

## Research

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# Assessment of the Pittsburgh Sleep Quality Index among Physician's Speciality Who Work Night Shifts

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## ABSTRACT

**Objective:** As with other people, sleep quality has an impact on a physician's work safety. Aim of this study is determine the sleep quality among medical specialists whose working night shifts, and detect other independent factors that affect their sleep quality. This is essential for improving the physician health and their daily performance for patient care.

**Methods:** A qualitative study was design with a cross-sectional method. Sampling was conducted with stratification among night shift physicians who work in the emergency, internal medicine and surgical departments at an education and research hospital. Scores on the Pittsburgh Sleep Quality Index (PSQI) and the Swedish Demand-Control-Support Questionnaire (DCSQ) were assessed.

**Results:** One hundred eight physicians who worked night shifts responded to the questionnaire. The average age of the physicians was  $31.3 \pm 5.9$ , and 40.7% were women. The average PSQI score in male participants was significantly higher ( $8.1 \pm 3.7$  vs. female  $7.6 \pm 3.9$ ;  $p=0.014$ ). The majority of physicians (83.3%) had high PSQI values, i.e., scores of 5 or more. No significant difference was found in the average PSQI values between the emergency and internal medicine physicians and surgeons ( $p>0.05$ ). The most important factors that affected physicians' sleep quality were the number of night shifts per month, age, gender and the existence of a chronic disease.

**Conclusion:** The sleep quality of medical specialists who work night shifts is equally low. The existence of a chronic disease, age, gender and higher numbers of night shifts affect sleep quality as powerful independent factors.

**KEYWORDS:** Sleep quality; Sleep disorder; Medical specialties; Emergency physician; Night shift work

## INTRODUCTION

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Along with the scientific improvements, performance and wakefulness situations of mankind became more comprehensible. Sleep is not only a state of unconsciousness in which body rhythm is restored, but also, it is an unalterable and inevitable period of reconstruction and regain the energy for humans daily routine, as by physicians working on night shifts.<sup>1,2</sup> Therefore measure the quality of sleep is important for increase the productivity. The Pittsburgh Sleep Quality Index is a psychometric and nonpolysomnographic test, can be used to measure the sleep quality.<sup>3-6</sup>

Sleep health of a physician, as they are a part of the society and healthcare system, is very important. Sleep can affect, in short term quality of their work performance, and in long term the academic career and their health. Background studies mostly have assessed the effect of sleeplessness on the performance of physicians.<sup>7-10</sup> But the differences and effecting factors on the sleep quality between the specialties in medicine is not investigated. Emergency physician's sleep quality (who must passed all the night sleepless) compared to medical colleagues in other specialties are unknown. A qualitative data must be determined for follow the sleep quality and make an improvement in healthcare and patient outcome with the healthy physicians. These reasons led us to perform this study of physicians from different specialties working night shifts from a workload management perspective by assessing scores of sleep quality.<sup>11,12</sup>

The primary object in this study is to determine the sleep quality of nightshift worker physicians (emergency medicine, internal medicine and surgical branches) and to propound the meaningful differences. And the secondary object is to determine the factors, that could effect the sleep quality, originated from social life and working conditions. Than after the effecting factors are decided, can healthcare thinker give better policy for accomplish the objectives.

## METHOD

A qualitative study was design, which was cross-sectional conducted in January, 2014, was applied as a face-to-face questionnaire to nightshift worker physicians who were volunteers and are working at the third level health care.

### **Selection of Participants**

The study population is composed of 146 physicians who worked night shifts. Three strata were constituted; emergency, internal medicine branches and surgical branches with stratified sampling in population. All the emergency physicians were taken into study ( $n=37$ ), and samples were randomly chosen from internal (total  $n=39$ ; infectious disease, internal medicine, cardiology, neurology, pediatrics, or radiology), and surgical branches (total  $n=39$ ; neurosurgery, general surgery, orthopedics, otolaryngology, urology, ophthalmology, and anesthesiology): they were approached for participation from the monthly night on-call list which was prepared double blind.

