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KLİNİK ÇALIŞMA
RESEARCH ARTICLE

Assessment of the risk of obstructive sleep apnoea syndrome among healthcare workers

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SUMMARY

Assessment of the risk of obstructive sleep apnoea syndrome among healthcare workers

Introduction: *Sleep deprivation is known to increase the risks for workplace accidents, neuro-behavioural symptoms and reduced quality of life. Shift work leads to sleep related problems, such as sleep deprivation, poor sleep quality and daytime sleepiness. The purpose of our study is to assess snoring prevalence and obstructive sleep apnoea risk among healthcare workers (HCWs) by using the Berlin Questionnaire.*

Materials and Methods: *HCWs employed at different centres that agreed to take part in this study were enrolled. Employing the Berlin Questionnaire, demographic characteristics, smoking histories, comorbidities, on-call shifts, number of on-call shifts and sleep durations of the participants were surveyed.*

Results: *604 HCWs including specialist, nurse, junior doctor, medical student, clinical academic, health technician and hospital staff were enrolled in this study. In terms of sleep apnoea, 92 (15.1%) participants were identified as*

high-risk and 512 (84.8%) as low-risk according to the findings of the questionnaire. When the two groups identified as high and low risk for sleep apnoea according to the Berlin Questionnaire were compared, significant differences were found between the two groups in terms of age, sex, height, weight, BMI value and hypertension (p< 0.001 for all variables). Multivariate logistic regression analysis has shown that on-call shifts (OR= 0.199, CI= 0.053-0.747, p= 0.017) are negative associated with sleep apnoea risk.

Conclusion: *With extended working hours and on-call shifts increasing the risk of sleep disorders among HCWs, surveys designed for screening can be used to identify the prospective cases in this population for further examination.*

Key words: *Shift work; on-call shifts; healthcare workers; Berlin Questionnaire; sleep apnoea*

ÖZET

Sağlık çalışanlarında obstrüktif uyku apne sendromu riskinin değerlendirilmesi

Giriş: *Uyku yoksunluğunun kronik hastalıklar, iş kazaları, nöro-davranışsal semptomlar ve yaşam kalitesinde azalma riskini artırdığı bilinmektedir. Vardiyalı çalışma, uykusuzluk, yetersiz uyku kalitesi ve gündüz uyku hali gibi bazı uyku şikayetlerini tetiklemektedir. Çalışmamızın amacı, Berlin anketi uygulanarak sağlık çalışanlarında obstrüktif uyku apne riskini ve bu risk ile ilişkili faktörleri araştırmaktır.*

Materyal ve Metod: *Farklı merkezlerden çalışmaya katılmayı kabul eden sağlık çalışanları çalışmaya dahil edildi. Katılımcılara Berlin anketi uygulanıp; katılımcıların demografik özellikleri, sigara öyküsü, komorbid hastalıkları, nöbet şifti, nöbet sayısı ve uyku süreleri sorgulandı.*

Bulgular: *Çalışmaya uzman hekim, asistan hekim, akademisyen, tıp öğrencisi, hemşire, sağlık teknisyeni ve hastane personeli olmak üzere toplam 604 sağlık çalışanı dahil edildi. Anket sonuçları doğrultusunda katılımcıların 92 (%15.1)'si uyku apne bakımından yüksek riskli, 512 (%84.8)'si düşük riskli olarak değerlendirildi. Berlin anketine göre uyku apne riski olup olmadığına göre değerlendirildiğinde; yaş, erkek cinsiyet, boy, kilo, vücut kitle indeksi (VKİ) değerleri, obezite ve hipertansiyon varlığı bakımından iki grup arasında anlamlı farklılık bulunduğu saptandı (tüm değişkenler için p< 0.001). Çok değişkenli lojistik regresyon analizi, sağlık çalışanlarında nöbet şiftinin (OR= 0.199, CI= 0.053-0.747, p= 0.017) uyku apne riski ile negatif ilişkili olduğunu göstermiştir.*

Sonuç: *Sağlık çalışanlarının uzun çalışma saatleri ve nöbet programlarına bağlı olarak uyku bozukluğu gelişme riski olması nedeniyle tarama amacıyla kullanılan anketler kullanılarak bu popülasyonda ileri incelemeye aday olgular tespit edilebilir.*

Anahtar kelimeler: *Sağlık çalışanları; vardiyalı çalışma; Berlin anketi; uyku apnesi*

INTRODUCTION

Obstructive sleep apnoea syndrome (OSAS) is characterized by recurrent obstruction of the upper respiratory tract during sleep and is associated with episodes of arterial oxygen desaturation (1). OSAS leads to repeated arousals during the night and excessive sleepiness during the day (2). Its prevalence in the general population ranges from 6% to 17%, varying with sex and age (3).

