

Daytime Sleepiness Among Young Adult Omani Car Drivers

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النعاس النهاري بين الشباب البالغين سائقي المركبات في عمان

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ABSTRACT: Objectives: Sleepiness and fatigue play significant roles in exacerbating the occurrence of car crashes. However, there is a dearth of studies examining the prevalence of sleepiness while driving among Omanis. This study aimed to determine the proportion of young Omani adults who confess to daytime sleepiness while driving and to investigate associations between gender, daytime sleepiness and risk of obstructive sleep apnoea syndrome (OSAS). **Methods:** This cross-sectional study took place at the Sultan Qaboos University Hospital, Muscat, Oman, between May and July 2014 and included 600 young adult Omani non-commercial drivers. The Berlin Questionnaire and Epworth Sleepiness Scale (ESS) were distributed among the participants, along with additional questions about their sleeping habits. Associations between daytime sleepiness while driving and nocturnal sleep duration, risk of OSAS and gender were determined. **Results:** A total of 492 private vehicle drivers took part in the study (response rate: 82%), of which 50.4% were male. Overall, 124 Omanis (25.2%) reported experiencing daytime sleepiness while driving at least once per month. There was a significant association between nocturnal sleep duration of <6 hours and sleepiness while driving ($P = 0.042$). Female participants were significantly more likely to score >10 on the ESS, indicating a greater propensity for daytime sleepiness ($P = 0.006$). However, male drivers were significantly more likely to report sleepiness while driving ($P = 0.001$). **Conclusion:** Sleepiness while driving was common among young male drivers in Oman and might be due to nocturnal sleep deprivation. Further studies are needed so that preventative measures can be developed.

Keywords: Motor Vehicles; Traffic Accidents; Sleep; Fatigue; Obstructive Sleep Apnea Syndrome; Oman.

المخلص: يعتبر النعاس والإرهاق سبباً رئيسياً في وقوع حوادث المركبات، ومع ذلك، فإن هناك ندرة في الدراسات التي تُعنى بدراسة مدى انتشار النعاس أثناء قيادة المركبة بين العمانيين، لذلك هدفت هذه الدراسة إلى تحديد نسبة الشباب العماني الراشدين الذين يعترفون بإصابتهم بالنعاس أثناء القيادة فترة النهار وللتحقق من الترابط بين الجنس والنعاس النهاري وخطر متلازمة انقطاع التنفس أثناء النوم. **الطريقة:** أجريت هذه الدراسة المستعرضة في مستشفى جامعة السلطان قابوس بمسقط في عمان، بين مايو ويوليو 2014 وشملت عدد 600 من السائقين العمانيين الشباب الغير عاملين في مهنة سيطرة المركبات بشكل تجاري، تم توزيع استبيان برلين ومقياس إبورث لمقياس النعاس (Epworth Sleepiness Scale) على المشاركين، بالإضافة إلى أسئلة إضافية حول عادات نومهم، تم تحديد مدى الارتباطات بين النعاس أثناء فترة النهار أثناء قيادة المركبات ومدة النوم فترة المساء، وكذلك مخاطر متلازمة انقطاع التنفس أثناء النوم ونوع الجنس. **النتائج:** شارك في الدراسة ما مجموعه 492 من سائقي المركبات الخاصة (معدل الاستجابة: 82%)، منهم 50.4% من الذكور، وبشكل عام، أفاد 124 شاب عماني (25.2%) أنهم يعانون من النعاس خلال النهار أثناء القيادة مرة واحدة على الأقل كل شهر، وكان هناك ارتباط كبير بين مدة النوم الليلي الأقل عن 6 ساعات والنعاس أثناء قيادة المركبة ($P = 0.042$)، كما كانت المشاركات من الإناث أكثر احتمالاً بكثير في تسجيل معدل أكثر من 10 حسب مقياس إبورث لمقياس النعاس، مما يدل على زيادة الميل للإصابة بالنعاس أثناء فترة النهار ($P = 0.006$)، ومع ذلك، كان السائقون الذكور أكثر عرضة للإبلاغ عن النعاس أثناء القيادة ($P = 0.001$). **الخلاصة:** كان النعاس أثناء القيادة أمراً شائعاً بين السائقين الشباب الذكور في عُمان وربما يعود ذلك إلى نقص النوم أثناء فترة الليل، هناك حاجة إلى مزيد من الدراسات حول هذا الموضوع حتى يمكن وضع التدابير الوقائية اللازمة.