### **INTERVENTIONS**

Besides the demographical data (age, sex, years employed in work, chronic disease, sleep problems), physicians were administered the Pittsburgh Sleep Quality Index (PSQI) and the Swedish Demand Control Support Questionnaire (DCSQ).<sup>3-6</sup> Approval from Katip Çelebi University Medical School ethics committee was obtained before commencement of the investiga-

tion. Physicians were illuminated with informed consent form before they agree their consent to the study. Emergency medicine physicians worked a 16-hour night shift (4 p.m. to 8 a.m.) whereas those from other physicians worked a 32-hour shift (8 a.m. until 4 p.m. the next day). Other than emergency physicians have had a small sleepy time period in the late night and were on call.

Sleep quality was measured with PSQI questionnaire, consists of 19 questions. PSQI assesses the sleep quality with questions asked under 7 different components (subjective sleeping quality, sleep latency, sleeping time, habitual sleep efficiency, sleep disorders, usage of sleeping pills and daytime dysfunctions). Each question was given a score interval of 0-3. Points of 7 components were collected. If total score are 5 or more, the sleeping quality was considered to be low. Study of validity and reliability of the scale in Turkish was conducted before.<sup>4</sup>

## OUTCOMES

Primary outcome of the study is to assess the sleep quality among night shift worker physicians with PSQI. Secondary outcome is determining the other factors that can affect the sleep quality such as from social live or workplace. This paper focuses on the results of the PSQI; the results DCSQ will be published in a separate research paper.

## ANALYSIS

Statistics were assessed in the software of Statistics Package for Social Sciences (SPSS for Windows Ver. 20.0, SPSS Inc., IL. USA). Homogeneity of variables and normalcy of distribution were assessed by histogram. Mann-Whitney U and Kruskal-Wallis significance tests were used for the comparison of dependent and independent variables. Independent variables with pearson correlation less than 0.50 were taken into multiple regression model as a result of normative correlation. Quantitative data were given as percentage (%) and qualitative data as mean  $\pm$  Standard Deviation (SD). Statistically analysis value of  $p<0.05$  was accepted to be significant by confidence interval of 95%.

## RESULTS

115 physicians were taken into study (78.8% of night shift worker physician). While, two declined to participate, and the questionnaires of five physicians were incomplete, thus data from 108 physicians were evaluated. Mean age of the participants was  $31.3\pm5.9$  (25-52 years), 40.7% were women and 21.3% were specialists and associate professors. In responses to socio-demographic questions, 84.3% of the physicians did not state any complaints of sleeping problem, 9.3% had restless leg syndrome and 0.9% had sleep apnea. Other socio-demographic properties were shown in table 1 and table 2.

Socio-Demographic Factors (n=108) Mean±SD or %	PSQI total score p
Age; Under 31 years of 65.7% Mean 31.3±5.9 (25-52 years)	=0.001
Sex; female of 40.7% Female's mean PSQI: 7.6±3.9 Male's mean PSQI: 8.1±3.7	>0.05
PSQI total score of Resident 7.3±2.9 vs. Faculty physician 8.1±3.1	>0.05
Years employed in work 0-4 years: 50.0% 5-9 years: 30.6 % 10-14 years: 11.1% ≥15 years: 8.3%	>0.05
Average time spent with a patient /hour < 30 min: 43.5% 30 min-1 hour: 28.7% 1-hour: 11.1% >2hour: 16.7%	>0.05
Average sleeping time (hour): 5.6±1.4 (min-max:5.4-5.9) Emergency physician: 5.7±1.8 (5.1-6.3) Internal branches: 5.4±1.1 (5.0-5.8) Surgical branches: 5.9±1.1 (5.4-6.2)	>0.05
Chronic Diseases (Marked more than one) None: 63.0% HT 1.9% Lung Disease 0.9% Depression, anxiety, or psychotic disorders 17.5% Hypothyroidy, Diabetes or obesity 6.5% Sleep disorder 15.7% Other (loss appetite, rash, pruritus, dyspepsia) 6.5%	<0.001
Complaints of sleep disorder None: 84.3% Sleep disorder: Restless leg syndrome 3.7% Sleep latency 9.3% Other; obstructive apnea, oversleeping 2.7%	>0.05

