Original Research

Sleep Disorders and Fatigue among Health Care Providers Working at University Hospitals

Nasim Tabrizi*, Athena Sharifi-Razavi, Mitra Alizadeh

Department of Neurology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran

Received: 01 Nov. 2019 Accepted: 05 Dec. 2019

Abstract

Background and Objective: Sleep disorder and fatigue are common among health care workers (HCWs) and negatively affect their quality of life and caregiving to the patients. Early diagnosis and rapid modification of causative factors might prevent the potential disastrous results of these problems on personal and population health. This study aimed to evaluate the state of sleep and fatigue among HCWs of hospitals affiliated to Mazandaran University of Medical Sciences, Iran, and their related factors.

Materials and Methods: This cross-sectional study was conducted from September 2014 to December 2014 among HCWs at hospitals of Mazandaran University of Medical Sciences. Demographic data, medical history, and occupational shift information were recorded. Sleep quality was assessed by the valid and reliable Persian versions of Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI). Fatigue was evaluated by valid and reliable Persian version of Fatigue Severity Scale (FSS). Statistical analysis was performed using SPSS software.

Results: 595 HCWs participated in the study. According to ISI, 48.4% of HCWs experienced subthreshold insomnia, 25.4% were affected by moderate, and 5.0% by severe clinical insomnia. PSQI indicated poor sleep quality in 79.8% of the participants. 71.6% of HCWs had FSS of 4 or more, which was correlated to gender, age, and sleep quality. Correlation of sleep quality components with participants' shift characteristics was also investigated.

Conclusion: Sleep disorders and fatigue are common in HCWs of university hospitals. Correction of certain modifiable factors can reduce negative consequences of sleep disorders and fatigue in HCWs.

Keywords: Sleep disorders; Fatigue; Health personnel; Shift work schedule

Citation: Tabrizi N, Sharifi-Razavi A, Alizadeh M. **Sleep Disorders and Fatigue among Health Care Providers Working at University Hospitals.** J Sleep Sci 2020; 5(1): 28-34.

Introduction

Sleep problem is a common complaint among health care workers (HCWs) and can adversely affect their productivity and quality of life (1). Shift work is an essential component of contemporary society, but displacement of work hours to sleep time and vice versa interferes with the circadian rhythm and homeostatic regulation of sleep and causes sleep-wake disturbance in many night-shift workers (2). According to the international classification of sleep disorders, following criteria have been set to diagnose shift work sleep disorder (SWSD): "1. complaints of insomnia or excessive sleepiness temporarily associated with a recurring work schedule that overlaps the usual time for sleep, 2. symptoms must be associated with the work schedule for at least one month, 3. evidence that the circadian and sleep-time misalignment were present for ≥ 7 days using sleep log or actigraphic recording, and 4. the sleep disturbance cannot be explained by another sleep, medical, neurological, or mental disorder, or the result of medication or substance abuse" (3, 4). SWSD commonly associates with fatigue, cognitive impairment, accidents, injuries, and many other health problems (5). The resultant negative effects also reduce the standards of caregiving to the patients (6). In order to evaluate current state, in this study we have used a comprehensive combination of standard sleep disorder and fatigue questionnaires to investigate the sleep and fatigue

*** *Corresponding author***: *N. Tabrizi, Department of Neurology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran*
Tel: +98 911 126 3538, Fax: +98 11 33343017
Email: nasimtabrizi@gmail.com

state of HCWs in our university hospitals. We also assessed the related factors which might help in planning for preventive interventions.

Materials and Methods

This cross-sectional study was conducted from September 2014 to December 2014. The target group was HCWs of all university hospitals affiliated to Mazandaran University of Medical Sciences located in Sari, the center of Mazandaran Province, Iran. The study was approved by the Review Board of Mazandaran University of Medical Sciences. The inclusion criterion consisted of hospital staffs who had a constant shift working schedule during at least the last one year. Shift work was defined as working for at least two shifts a day or having night shifts. The exclusion criteria were determined as known psychiatric diseases, alcohol or illegal drug abuse, and caffeine overuse (more than 8 cups of coffee or 16 cups of tea per day).