الكلمات المفتاحية: المركبات؛ حوادث المرور؛ نوم؛ إعياء؛ متلازمة توقف التنفس أثناء النوم؛ عمان.

ADVANCES IN KNOWLEDGE

- To the best of the authors' knowledge, this study is the first to illustrate the prevalence of sleepiness while driving among young adult Omanis. These findings may be of use in legislative and educational measures for road traffic safety and the prevention of motor vehicle crashes.

APPLICATION TO PATIENT CARE

- Sleepiness while driving can result in significant morbidity and mortality. As such, the results of this study may encourage physicians to refer sleepy drivers for further tests and early medical intervention.

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SLEEPINESS AND FATIGUE CAN DECREASE MENTAL alertness and increase the likelihood of errors and unintentional injuries among children, adolescents and adults.^{1,2} In particular, fatigue and daytime sleepiness have been shown to impair cognitive function while driving, which results in a higher risk of road traffic crashes.³ Extended work shifts can also disrupt the sleep-wake cycle and therefore heighten the risk of occupational injuries and motor vehicle crashes.⁴ In the UK, it is estimated that daytime sleepiness causes approximately 16% and 20% of all car crashes and those occurring on motorways, respectively.⁵

Nocturnal sleep deprivation and poor sleep hygiene are well-known causes of daytime sleepiness and tiredness, particularly among younger individuals.^{6,7} In addition to lack of sleep, there is evidence to suggest that sleep disorders such as obstructive sleep apnoea syndrome (OSAS) can trigger excessive daytime sleepiness.⁸ As such, patients with OSAS are at a 1.3–7-fold greater risk of having car crashes than the general population.^{8,9}

Car crashes are one of the most common causes of mortality and morbidity among young people in Oman, a country of approximately 4.5 million individuals.^{10,11} In a review of epidemiological studies available in the literature, the prevalence of excessive daytime sleepiness ranged between 4–20.6%, depending on the methods and definitions used.¹² However, no studies have yet been conducted in Oman to determine the prevalence of daytime sleepiness among young adult drivers. This study therefore aimed to determine the proportion of young Omani drivers who confess to daytime sleepiness and to study the association of certain key risk factors such as gender, OSAS, body mass index (BMI) and snoring.

Methods

This cross-sectional study was conducted among 600 young adults visiting the Sultan Qaboos University Hospital in Muscat, Oman, between May and July 2014. A systematic sampling technique was used to select every fifth Omani bystander or patient's relative between 20–40 years old passing through the main entrance of the hospital during outpatient clinic opening hours. There were 10 subjects approached per day for a total of 200 participants per month. Only apparently healthy individuals who drove non-commercial vehicles were included in the study. Subjects working night-shifts and commercial drivers (e.g. truck or taxi drivers) were excluded. In order to ascertain the prevalence of daytime sleepiness among young adult Omani drivers, the necessary sample size was determined based on a hypothesis testing a single proportion, with an alpha value set at 0.05 and a power of 80%. Based on the findings of an earlier

study in which 23% of drivers initially reported driving impairment due to sleepiness, daytime sleepiness while driving was assumed to be 26% in the current study, leading to a total required sample size of 369 drivers.³

