiple linear logistic regression analysis

	β	Standard error	*p*	OR
Age	−0.122	0.076	0.108	0.885
Neck circumference	−0.013	0.127	0.916	0.987
Driving experience duration	0.095	0.070	0.175	1.099
ESS score	0.261	0.111	0.019	1.298
Failed early reaction time test	1.315	0.635	0.038	3.726
BMI≥30 kg/m^2	2.299	0.775	0.003	9.962
RTA (+)	−0.576	0.788	0.465	0.562

ESS Epworth Sleepiness Scale, *BMI* body mass index, *RTA* road traffic accident

In this study, we have not found any correlation between OSA risk and RTA history. However, two substantial meta-analyses [24, 25] have clearly demonstrated increased traffic accident risk for OSAS patients. This risk was determined to be more profound for patients with severe OSAS. According to the Ward et al. [26] study involving 2673 patients, accident rates among untreated OSA patients were significantly higher relative to the general population. In the said meta-analysis [24], factors predictive of crash for OSA patients were BMI, apnoea-hypopnoea index (AHI), oxygen saturation and possibly EDS. In the light of these findings, the lack of a significant association between sleepiness scores and accident risk was attributed to the fact that OSAS patients demonstrate less variability in their ESS scores in comparison to the general population and to the possibility that the fear of permanently losing their licences might have led to a bias in drivers' answers. In another study similar to ours, in that the RTA history was based on self-reporting instead of official records, no direct relation was found between self-reported RTA history and OSA risk and ESS score [7]. This leads us to consider that the results might be biassed. While there are studies that demonstrate traffic accident rates to be not associated with severity of sleep disordered breathing [20, 27], a retrospective study made in Turkey [28] that involved patients with OSAS and simple snoring has shown that the accident risk increased 4.35-fold for mild and 6.59-fold for severe OSAS patients, as opposed to those with simple snoring.

In this study, no association was found between self-reported RTA history and obesity. However, rate of failure in peripheral vision test of the simulator was significantly higher for the obese. In a study of 56 patients referred to a trauma unit, following a motor vehicle accident, during a period of 5 months, BQ positive patients had significantly higher BMIs compared to BQ negative ones, as our study has also demonstrated [29]. Studies have shown that BMI values of subjects

Table 5 Association of self-reported RTA history with obesity and driving simulation performance

	RTA (−) (n=202)	RTA (+) (n=72)	p	OR (95 % CI)	BMI <30 (n=200)	BMI ≥30 (n=78)	p	OR (95 % CI)
Sustained attention test failed	13 (6.5 %)	5 (6.9 %)	1	–	12 (6 %)	5 (6.4 %)	1	–
GI of visual perception and memory test failed	131 (65.2 %)	47 (65.3 %)	0.98	–	123 (61.8 %)	56 (71.8 %)	0.11	–
Reasoning test failed	51 (25.6 %)	14 (19.4 %)	0.29	–	49 (24.9 %)	18 (23.1 %)	0.75	–
Coordination test failed	16 (8 %)	8 (11.1 %)	0.41	–	17 (8.5 %)	7 (9 %)	0.90	–
Speed-distance estimation test failed	84 (41.8 %)	16 (22.2 %)	0.003	2.5 (1.34–4.68)	70 (35.2 %)	28 (35.9 %)	0.90	–
Reaction rate test failed	62 (30.8 %)	20 (27.8 %)	0.62	–	54 (27.1 %)	29 (37.2 %)	0.10	–
Peripheral vision test failed	17 (8.5 %)	3 (4.2 %)	0.23	–	10 (5 %)	10 (12.8 %)	0.02	2.78 (1.1–6.9)
Total test failed	27 (13.5 %)	7 (9.7 %)	0.40	–	20 (10.1 %)	14 (17.9 %)	0.07	–

RTA road traffic accident, *BMI* body mass index

with a RTA history were significantly higher than those of subjects without past accidents [30, 31]. In yet another study [27], hypoxaemia and obesity and sleep disordered breathing were identified as risk factors for automobile accidents. Among obese drivers, accident rates are twice that of non-obese drivers. The same study suggests that the obesity classification may be a predictor for traffic accidents, with 49 % sensitivity and 71 % specificity. Analysing all the accidents for 783 drivers suspected of having OSA and the control group, Mulgrew et al. [21] have identified a small but statistically significant increase in the BMI values of the subset with past accidents.