Sleep deprivation is known to increase the risks for workplace accidents, neuro-behavioural symptoms and reduced quality of life (4,5). Healthcare workers (HCWs) may experience sleep deprivation due to unfavourable working conditions and sleep disturbances (6). Shift work leads to sleep related problems, such as sleep deprivation, poor sleep quality and daytime sleepiness (7). Studies have shown night shifts and sleep deprivation to be among the leading causes of medical errors, such as medication errors, medical device misuse, needle stick injuries, surgical errors and patient falls (8). Because sleep deprivation leads to lapses of attention and concentration, screening sleep disorders among HCWs, whose sleep durations get significantly shortened, is of utmost importance.

Although Polysomnography (PSG) is the gold standard in diagnosing OSAS, screening tests in the form of questionnaires are also widely used to assess risk groups (9). The Berlin Questionnaire was the first test used for OSAS screening (10). It is used as a tool to identify the factors that predict sleep disordered breathing and to categorize symptoms according to risk groups (11).

The purpose of our study is study is to assess snoring prevalence and obstructive sleep apnoea risk among HCWs and evaluating the associated factors by using the Berlin Questionnaire.

MATERIALS and METHODS

This cross-sectional survey was conducted with the approval of the Clinical Research Ethics Board of the Medical School of Uludağ University. HCWs

employed at different centres that agreed to take part in this study were enrolled between March 2017 and June 2017. Employing the Berlin Questionnaire, demographic characteristics, smoking histories, comorbidities, on-call shifts, number of on-call shifts per month and sleep durations (hrs/day) of the participants were surveyed. Our study was conducted in adherence to ethical values, in line with the Helsinki Declaration, by voluntary participation and informed consent.

Berlin Questionnaire

The Berlin Questionnaire consists of 10 questions in three categories. The first category questions the presence and characteristics of snoring, and whether arrest of respiratory airflow during sleep was witnessed by family members. The second category questions fatigue after awakening and during the day and whether the participant nodes off or falls asleep while driving, while the third questions the existence of hypertension and a BMI > 30. Each category is assessed on its own and if 2 or more categories result positive OSAS risk is considered to be high according to the Berlin Questionnaire.

Data Collection

HCWs that agreed to participate in this study have self-completed to the questionnaire and other relevant information with confidentiality.

Data Analysis

By using the SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) software for statistical analysis, sleep apnoea risk and its relationship to the socio-demographic and other probable factors were assessed. Those cases for which Type-1 errors were less than 0.05 were considered to be statistically significant. Shapiro Wilk test was used to assess variables conformance to normal distribution. Continuous variables were shown with mean ± standard deviation. Categorical variables were shown as n (%). Categorical variables for different groups were compared with the chi-square test, which was followed by multiple comparison procedures to identify the group(s) that were different. Mann-Whitney U test was used to compare two groups deviating from normal distribution according to the normality test, while independent samples t test was employed to compare parameters found to be of normal distribution. In terms of multivariate analysis, independent predictors of sleep apnoea risk were assessed with the logistic regression analysis of the probable factors identified by prior analyses. Hosmer-Lemeshov test was used for model data fit. A posteriori power analysis was performed for this study. With regards to sleep apnoea risk, the present study's power was calculated as 99.8% for the current sample size with 0.05 Type-1 error.