**Table 1:** Socio-demographic and work properties and the significance of the PSQI total score.

Factor	Factor compared with 3 speciality group's p
PQSI total score: 7.9±3.8 (7.1-8.6)* Emergency physician: 8.21±3.9 (6.9-9.5) Internal branches: 8.63±3.9 (7.3-10.0) Surgical branches: 6.69±3.4 (5.5-7.8) 75% of employer's sleep were below 6.0 hour/night	>0.05
More than 4 night shift/month Emergency medicine 68% Internal Branches 3% Surgery %33	<0.001
Marital status: Single 44.4% Married 31.5% Married and have children 20.4% Widow 3.8%	>0.05
Habits out of routine in the night shift work Coffee or tea more than 2 glasses 54.6% Cigarette 21.3% None 7.4% Routine 16.7%	>0.05
Irregularity in self-care None 38.0% Positive: Postponing the need to use the toilet 32.3% Negligence in personal hygiene for sleep 19.4% Other: bath, and all of the above 11.3%	>0.05
Social inhibition None %25.9 Positive: Social activity (cinema, theater etc.) 13.9% Visiting friends and relatives 13.0% Conflict with family 25.2% All of the above %25.0	>0.05
Sick leave: None (75.9%) Leave: 1-3 days (13.9%) 4-14 days (10.3%) ≥15 days (1.9%)	>0.05

**Table 2:** PSQI and Socio-demographic properties among 3 group of physician's specialty.

## DISCUSSION

Total average of PSQI was 7.9±3.8 (interval 4-18). Physicians of 83.3% had a bad PQSI total score ( $\geq 5$ ). No difference between specialists and resident physicians was found with regard to sleep quality (mean PSQI total score 7.3±2.9 vs. 8.14±3.79,  $p>0.05$ ). No significant difference was found between total average point of PSQI and specialty groups of physician ( $p>0.05$ ) (Table 1). Emergency physicians were compared to other specialties by PSQI total point, no significant difference was detected (Table 3). Correlations with factors lower than 0.5 were sex, age, number of night shifts in a month and existence of a chronic diseases besides physician's specialty, found to be strong determining factors in PSQI total scores (95% CI, constant total PSQI values, Models 1 and 2,  $p<0.05$ ,  $R^2=0.12$  and 0.16 and Durbin Watson=1.97) (Table 4A and Table 4B).

Factors affecting the sleep quality are sleep time during

		PSQI total scope		Total
		0-4	>=5	
Group	Emergency Physicians	7 (18.9%)	30 (81.1%)	37 (100.0%)
	Internal medicine and Surgery	11(15.5 %)	60 (84.5%)	71 (100.0%)
Total		18 (16.7%)	90 (83.3%)	108 (100.0%)

Odds R=1.3, %95 CI;0.3-2.2, p>0.05

**Table 3:** Distribution of PSQI total component by points between emergency physician and other specialties.

Pearson Correlation	PSQI total point	Age	Sex	3 specialty groups	Chronic Disease
Age	,016				
Sex	,064	,101			
3 specialty groups <sup>c</sup>	-,163 <sup>a</sup>	-,191 <sup>a</sup>	-,180 <sup>a</sup>		
Chronic Disease	,357 <sup>b</sup>	,198 <sup>a</sup>	-,040	-,183 <sup>a</sup>	
Number of night shifts/month	,190 <sup>a</sup>	-,253 <sup>b</sup>	,069	-,414 <sup>b</sup>	-,066

a<0.05, b<0.01, c=Groups:Emergency, Internal Medicine and Surgery

**Table 4A:** Correlations (4A) among the variables and Regression (4B).

Variable	Model 1*		Model 2**	
	B	B	B	B
Age	-0.057		-0.003	
Sex	0.079		0.065	
3 Specialty groups	-0.101		-0.008	
Cronic Desease <sup>a</sup>	0.42		0.43	
Number of nightshift /month <sup>b</sup>	-		0.96	
Constant	6.91		4.88	
F	15.45		10.97	
R <sup>2</sup>	0.119		0.157	

a: p<0.001, b: p<0.05, Durbin Watson=1.97

\*Model 1 (4 variable) Predictor: Cronic disease,(95% CI for B=0.2-0.6)