Procedure: The questionnaires were distributed to hospital wards and were collected by the head nurse of each ward after two weeks. The questionnaires were completed anonymously by nurses, midwives, operation room technicians, patient care technicians, and unskilled workers .

Measures: The first part of the questionnaire evaluated demographic data, habits, medical history, drug history, weight, height, data of routine work shifts, and daily work hours. In order to investigate sleep quality, the valid and reliable Persian versions of Insomnia Severity Index (ISI) (7, 8) and Pittsburgh Sleep Quality Index (PSQI) (9, 10) were used. Fatigue was also assessed by valid and reliable Persian version of Fatigue Severity Scale (FSS) (11, 12). The ISI is a 7-item questionnaire with a total score of 0 to 28 (13). The score ranges of 0-7, 8-14, 15-21, and 22-28 were interpreted as no clinically significant insomnia, subthreshold insomnia, moderate clinical insomnia, and severe clinical insomnia, respectively (7).

PSQI is an efficient instrument which measures the quality and patterns of sleep through seven domains including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month. The score range for each domain is from 0 to 3 and a total score of 5 or more suggests a "poor" sleeper (9).

FSS is a 9-item scale that determines fatigue degree and its negative influence on daily activities. The components are scored on a 7-point scale with 1 meaning strongly disagree and 7 representing strongly agree. The raw score ranges from 9 to 63 and to calculate final score, total score is divided by question numbers. Final score of 4 or more suggests suffering from fatigue (11).

Data analysis: Statistical analysis was performed using SPSS software (version 22, IBM Corporation, Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation (SD). Qualitative variables were reported as number and percentage. Independent samples t-test, chi-square test, Mann-Whitney U test, and one-way analysis of variance (ANOVA) were used. Level of significance was defined as $P \leq 0.05$.

Results

595 hospital shift workers filled the questionnaires. The characteristics of the participants are summarized in table 1.

Table 1. General characteristics of the study participants

Characteristics	Category	Mean ± SD
Age (year)		32.5 ± 7.2
Night shift per month		7.0 ± 2.9
		Number (%)
Smoker		5 (0.8)
Gender	Male	126 (21.1)
	Female	469 (78.9)
Marital status	Single	160 (26.9)
	Married	435 (73.1)
BMI (kg/m^2)	Underweight	19 (3.4)
	Normal	305 (55.0)
	Overweight	193 (34.8)
	Obese	38 (6.8)
Daily work hours	1-7	218 (37.5)
	8-15	362 (62.2)
	> 15	2 (0.3)
Job	Unskilled workers	24 (4.0)
	Patient care technicians	54 (9.1)
	Nurse	481 (81.0)
	Midwife	9 (1.5)
	OR technician	26 (4.4)
Shift time	Morning	519 (88.0)
	Afternoon	417 (70.7)
	Night	454 (76.7)
Wards	OR	48 (8.1)
	Burn & graft	48 (8.1)
	Psychiatry	54 (9.1)
	Pediatrics	58 (9.7)
	Emergency department	59 (9.9)
	Internal	85 (14.3)
	Surgery	114 (19.2)
	Special care units	129 (21.7)
Pattern of night shift	Regular	201 (45.2)
	Irregular	244 (54.8)

SD: Standard deviation; BMI: Body mass index; OR: Operation room

57.9% of the participants reported a somatic disorder including gastroesophageal reflux disease (GERD) (n = 82, 13.8%), arthritic disorder (n = 62, 10.4%), premenstrual syndrome (n = 58, 9.7%), gastrointestinal (GI) problem (n = 35, 5.9%), thyroid disorder (n = 26, 4.4%), diabetes mellitus (DM) (n = 15, 2.5%), hypertension (HTN) (n = 15, 2.5%), discopathy (n = 14, 2.4%), migraine (n = 11, 1.8%), cardiac problem (n = 10, 1.7%), pulmonary disorder (n = 9, 1.5%), cancer (n = 3, 0.5%), benign prostatic hyperplasia (BPH) (n = 2, 0.3%), epilepsy (n = 2, 0.3%), and multiple sclerosis (MS) (n = 1, 0.2%).