Using multivariate analysis that included age as a variable, our study has found that for drivers with high OSA risk, early reaction time performance at the simulator was significantly poorer. Pichel et al. [32] have identified a significant relation between traffic accident history within the year prior to the study and poor tracking error performance. Juniper et al. [33] have found that for three road visibility scenarios, steering error, number of off-road events and mean reaction time performance were poor for the patients with OSAS. Barbe et al. [20] have determined that OSAS-diagnosed cases performed poorly in the simulator for reaction time, reaction fatigue and steer clear. The APPLES study [34] detected no association between neurocognitive performance and AHI. In the large cohort, analysed weak correlation was found between oxygen desaturation and deterioration of neurocognitive functions like intelligence, attention and processing speed.

Table 6 Determinants of self-reported RTA risk with multiple logistic regression analysis

	β	SE	p	OR
Age	−0.007	0.031	0.810	0.993
Neck circumference	−0.093	0.069	0.177	0.911
Driving experience duration	−0.037	0.033	0.258	0.964
ESS score	0.144	0.062	0.020	1.155
BQ-HR	−0.785	0.607	0.196	0.456
BMI ≥30 kg/m^2	0.261	0.424	0.538	1.298
Speed-distance estimation test failed	−0.484	0.418	0.246	0.616
Late reaction time test failed	−0.833	0.580	0.151	0.435

ESS Epworth Sleepiness Scale, *BMI* body mass index, *BQ-HR* Berlin Questionnaire-high risk of OSA

Our study has found RTA histories to be more common for the younger population. Consequentially, it was thought that the significantly worse performance of drivers without an accident history in speed-distance estimation test, and one of its important components, mean late reaction time, could be related to their age. The analysis that incorporates age has revealed no association between accident history and simulation parameters. In our study, no correlation was observed between ESS score and simulation parameters, either. For instance, multivariate analysis in the Turkington et al. [22] study found independent relationship between accident history and number of off-road events per hour. Similarly ESS score is independently correlated with both episodes of falling asleep at the wheel and near-miss accidents. Studies exist which reveal no correlation between severity of OSA and performance at the simulator [22, 32]. In those studies, the trial test was limited to a short time and it was stated that this short duration might have been insufficient for the practice run. By not limiting the time for the trial, our study has aimed to make sure the driver comprehended what was expected of him in the test. In Pizza et al. study [1], patients that reported EDS or a history of RTA were found to perform more poorly on the driving simulator. In a study [8] that aimed to compare the results of driving simulation with real-life driving, inappropriate line crossings were found to be significantly more frequent in the driving simulator than in real-life driving.

The present study is limited by certain constraints. Due to limited access to polysomnography (PSG), congestion at sleep laboratories and the high costs involved, PSG was not employed. Survey-based studies have low validity in OSA and BQ may not identify the sleep apnoea risk in some non-obese individuals. Subjective sleepiness tests may be unreliable due to commercial drivers being afraid of risking their licences, on which their livelihood depends. The results of these tests are instructive for identifying high-risk individuals for further examination and treatment. Furthermore in this study, RTA history is not based on official records but on drivers' reporting. It is possible that this might have led to a bias in the results. By providing a real motivation, real-world driving experiences prove to be superior to simulated driving performances. However, it should be remembered that the presence of an examiner watching the performance might help prevent accidents [35]. Since they provide a chance to assess the driving skills of certain groups of patients and are less dangerous, as well as less costly, driving simulators remain to be popular tools for research. Moreover, driving simulators become more and more realistic as time goes by [32].

This study is the first in Turkey to compare OSA risk, RTA history, obesity, EDS and PTAS (including driving simulator test) performance of commercial drivers. Subjective tests that assess OSA risk and EDS in drivers applying for commercial licences can be useful in identifying patients who need further examination for OSAS. In our opinion, requiring obese and/or high risk of OSA drivers to take PTAS tests that assess driving skills and psychomotor-cognitive functions crucial to those skills would significantly improve road traffic safety, which is of considerable importance to public health. Assessment and education programmes that will target high OSA risk, obese drivers, utilising driving simulators and simulating various different road conditions would play an important role in preventing OSAS-related traffic accidents, as well as assessing the cognitive and psychomotor functions of these individuals.

Conflict of interest The work has been seen and approved by all co-authors. The authors have no conflict of interest.

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