RESULTS

604 HCWs including specialist (29.3%), nurse (25.5%), junior doctor (18.7%), medical student (8.6%), clinical academic (7.6%), health technician (5.4%) and hospital staff (4.9%) were enrolled in this study. 850 HCWs were given questionnaires and 71% of them were completed. Demographic characteristics of the participants are summarised in Table 1. Their mean age was 34.94 ± 5.57 [20-80]. Most common seen comorbidities in HCWs were hypertension (9.4%), diabetes mellitus (3.5%), hypothyroidism (3.2%) and asthma (2.9%), respectively. Of the HCWs, while 352 (58.4%) worked on-call shifts, 252 (41.6%) did not. Among the participants that worked on call shifts, 172 (28.5%) took a day off after a 24-hours on-call shift, while 99 (16.4%) did not take off-days. Mean number of on-call shifts was 6.52 ± 3.20 per month. Table 2 summarises the distribution of the number of on-call shifts according to occupational groups. Mean BMI value was 24.84 ± 4.12 kg/m^2. Snoring symptom was found in 180 (29.8%) of the HCWs. Participants' answers to the Berlin Questionnaire are summarised in Table 3. In terms of sleep apnoea, 92 (15.1%) participants were identified as high-risk and 512 (84.8%) as low-risk according to the findings of the questionnaire. When the two groups identified as high and low risk for sleep apnoea according to the Berlin Questionnaire were compared, significant differences were found between the two groups in terms of age, sex, height, weight, BMI value and hypertension ($p< 0.001$ for all variables) (Table 4). No significant association was found with cumulative smoking, working on call shifts, frequency of on call shifts and sleep duration. Differences were found between occupational groups when these were assessed for sleep apnoea risk ($p= 0.001$). Subgroup analysis to determine which occupation was the source of the said differ-

Table 1. Socio-demographics of participants

	n= 604
Age (year)	34.94 ± 5.57
Gender (F/M)	362/242
Smoking	n (%)
Smoker	95 (15.7)
Exsmoker	24 (4)
Nonsmoker	485 (80.3)
Packs/year	10.88 ± 7.52
BMI (kg/m^2)	24.84 ± 4.12
Occupation	n (%)
Specialist	177 (29.3)
Nurse	154 (25.5)
Junior doctor	113 (18.7)
Medical student	52 (8.6)
Clinical academic	46 (7.6)
Health technician	32 (5.3)
Staff	29 (4.8)
Comorbidities	n (%)
Yes	68 (11.3)
No	536 (88.7)
On-call shift	n (%)
Yes	352 (58.4)
No	252 (41.6)
Duration of on call periods	n (%)
16 hrs	82 (13.6)
24 hrs	172 (28.5)
36 hrs	99 (16.4)
Number of on-call shifts (day/month)	6.52 ± 3.20 (1:20)
Duration of sleep	n (%)
<4 hrs	24 (4)
≥4 hrs	574 (96)
Duration of sleep (hrs/day)	6.99 ± 1.92

BMI: Body mass index.
Data were presented as mean ± st.deviation and n (%).

ence revealed that in comparison to medical students, specialist doctors and clinical academics had higher risk of sleep apnoea (p< 0.001, in both cases). Independent effects of age, sex, BMI, on-call shifts, duration of sleep, obesity and hypertension on sleep apnoea risk were analysed with a multivariate logistic regression model. This analysis has shown that on-call shifts (OR= 0.199, CI= 0.053-0.747, p= 0.017) are statistically significantly negative associated with sleep apnoea risk.

Table 2. Mean number of on-call shifts per month by occupation

	Number of on-call shifts (day/month)
Occupation	
Specialist	4.82 ± 3.01
Nurse	7.77 ± 2.83
Junior doctor	6.60 ± 2.44
Medical student	4.66 ± 2.25
Clinical academic	6.14 ± 3.48
Health technician	8.37 ± 4.39
Staff	7.91 ± 5.12

Data were presented as mean ± st.deviation (min: max).

DISCUSSION

Our study has found that in a population of healthcare workers, 15.2% had high risk for sleep apnoea and that age, gender, height, weight, BMI and hypertension were associated with this higher risk. Multivariate analyses have shown that working on-call shifts are negative associated independent variable for sleep apnoea risk.

Among the studies of the general population that have used the Berlin Questionnaire, sleep apnoea risk was found to be 4.98% by Amra et al., and 27.3% by Khazaei et al. (12,13). Examining the studies of sleep apnoea risk among HCWs reveals that by employing the Berlin Questionnaire, Geiger-Brown et al. found that 24% of the nurses working 12-hours night shifts had high sleep apnoea risk, while Seyedmehdi et al. identified this risk for 6,9% of all HCWs (14,15).

Our study has found that 29.8% of HCWs had snoring symptom. This rate was identified as 42.8% by Geiger-Brown et al. and 12.6% by Seyedmehdi et al. (14,15). Differences in these rates might be related to the differences in the mean age of each study's participants.