ISI results showed that 21.2% of the participants had no clinically significant insomnia, 48.4% experienced subthreshold insomnia, 25.4% were affected by moderate clinical insomnia, and 5.0% by severe clinical insomnia. ISI was significantly lower in HCWs with regular shifts (P = 0.006) and had a proportionate correlation with body mass index (BMI) increase as the most workers with severe clinical insomnia were in the obese group (P = 0.040). We could not find any significant correlation between ISI and sex, age, marital status, daily work hours, working at wards, and night shift numbers. Although it was not significant, patient care technicians and unskilled workers experienced clinical insomnia more frequently (Table 2).

Using PSQI, only 20.2% of HCWs had good sleep quality (Table 3). Poor sleep quality based on PSQ score showed a substantial concomitance with female sex (P = 0.060) and night shifts per month (P = 0.090). The score also had a non-statistically significant increase with longer work hours, obesity, and among patient care technicians. (P = 0.530, P = 0.260, and P = 0.210 for daily work hours, age, BMI, and pattern of night shift work, respectively). The detailed components of PSQI are shown in table 4.

High PSQ1 score as a marker of subjective sleep quality was significantly correlated to female sex, married state, and 30-39 years of age. There was an increasing trend of score in participants with higher BMI, daily work hours, night shift numbers, and also in patient care technicians. The mean sleep latency (PSQ2) score was 1.35 ± 1.00. Sleep latency had no significant correlation with any of the investigated factors, but it was higher in participants with single state, longer work hours, and among patient care technicians. Sleep duration (PSQ3) was significantly shorter in women, patient care technicians, and those with higher work hours. The score increased with increment in age, BMI, and night shift numbers. Habitual sleep efficiency (PSQ4) showed significantly higher score in single participants and those with obesity and 8-11 night shifts per month. However, those with longer work hours and irregular shifts also had poorer sleep efficiency. Sleep disturbances (PSQ5) were significantly higher in the participants with obesity and longer work hours and according to job, they were highest in unskilled workers and patient care technicians. 18.4% of the participants reported the use of sleeping medications.

Table 2. Association of insomnia severity in terms of Insomnia Severity Index (ISI) with characteristics of the participants

Variable	Category	No clinically significant insomnia	Subthreshold insomnia	Clinical insomnia (moderate severity)	Clinical insomnia (severe)	P-value
Gender	Male	33 (26.4)	57 (45.6)	29 (23.2)	6 (4.8)	0.470
	Female	93 (19.9)	229 (49.0)	121 (25.9)	24 (5.1)	
Age (year)	< 30	63 (26.1)	112 (46.5)	54 (22.4)	12 (5.0)	
	30-39	35 (14.9)	125 (53.2)	64 (27.2)	11 (4.7)	0.070
	40-49	25 (25.8)	39 (40.2)	28 (28.9)	5 (5.2)	
	≥ 50	2 (11.8)	10 (58.8)	3 (17.6)	2 (11.8)	
BMI (kg/m^2)	Underweight	7 (36.8)	9 (47.4)	3 (15.8)	0	
	Normal	67 (22.0)	151 (49.5)	79 (25.9)	8 (2.6)	0.040
	Overweight	35 (18.1)	92 (47.7)	50 (25.9)	16 (8.3)	
	Obese	5 (13.2)	16 (42.1)	13 (34.2)	4 (10.5)	
Night shift per month	< 4	11 (24.4)	26 (57.8)	5 (11.1)	3 (6.7)	
	4-7	45 (21.1)	103 (48.4)	55 (25.8)	10 (4.7)	0.160
	8-11	29 (17.5)	74 (44.6)	55 (33.1)	8 (4.8)	
	≥ 12	6 (24.0)	12 (48.0)	4 (16.0)	3 (12.0)	
Night shift pattern	Regular	53 (26.4)	89 (44.3)	47 (23.4)	12 (6.0)	
	Irregular	33 (13.5)	126 (51.6)	73 (29.9)	12 (4.9)	0.006

Data are presented as number (%)
BMI: Body mass index

Table 3. Association of sleep quality in terms of Pittsburgh Sleep Quality Index (PSQI) score with characteristics of participants