Validated English or Arabic versions of the Epworth Sleepiness Scale (ESS) were distributed to the participants in order to determine daytime sleepiness.^{13,14} The ESS is scored on a 3-point Likert scale, with the total score ranging from 0–24; a propensity towards daytime sleepiness is indicated at scores of >10.¹³ Subsequently, participants were requested to complete either an English or Arabic version of the 10-item Berlin Questionnaire (BQ) to determine various symptoms of OSAS, such as the presence of snoring (category 1), daytime somnolence (category 2) and hypertension and high BMI (category 3).^{15,16} Participants were classified as being at either high or low risk of OSAS based on their responses to individual items and their overall BQ scores in each category, with those who scored positive in two or more categories classified as high-risk.¹⁵ The psychometric properties of the Arabic versions of both the ESS and BQ tools have been found to be adequate in Arab populations.^{14,16} In addition, participants were asked specific questions to gauge their average nocturnal sleep duration and the occurrence of daytime sleepiness over the preceding month. The height and weight of all subjects was also measured to calculate their BMI.

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), Version 21.0 (IBM Corp., Armonk, New York, USA). Summary stat-

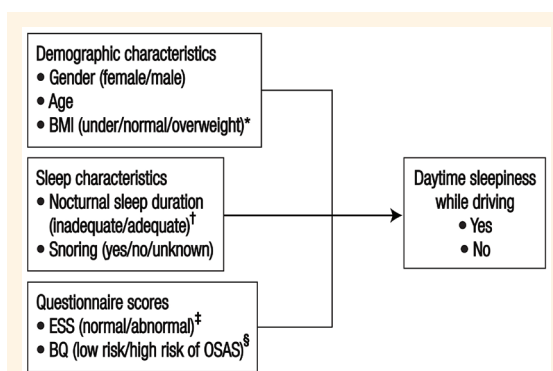


Figure 1: Diagram illustrating the various factors used in the current study to determine associations with daytime sleepiness while driving among young adult Omani drivers.

BMI = body mass index; ESS = Epworth Sleepiness Scale; BQ = Berlin Questionnaire; OSAS = obstructive sleep apnoea syndrome.

*BMI category was classified as underweight (<20 kg/m²), normal weight (20–25 kg/m²) or overweight (>25 kg/m²). [†]Nocturnal sleep duration was categorised as adequate (≥6 hours) or inadequate (<6 hours).¹⁷ [‡]ESS scores were categorised as normal (0–10) or abnormal (>10). [§]BQ scores were categorised as high risk of OSAS (positive scores in two or more categories) or low risk of OSAS (positive scores in one or zero categories).

Table 1: Prevalence of daytime sleepiness and nocturnal sleep deprivation according to gender among young adult Omani drivers (N = 492)

Factor	n (%)		P value
	Male drivers (n = 248)	Female drivers (n = 244)	
Mean age in years ± SD	30.0 ± 8.5	32.5 ± 5.0	<0.001
Mean BMI in kg/m ² ± SD	25.6 ± 4.0	24.6 ± 4.2	0.007
Daytime sleepiness while driving			
Yes	83 (33.5)	44 (18)	0.001
No	165 (66.5)	200 (82)	
Nocturnal sleep duration in hours			
<6	157 (63.3)	147 (60.2)	0.485
≥6	91 (36.7)	97 (39.8)	

SD = standard deviation; BMI = body mass index.

istics and two sample t-tests were computed and P values provided where appropriate. A Chi-squared test was used to determine associations between categorical variables such as age, gender, BMI, snoring, ESS scores, risk of OSAS and sleepiness while driving [Figure 1]. A cut-off time of 6 hours was deemed to indicate adequate nocturnal sleep, with anything under this deemed to constitute nocturnal sleep deprivation.¹⁷ The level of statistical significance was set at $P \leq 0.050$ ($\alpha = 0.05$).

This study was approved by the Medical Research & Ethics Committee of the College of Medicine & Health Sciences, Sultan Qaboos University (#MREC 963). Participants provided informed written consent prior to their enrolment in the study.