It is suggested that there exists an exaggerated blood pressure response to progressive hypoxemia in OSAS cases and that recurrent obstructive apnoea may induce hypertension by causing a chronic increase in sympathetic tone (16). Studies have shown that about 50% of OSAS patients have hypertension and about

Table 3. The healthcare workers' response to different parts of the Berlin Questionnaire

	The Healthcare Workers' Response (n= 604)	
Question	**Category-A**	**n (%)**
1. Do you snore during sleep?	a. Yes (1 point)	180 (29.8)
	b. No	368 (61.2)
	c. Don't know	54 (8.9)
2. Your snoring?	a. Slightly louder than your breathing	122(20.2)
	b. As loud as your speaking	77 (12.7)
	c. Louder than normal speaking (1 point)	27 (4.5)
	d. Very loud so that can be heard from the adjacent room (1 point)	5 (0.8)
	Did not answer	373 (61.8)
3. How often do you snore?	a. Almost every day (1 point)	42 (7)
	b. 3-4 times a week (1 point)	45 (7.5)
	c. 1-2 times a week	68 (11.3)
	d. 1-2 times a month	56 (9.3)
	e. Never or almost never	106 (17.5)
	Did not answer	287 (47.5)
4. Have you ever annoyed others by snoring?	a. Yes (1 point)	80 (13.2)
	b. No	146 (24.2)
	c. Don't know	378 (62.5)
5. Has anybody ever noticed your breathing interruption during sleep?	a. Almost every day (1 point)	7 (1.2)
	b. 3-4 times a week (1 point)	10 (1.7)
	c. 1-2 times a week	14 (2.3)
	d. 1-2 times a month	30 (5)
	e. Never or almost never	367 (60.8)
	Did not answer	176 (29.1)
	Category-B	
6. How often do you feel tired after sleep?	a. Almost every day (1 point)	139 (23)
	b. 3-4 times a week (1 point)	129 (21.4)
	c. 1-2 times a week	148 (24.5)
	d. 1-2 times a month	98 (16.2)
	e. Never or almost never	77 (12.7)
	Did not answer	13 (2.2)
7. Do you feel tired when you are awake?	a. Almost every day (1 point)	118 (19.5)
	b. 3-4 times a week (1 point)	146 (24.2)
	c. 1-2 times a week	156 (25.8)
	d. 1-2 times a month	106 (17.5)
	e. Never or almost never	61 (10.1)
	Did not answer	17 (2.8)
8. Have you ever gone to sleep while driving?	a. Yes (1 point)	85 (14.1)
	b. No	440 (72.8)
	c. Don't know	79 (13.1)
9. If yes, how often does it occur?	a. Almost every day (1 point)	5 (0.8)
	b. 3-4 times a week (1 point)	13 (2.2)
	c. 1-2 times a week	18 (3)
	d. 1-2 times a month	59 (9.8)
	e. Never or almost never	427 (70.4)
	Did not answer	82 (13.6)
	Category-C	
10. Are you suffering from high blood pressure or obesity (BMI > 30 kg/m^2)?	a. Yes (1 point)	73 (12.1)
	b. No	531 (87.9)
Presence of HT		57 (9.4)
BMI > 30 kg/m^2		66 (10.9)

Table 4. Association of obstructive sleep apnea risk with demographic factors and other possible factors

	OSAS		
	Risk exists (n= 92)	**No risk (n= 512)**	**p**
Age (year)	38.62 ± 9.40	34.29 ± 6.46	**< 0.001[a]**
Sex (F/M)	37/53	323/188	**< 0.001[b]**
Height (cm)	171.26 ± 9.23	167 ± 8.59	**< 0.001[c]**
Weight (kg)	82.87 ± 16.23	68.25 ± 13.20	**< 0.001[c]**
BMI (kg/m^2)	28.19 ± 4.90	24.2 ± 3.65	**< 0.001[a]**
Cigarettes (pkg/year)	13.7 ± 9.29	10.1 ± 6.81	0.089[a]
Number of on-call (day/month)	7.03 ± 3.77	6.42 ± 3.06	0.411[a]
Duration of sleep (hours/day)	6.85 ± 1.27	7.02 ± 1.21	0.199[a]
On-call shifts	62 (67%)	291(56.8%)	0.066[c]
Presence of Obesity	35 (53%)	31 (5.1%)	**< 0.001[b]**
Presence of HT	57 (9.4%)	0 (0%)	**< 0.001[b]**

OSAS: Obstructive sleep apnea syndrome; BMI: Body mass index.
Data were presented as mean ± st.deviation.
[a] Mann-Whitney U test, [b] Pearson chi-square test, [c] Independent samples t test.