\*\*Model 2 Predictor: Cronic diseas and number of nightshift/month (95% CI for B=0.2-1.8)

**Table 4B:** Regression estimates for PSQI total point.

laying on bed (in percentage and duration) and number of awaking and disruption from sleep.<sup>19,20</sup> But for emergency physicians compared to other's night shift, sleeping is mostly impossible and they must be awake whole the night. Even one single disrupt from sleep can drop the sleep quality can cause sleepiness during the day and decrease in performance. In case of recurrence this leads to sleep withdrawal.<sup>19,20</sup> Sleep withdrawal have negative effects on cognitive functions.<sup>11,21-25</sup> Accidents, death risk and hazardous effects on psychological and physical health have been seen as consequences of sleep withdrawal.<sup>21-23</sup> Sleep withdrawal can cause sleep diseases by accumulating and symptoms

such as sleep apnea and involuntary leg movements.<sup>1,2,19-23</sup> Also, it was mentioned that poor sleep hygiene is a part of sleep disorder stated under insomnia.<sup>2</sup> In our questionnaire research, sleeping time was found to be below 6 hours in 65.7% of participants. Symptoms of sleep withdrawal such as restless leg syndrome and sleep apnea were on our physicians. The call of nature sleep hygiene was neglected, too.

Mortality and morbidity have connection with sleeping time.<sup>26,30</sup> Blood pressure and cardiac vascular structure might be negatively affected due to hypoxemia, and respiration re-

sponse to hypercarbia in sleep withdrawal syndromes was found decreased.<sup>26-30</sup> Sleeping 5 hours compared to 7, risk of acute myocardial injury, cerebrovascular event and angina was found 2.2 times more.<sup>30</sup> 40 hours of sleeplessness increases the energy need of body 32%, and then decreases it 4% according to basal.<sup>31</sup> In our study, rate of occurrence of at least one chronic disease by night shift physicians was found 37%, despite low mean age. Depressive and psychotic diseases could be common. It is essential to consider this subject, especially, in terms of "burn out". Literature demonstrated that the rate of "burn out" with low sleeping quality came out high.<sup>8,32</sup> Depending upon sleep withdrawal, heat regulation of body changes, circadian rhythm breaks down, immune disorders, sleeping disease, obesity and endocrinological problems might occur.<sup>33</sup> In PSQI questions for heat changes in our questionnaire research, the physicians stated that they experienced chill during sleep once a week or more were determined to be 32.4% and those who felt increase in heat were to be 21.3%. Physicians' endocrinological problems represented 6.5% of them. Hence in this study was found, existence of chronic diseases is an important independent factor which determines the sleep quality in night shift worker physicians.

Basic on literature is clear, that regulating the working hours, including education, with law and joint councils due to negative effects of night shift worker is a necessity.<sup>16-18</sup> Suggestion is physicians won't be pass 80 hours in a week and 16-30 hours at once a shift. Thus, sleep withdrawal, medical mistakes and accidents can be avoided. On the other hand, this suggestion hinders medical studies which require a long process, including education, and patient care.<sup>34</sup> It can take more shift number in a month. But, this study suggest that more night shifts number in a month will more overcome decrease in sleep quality.