Variable	Category	Good sleep quality	Poor Sleep Quality	P-value
Gender	Male	32 (25.6)	93 (74.4)	0.060
	Female	88 (18.8)	379 (81.2)	
Age (year)	< 30	54 (22.4)	187 (77.6)	0.120
	30-39	38 (16.2)	197 (83.8)	
	40-49	25 (25.8)	72 (74.2)	
	≥ 50	2 (11.8)	15 (88.2)	
BMI (kg/m^2)	Underweight	4 (21.1)	15 (78.9)	0.260
	Normal	64 (21.0)	241 (79.0)	
	Overweight	42 (21.8)	151 (78.2)	
	Obese	3 (7.9)	35 (92.1)	
Daily work hours	1-7	48 (22.0)	170 (78.0)	0.530
	8-15	69 (19.1)	293 (80.9)	
	> 15	0	2 (100)	
Night shift per month	< 4	13 (28.9)	32 (71.1)	0.090
	4-7	44 (20.7)	169 (79.3)	
	8-11	24 (14.5)	142 (85.5)	
	≥ 12	3 (12.0)	22 (88.0)	
Pattern of night shift	Regular	36 (17.9)	165 (82.1)	0.440
	Irregular	46 (18.9)	198 (81.1)	

Data are presented as number (%)
BMI: Body mass index

Taking medication had a significant correlation with age (41.2% of participants of ≥ 50 years old), but was more common in those with higher BMI, more night shifts, unskilled workers, and patient care technicians. Daytime dysfunction score (PSQ7) was significantly higher in women. Participants with higher BMI and night shift numbers also showed higher scores in PSQ7.

ISI score had a moderate correlation with PSQI score (Pearson correlation: 0.43, $P \leq 0.001$). The mean FSS was 4.7 ± 2.4. 71.6% of participants had the FSS of 4 or more. FSS ≥ 4 had a significant correlation with female gender ($P = 0.001$), age of 30-39 years ($P = 0.020$), clinical insomnia based on ISI ($P < 0.001$), poor subjective sleep quality and sleep latency ($P < 0.001$), habitual sleep efficiency ($P = 0.040$), sleep disturbance ($P = 0.010$), use of sleep medication ($P = 0.020$), daytime dysfunction ($P < 0.001$), and poor sleep quality based on PSQ ($P < 0.001$). It also had a substantial correlation with working in night shifts ($P < 0.010$), sleep duration ($P = 0.060$), and irregular night shifts ($P = 0.070$).

Discussion

Poor sleep quality among HCWs is a critical issue which affects their quality of life and caregiving to patients. The present study showed a high prevalence of sleep disturbance and fatigue among HCWs of four university hospitals using standard sleep and fatigue questionnaires. SWSD has been reported in 32.4%-72.0% of HCWs using different assessment methods (1, 2, 14, 15). In our study, clinical and subclinical insomnia were detected by ISI in 30.4% and 48.4% of HCWs, respectively, and 79.8% of the participants experienced poor sleep quality based on PSQI which are slightly higher than similar studies.

Sleep and physical characteristics: Investigation by PSQI showed that female HCWs had a poorer subjective sleep quality, shorter sleep duration, and more severe daytime dysfunction. There are reports of increased prevalence of sleep problems in women (1, 16, 17). Moreover, previous studies have indicated that excessive daytime sleepiness (EDS), which is a serious concern in HCWs, is more common among female workers (15, 17). According to high number of women working as nurses, the significance of prevention of sleep disorder in HCWs cannot be overemphasized.

Many studies have confirmed the role of short sleep duration in incidence of obesity (18-20).