Table 5. Multivariate logistic regression analysis of factors associated with the risk of OSAS

	p	**OR**	**95% CI**
Age	0.244	1.052	0.966-1.146
Sex (male)	0.051	3.562	0.992-12.788
BMI	0.833	1.028	0.792-1.335
On-call shift	**0.017**	0.199	0.053-0.747
Duration of sleep	0.671	1.108	0.689-1.1783
Obesity	0.991	-	-
Hypertension	0.994	-	-

OSAS: Obstructive sleep apnoea syndrome, BMI: Body mass index.

30% of hypertensive patients have OSAS (16-19). Obesity increases the disposition for OSAS (20). OSAS risk is 8 to 12 times higher for individuals whose BMI > 29 (21). In a survey conducted by Gislason et al. 29.6% of the participants reported snoring and 5.8% complained of daytime sleepiness, while both symptoms were found to be associated with the BMI (22). Our study has found hypertension and obesity to be associated with sleep apnoea risk.

In line with the findings of earlier studies, a direct relationship was found between age and sex and sleep apnoea risk in our study, which has indicated that this risk increases with aging (23-25).

When the sleep apnoea risks of participating HCWs were assessed with regards to occupational groups, specialists and academics were found to have higher risk than medical students. When compared to the medical students, the higher rate of sleep apnoea risk in this group might be due to the age difference that exists between the two groups.

Problems in falling asleep and maintaining it, along with excessive daytime sleepiness are more frequently encountered among smokers (26). It is also suggested that smoking compounds upper airway resistance by causing mucosal oedema and as such may intensify apnoea-hypopnoea (27,28). Numerous studies have reported that smoking causes sleep apnoea by inflaming the airways (29). However, despite finding higher sleep apnoea risk in the group with higher rates and longer duration of smoking, our study found smoking to bear no statistical significance. Bearing in mind that our population consists

of HCWs from the field of pulmonary medicine, this lack leads us to consider the possibility that some participants have denied being smokers and thus were assessed within the non-smoking group.

19.5% of this study's participants have reported feeling daytime fatigue and tiredness nearly every day, while 14.1% have reported excessive sleepiness and/or falling asleep at the wheel. Similar to our study, in the study conducted by Seyedmehdi et al. 22.6% of participants had reported feeling daytime fatigue and tiredness nearly every day, while 15.4% had indicated excessive sleepiness and falling asleep at the wheel (15). Left untreated, OSAS leads to disruption of work performance, as well as lapses of attention and concentration; identification of the population under risk among HCWs is of key importance.

Among a population of doctors and nurses, those cases with witnessed apnoea and daytime sleepiness were administered PSG by Soylu et al., who found OSAS prevalence at 4.7% and no association with on-call shifts (31). Similarly, applying the Berlin Questionnaire to the workers of a textile factory, Yazdı et al. found no difference between shift workers and non-shift workers in terms of sleep apnoea risk (32). The study conducted by Seyedmehdi et al., also found no association between on-call shifts and sleep apnoea risk (15). In contrast to these previous studies, by employing multivariate analyses, our study has identified on-call shifts to be a negative associated independent variable for sleep apnoea risk.

The fact that in a broad population of HCWs we were only able to identify high sleep apnoea risk cases with the Berlin Questionnaire, yet unable to definitively diagnose OSAS due to the high cost of PSG is a limitation of our study.

Disordered sleep is an important public health issue that reduces one's quality of life by adversely affecting productivity and performance. With extended working hours and on-call shifts increasing the risk of sleep disorders among HCWs, surveys designed for screening can be used to identify the prospective cases in this population for further examination.

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CONFLICT of INTEREST

The authors declare that they have no conflict of interest.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: All of authors.

Analysis/Interpretation: ÖAG

Data Acquisition: All of authors.

Writting: ÖAG, MK

Critical Revision: All of authors.

Final Approval: All of authors.

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