Our questionnaire study is significant in recognition of stating the PSQI level between physician's specialties by night shift worker. There aren't many data on this subject in international literature. Average score of PSQI was stated to be  $6.96 \pm 3.19$  in anesthesia residents, and  $7.32 \pm 3.42$  in nurses from Turkey.<sup>6,35</sup> The PSQI level of paramedics in international studies was detected  $6.9 \pm 0.6$ .<sup>5</sup> This study reveal, that sleep quality do not change on physicians specialty or profession in work (both in residents and attending physicians). Despite participants had lower complaints of sleep disorder, sleep quality was found to be unwell. This situation shows that physicians suffered from sleep withdrawal are not aware of their poor sleep quality. In this state, others care will be badly affected as a result of reduced performance. In this study we found the disarray in physicians sleep quality was independent from their productivity and habits in social and work life (number of patient care, consumption of coffee and tea, conflict with family, low social activity). Just the night shift seems to be the problems of poor sleep quality. Therefore we recommend that physicians may have to spend a short sleepy period during the night shifts.

A strong connection was found in the modeling design

in night shift physicians between sleep quality and their chronic diseases, number of nightshifts in a month, age, sex and specialty. Chronic diseases in participant physicians were determined to be hypertension, endocrine disease, depression and obesity. This result provides the preception that sleeplessness will directly affect the physician's health and therefore their productivity.

Why wasn't a meaningful difference on sleep quality among speciality groups is an interesting point. In generally accepted application in Turkey, emergency physicians work 16 hours at night shift and rarely on 14-24 hours midshifts. Other branch physicians usually work 30 hours without a break, but have mostly a short sleep period in the night. For education are emergency medicine residents and instructors 32 hour in work (once in a week). The exposure of sleep withdrawal seemed to be the same, according to PSQI results. But, similarity of sleep quality of physicians in the three specialty groups might be a result of similarly arduous workload they had. Probably they might be stress caused by night shifts.<sup>31</sup> Emergency physicians are far more likely to see over 60 patients in a shift which is half the length and much more likely to work over 9 shifts per month. We have assessed the stress level of the night shifts physician with DCSQ too, and will give the results in a separate paper. The working conditions on night shifts seems to be hard in emergency medicine, at least as in other physician specialty groups.<sup>16,32</sup> When health care managers want to improve working standards for night shift worker physicians, they could assess the sleep quality and their healthy.

#### Limitations

This study is conducted in a single-center. But a big sample was being better to detect more details. Most participants were residents of the specialty programs naturally. A questionnaire of sleep quality by nightshift worker compared on non night shift worker physician should be done further.

#### Generalizability

We believe that our results can be valuable to other physician-staffed hospital services as well as when comparing the sleep quality by PSQI, especially by emergency physicians with different hospital systems and different staffing. Assessing sleeping quality with scoring method is suitable.

#### Conclusion

Sleeping quality of night shift worker physicians is equally low in all specialties. Disarray in physicians sleep quality pointed as a problem, which might affect their performance, health, labor force and academic success. All medical professions should be informed on sleep disorders and factors affecting it. It is important to eliminate the manageable factors for the productivity and safety of the health professions.