Results

A total of 492 drivers agreed to participate in this study (response rate: 82%). Of these, 248 (50.4%) were male and 244 (49.6%) were female. The mean age of the male drivers was 30.0 ± 8.5 years and the mean age of the female drivers was 32.5 ± 5.0 years. The mean BMI was 25.6 ± 4.0 kg/m² and 24.6 ± 4.2 kg/m² for male and female drivers, respectively. There were significant differences noted in terms of age and BMI according to gender ($P < 0.050$ each). Overall, 127 young drivers (25.8%) had experienced daytime sleepiness while driving. Male drivers reported significantly greater daytime sleepiness compared to females (33.5% versus 18%; $P = 0.001$). However, no gender difference was noted in terms of average nocturnal sleep duration [Table 1].

There was a significant association between daytime sleepiness while driving and nocturnal sleep deprivation

Table 2: Risk factors associated with daytime sleepiness while driving among young adult Omani drivers (N = 492)

Risk factor	Daytime sleepiness while driving, n (%)		P value
	Yes (n = 127)	No (n = 365)	
Nocturnal sleep duration in hours			
<6	88 (69.3)	216 (59.2)	0.041
≥6	39 (30.7)	149 (40.8)	
BMI in kg/m²			
<20	5 (3.9)	10 (2.7)	0.009
20–25	47 (37)	193 (52.9)	
>25	75 (59.1)	162 (44.4)	
Snoring			
No	67 (52.8)	268 (73.4)	<0.001
Yes	46 (36.2)	60 (16.4)	
Unknown	14 (11)	37 (10.1)	

BMI = body mass index.

Table 3: Associations between gender and Epworth Sleepiness Scale and Berlin Questionnaire scores among young adult Omani drivers (N = 492)

Score	n (%)		P value
	Male drivers (n = 248)	Female drivers (n = 244)	
ESS			
0–10	169 (68.1)	137 (56.1)	0.006
>10	79 (31.9)	107 (43.9)	
BQ			
High risk*	32 (12.9)	20 (8.2)	0.093
Low risk†	216 (87.1)	224 (91.8)	

ESS = Epworth Sleepiness Scale; BQ = Berlin Questionnaire.

*Positive scores in two or more categories. †Positive scores in one or zero categories.

($P = 0.041$), BMI ($P = 0.009$) and snoring ($P < 0.001$). Among those who reported sleepiness while driving, the majority had fewer than 6 hours of sleep per night (69.3%) and were overweight (59.1%). Furthermore, the proportion of those with daytime sleepiness was doubled among those who snored compared to those who did not snore (36.2% versus 16.4%) [Table 2]. Significantly more females than males were found to have a propensity towards daytime sleepiness as per their ESS scores (43.9% versus 31.9%; $P = 0.006$). However, although more males than females were categorised as at high-risk of OSAS based on their BQ scores, this difference was not significant (12.9% versus 8.2%; $P = 0.093$) [Table 3].

Table 4: Associations between daytime sleepiness while driving and Epworth Sleepiness Scale and Berlin Questionnaire scores according to gender among young adult Omani drivers (N = 492)

Score	Daytime sleepiness while driving, n (%)		P value	
	Yes (n = 127)	No (n = 365)		
ESS	Male		0.108	
	0–10	51 (61.4)		118 (71.5)
	>10	32 (38.6)		47 (28.5)
	Female			
BQ	Male		0.001	
	High risk*	19 (22.9)		13 (7.9)
	Low risk†	64 (77.1)		152 (92.1)
	Female			
BQ	Male		0.014	
	High risk*	8 (18.2)		12 (6)
BQ	Female		0.014	
	Low risk†	36 (81.8)		188 (94)

ESS = Epworth Sleepiness Scale; BQ = Berlin Questionnaire.

*Positive scores in two or more categories. †Positive scores in one or zero categories.

Overall, sleepiness while driving was significantly associated with ESS and BQ scores ($P = 0.023$ and <0.001 , respectively).

Female drivers who reported daytime sleepiness while driving had significantly higher ESS scores in comparison to those who did not report daytime sleepiness (61.4% versus 38.6%; $P = 0.010$). Moreover, in terms of BQ scores, there were significantly more women who reported daytime sleepiness at high risk of OSAS than at low risk (81.8% versus 18.2%; $P = 0.014$). Among the men who reported daytime sleepiness while driving, there was a significant association with BQ scores, with most being classified as low rather than high risk (22.9% versus 77.1%; $P = 0.001$) [Table 4].