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**REFERENCES**

1. American Academy of Sleep Medicine. International classification of sleep disorders, 2.second ed. Diagnostic and coding manual. Westchester, Illinois: American Academy of Sleep Medicine; 2005.
2. American Academy of Sleep Medicine. ICSD-2 - International classification of sleep disorders, 2nd ed. Diagnostic and coding manual. American Academy of Sleep Medicine; 2005.
3. Buysse DJ, Reynolds CF, Monk TH, Hoch CC, Yeager AL, Kupfer DJ. Quantification of subjective sleep quality in healthy elderly men and women using the Pittsburgh Sleep Quality Index (PSQI). *Sleep*. 1991; 14(4): 331-338.
4. Agargun MY, Kara H, Anlar O. The validity and reliability of Pittsburgh Sleep Quality Index [in Turkish]. *Turkish Journal of Psychiatry*. 1996; 7: 107-115.
5. Demiral Y, Ünal B, Kılıç B, et al. Validity and reliability of job stress questionnaire in İzmir-Konak municipality workers [in Turkish]. *Toplum HB*. 2007; 26:11-18.
6. Karasek R, Baker D, Marxer F, Ahlbom A, Theorell T. Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. *Am J Public Health*. 1981; 71: 694-705.
7. Patterson PD, Weaver MD, Frank RC, et al. Association between poor sleep, fatigue, and safety outcomes in emergency medical services providers. *Prehosp Emerg Care*. 2012; 16(1): 86-97. doi: [10.3109/10903127.2011.616261](https://doi.org/10.3109/10903127.2011.616261)
8. Zencirci AD, Arslan S. Morning-evening type and burn-out level as factors influencing sleep quality of shift nurses: a questionnaire study. *Croat Med J*. 2011; 52(4): 527-537. doi: [10.3325/cmj.2011.52.527](https://doi.org/10.3325/cmj.2011.52.527)
9. Smith-Coggins R, Howard SK, et al. Improving alertness and performance in emergency department physicians and nurses: the use of planned naps. *Ann Emerg Med*. 2006; 48: 596-604. doi: [10.1016/j.annemergmed.2006.02.005](https://doi.org/10.1016/j.annemergmed.2006.02.005)
10. Smith-Coggins R, Rosekind MR, Hurd S, Buccino KR. Relationship of day versus night sleep to physician performance and mood. *Ann Emerg Med*. 1994; 24: 928-934. doi: [10.1016/S0196-0644\(94\)70209-8](https://doi.org/10.1016/S0196-0644(94)70209-8)
11. Machi MS1, Staum M, Callaway CW, et al. The relationship between shift work, sleep, and cognition in career emergency physicians. *Acad Emerg Med*. 2012; 19: 85-91. doi: [10.1111/j.1553-2712.2011.01254.x](https://doi.org/10.1111/j.1553-2712.2011.01254.x)
12. Lockley SW, Barger LK, Ayas NT, Rothschild JM, Czeisler CA, Landrigan CP. Effects of health care provider work hours and sleep deprivation on safety and performance. *Jt Comm J Qual Patient Saf*. 2007; 33(11): 7-18.
13. Bonnet MH, Arand DL. We are chronically sleep deprived. *Sleep*. 1995; 18: 908-911.
14. Landrigan CP, Rothschild JM, Cronin JW, et al. Effect of reducing interns' work hours on serious medical errors in intensive care units. *N Engl J Med*. 2004; 351: 1838-1848. doi: [10.1056/NEJMoa041406](https://doi.org/10.1056/NEJMoa041406)
15. Saricaoglu F, Akinci SB, Gözaçan A, Güner B, Rezaki M, Aypar Ü. The Effect of Day and Night Shift Working on the Attention and Anxiety Levels of Anesthesia Residents. *Turkish Journal of Psychiatry*. 2005; 16(2): 106-112.
16. Frank JR, Ovens H. Shiftwork and emergency medical practice. *CJEM*. 2002. 4(6): 421-428.
17. Landrigan CP, Fahrenkopf AM, Lewin D, et al. Effects of the accreditation council for graduate medical education duty hour limits on sleep, work hours, and safety. *Pediatrics*. 2008; 122(2): 250-258. doi: [10.1542/peds.2007-2306](https://doi.org/10.1542/peds.2007-2306)
18. Kramer KM. Sleep loss in resident physicians: the cause of medical errors? *Front Neurol*. 2010; 1: 128. doi: [10.3389/fneur.2010.00128](https://doi.org/10.3389/fneur.2010.00128)

19. Martin SE, Engleman HM, Deary IJ, Douglas NJ. The effect of sleep fragmentation on daytime function. *Am J Respir Crit Care Med.* 1996; 153: 1328. doi: [10.1164/ajrccm.153.4.8616562](https://doi.org/10.1164/ajrccm.153.4.8616562)
20. Martin SE, Wraith PK, Deary IJ, Douglas NJ. The effect of nonvisible sleep fragmentation on daytime function. *Am J Respir Crit Care Med.* 1997; 155: 1596. doi: [10.1164/ajrccm.155.5.9154863](https://doi.org/10.1164/ajrccm.155.5.9154863)
21. Inges DF, Kribbs NB. Performing while sleeping: effects of experimentally induced sleepiness. In: Sleep, sleepiness, and performance, Monk TH. (Ed). Chichester, UK: Wiley & Sons; 1991: 97-128.
22. Van Dongen HP, Baynard MD, Maislin G, Dinges DF. Systematic interindividual differences in neurobehavioral impairment from sleep loss: evidence of trait-like differential vulnerability. *Sleep.* 2004; 27: 423-433.
23. King AC, Belenky G, Van Dongen HP. Performance impairment consequent to sleep loss: determinants of resistance and susceptibility. *Curr Opin Pulm Med.* 2009; 15: 559. doi: [10.1097/MCP.0b013e3283319aad](https://doi.org/10.1097/MCP.0b013e3283319aad)
24. Lim J, Dinges DF. A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychol Bull.* 2010; 136: 375-389. doi: [10.1037/a0018883](https://doi.org/10.1037/a0018883)
25. Tucker AM, Whitney P, Belenky G, Hinson JM, Van Dongen HP. Effects of sleep deprivation on dissociated components of executive functioning. *Sleep.* 2010; 33: 47-57.
26. Spengler CM, Shea SA. Sleep deprivation per se does not decrease the hypercapnic ventilatory response in humans. *Am J Respir Crit Care Med.* 2000; 161: 1124-1128. doi: [10.1164/ajrccm.161.4.9906026](https://doi.org/10.1164/ajrccm.161.4.9906026)
27. Phillips BA, Cooper KR, Burke TV. The effect of sleep loss on breathing in chronic obstructive pulmonary disease. *Chest.* 1987; 91: 29-32. doi: [10.1378/chest.91.1.29](https://doi.org/10.1378/chest.91.1.29)
28. Knutson KL, Van Cauter E, Rathouz PJ, et al. Association between sleep and blood pressure in midlife: the CARDIA sleep study. *Arch Intern Med.* 2009; 169: 1055-1061. doi: [10.1001/archinternmed.2009.119](https://doi.org/10.1001/archinternmed.2009.119)
29. King CR, Knutson KL, Rathouz PJ, Sidney S, Liu K, Lauderdale DS. Short sleep duration and incident coronary artery calcification. *JAMA.* 2008; 300: 2859-2866. doi: [10.1001/jama.2008.867](https://doi.org/10.1001/jama.2008.867)
30. Sabanayagam C, Shankar A. Sleep duration and cardiovascular disease: results from the National Health Interview Survey. *Sleep.* 2010; 33: 1037-1042
31. Jung CM, Melanson EL, Frydendall EJ, Perreault L, Eckel RH, Wright KP. Wright Energy expenditure during sleep, sleep deprivation and sleep following sleep deprivation in adult humans. *J Physiol.* 2011; 589(1): 235-244. doi: [10.1113/jphysiol.2010.197517](https://doi.org/10.1113/jphysiol.2010.197517)
32. Lee YK, Lee CC, Chen CC, Wong CH, Su YC. High risk of 'failure' among emergency physicians compared with other specialists: a nationwide cohort study. *Emerg Med J.* 2013; 30(8): 620-622. doi: [10.1136/emermed-2012-201440](https://doi.org/10.1136/emermed-2012-201440)
33. AlDabal L, BaHammam AS. Metabolic, Endocrine, and Immune Consequences of Sleep Deprivation. *Open Respir Med J.* 2011; 5: 31-43. doi: [10.2174/1874306401105010031](https://doi.org/10.2174/1874306401105010031)
34. Cohen-Gadol AA, Piepras DG, Krishnamurthy S, Fessler RD. Resident duty hours reform: results of a national survey of the program directors and residents in neurosurgery training programs. *Neurosurgery.* 2005; 56: 398-403. doi: [10.1227/01.NEU.0000147999.64356.57](https://doi.org/10.1227/01.NEU.0000147999.64356.57)
35. Karakoç B. A study on sleep quality: the example of health workers specialty hospitals. Unpublished master's thesis. Marmara University Institute of Health Sciences. (Advisor: Alper SE). 2009, Istanbul.