Discussion

Sleepiness while driving is a leading cause of car crashes.¹⁸ The findings of the current study indicated that sleepiness while driving was fairly common among private car drivers in Oman, with just over one-quarter of the drivers reporting that they experienced daytime sleepiness while driving at least once a month. In addition, a significantly greater proportion of male drivers experienced daytime sleepiness while driving compared to females. Despite this, females had ESS

scores of >10 significantly more frequently. Therefore, young males were found to carry a higher risk of daytime sleepiness while driving compared to females, despite the latter having a greater propensity towards daytime sleepiness in general.

Multiple factors were observed to contribute to daytime sleepiness among drivers in the current study. Almost two-thirds of the sample had an inadequate nocturnal sleep duration of <6 hours per night, with a significant association between nocturnal sleep deprivation and daytime sleepiness while driving. A previous study found that 57.6% of Omani adolescents had fewer than 7 hours of sleep per night.¹⁹ This lack of sleep could be due to social- or work-related reasons, particularly in a society wherein most social events take place late at night.²⁰ Earlier research from other parts of the world has indicated that nocturnal sleep deprivation is an important contributing factor to car crashes; for example, Valent *et al.* found that sleep deprivation and long working hours increased the risk of car crashes in Italy.²¹ Philip *et al.* reported that sleep deprivation negatively affected the vigilance and concentration necessary for safe driving under both real-life and simulated conditions.²²

Almost half of the participants in the present study had an ESS score of >10, indicative of a greater propensity towards daytime sleepiness. There was also a significant association between sleepiness while driving and ESS score. These findings suggest that this scale could potentially be used as a screening tool to assess daytime sleepiness among driving licence aspirants. A study from the UK found that self-reported excessive daytime sleepiness was common among bus drivers, with 20% reporting an ESS score of >10 and 8% admitting that they had fallen asleep at the wheel within the previous month.²³ In a similar study, Anund *et al.* found that 19% of bus drivers in Sweden experienced severe sleepiness, to the point that the affected individual had to fight to stay awake while driving at least two or three times per week.²⁴

The BQ is a useful tool to screen for OSAS and has been used in previous epidemiological research targeting the Omani population.²⁰ Young *et al.* previously demonstrated that individuals with OSAS are at greater risk of having car crashes due to the symptoms of daytime sleepiness associated with the disorder.²⁵ In the present study, there was a significant association between being at high risk of OSAS, according to BQ score, and sleepiness while driving; however, the actual number of subjects who were at risk of OSAS was relatively low. This could be explained by the fact that the studied population was relatively young and most were not overweight, as both of these factors (i.e. older age and high BMI) are associated with OSAS.²⁶ Nevertheless, the prevalence of OSAS in this sample was 10.6%, which is within the range reported by previous research (9–24%).²⁵

This study was subject to certain limitations, particularly as the findings were based solely on self-reported data. Future research should be performed in which the drivers are asked to maintain sleep and driving diaries to report their level of sleepiness every day. Such an investigation could also include objective measures such as the duration, approximate temperature and time of day or night during which each drive takes place. Additionally, this study did not precisely quantify the frequency of daytime sleepiness among the studied drivers and relied on general questions regarding the drivers' perceptions of their average level of sleepiness while driving over the previous month. Further studies should be conducted including objective measures of daytime sleepiness, such as multiple sleep latency or maintenance of wakefulness tests. Nocturnal sleep duration should also be measured more precisely via actigraphy. Finally, instead of relying on BQ responses, participants could undergo polysomnography in order to determine OSAS risk.

Conclusion

This study revealed that daytime sleepiness was fairly common among young Omani drivers. Various characteristics were found to be associated with daytime sleepiness while driving, including gender, BMI category, nocturnal sleep deprivation and snoring. These relationships should be explored further using psychometric tests.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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