Table 4. Components of Pittsburgh Sleep Quality Index (PSQI) in participants

PSQ components	Subjective sleep quality	Sleep latency	Sleep duration	Sleep efficiency	Sleep disturbance	Sleeping medications	Daytime dysfunction
Value	1.76 ± 0.70	1.35 ± 1.00	1.40 ± 1.00	0.40 (0-3)	1.05 ± 0.60	0.30 (0-3)	0.85 (0-3)

Data are presented as mean ± standard deviation (SD) and mean (range)
PSQ: Pittsburgh Sleep Quality

Also obesity results in many comorbidities that can disrupt sleep (21). In this study, 41.6% of the participants had a higher than normal BMI, while higher BMI was correlated with habitual sleep efficiency and sleep disturbances. Rahe et al. in a similar study on population-based adults have reported a significant association of poor sleep quality assessed by PSQI with general obesity, which more affected sleep latency, sleep disturbances, and daytime dysfunction (22). It has been shown that low sleep efficiency causes selective deprivation of stage N3 sleep that leads to abdominal obesity through mechanisms mediated by autonomic nervous system (ANS) and hypothalamic-pituitary-adrenal axis (HPA axis) (21). Moreover, obesity may cause or exacerbate obstructive sleep apnea (OSA), depression, asthma, osteoarthritis, and GERD, which can potentially play a role in sleep disturbance (21, 23-25). 25.7% of our patients were affected by these disorders with the possible cause and effect role on poor sleep quality.

Sleep and work characteristics: Our findings showed that increase in night shift numbers was significantly associated with lower habitual sleep efficiency. Moreover, longer work hours were correlated with decreased sleep duration and increased sleep disturbances. Previous studies have shown that higher number of night shifts and longer duration of working hours (> 12 hours) have significant association with SWSD (26-29). Night shifts lead to shorter duration of total sleep time and cause the greatest detrimental effect in comparison to morning and evening shift schedules (27, 30). The speed of shift rotation is also important. It has been shown that slowly-rotating shifts defined as at least 3 weeks per shift schedule have the least negative effect on sleep duration (30).

In our study, HCWs with regular distribution of night shifts had better sleep state based on ISI. We could not find any role for working ward and job type in sleep state of the participants. Thus, based on current and previous evidence, a standard shift schedule to reduce the possibility of sleep disorders should at least contain low number, regular, slowly-rotating night shifts and short duration working hours.

Fatigue in HCWs: More than two-third of our participants reported substantial fatigue that was strongly associated with poor sleep quality assessed by both ISI and PSQI. The most significant correlation was found with sleep latency and daytime dysfunction. Fatigue affects greater than half of HCWs and decreases their efficiency with the possibility of inaccuracy and serious faults (31). Our findings showed that fatigue was more common in female HCWs and those with 30-39 years of age. Previous studies did not show a tendency toward lower resistance to fatigue in female workers or specific range of age (32). A possible reason for our finding is that FSS significantly correlates with depressive symptomatology (33), and depression is a common disorder in young women with critical jobs (34). We did not investigate the psychiatric well-being of our participants by standard questionnaires which can affect fatigue state as an intervening factor. According to work characteristics, effect of shift duration on fatigue and function is controversial. Some studies reported favorable outcome of personnel and patients' safety in short duration shifts while others did not find any correlation (31, 35-37). We could not find any significant correlation between work hours and fatigue, but the association of fatigue with night shifts and irregular shift distribution was closely meaningful.

This study had some limitations. First of all, investigations of all factors which can affect sleep and fatigue state was not possible in this study even by using standard questionnaires. Thus, more detailed studies are needed to address related risk factors more precisely. The second limitation is that self-report questionnaires, as we used in this study, might lead to incomplete or incorrect findings that can negatively affect the results. Finally, comparison of sleep and fatigue state in two similar groups of participants with and without shift works was not possible in this study because of small number of HCWs without shift work. However, it seems that conducting case-control studies can result in more valuable findings in this regard.

Conclusion

Sleep disorders and fatigue are underestimated but seriously common findings in HCWs in university hospitals. These problems might lead to severe health problems in HCWs and also can seriously affect quality of caregiving to patients. Thus, periodic screening to find these disorders is necessary for all HCWs particularly more vulnerable persons and should be followed by prompt intervention to modify causative factors and improve sleep quality. Furthermore, due to important intervening role of shift schedule, preventive procedures such as evidence-based shift system de-

signs and training programs on sleep and working hours should be institutionalized in organizations with shift workers.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

We would like to thank HCWs who participated in this study.

References

1. Ghalichi L, Pournik O, Ghaffari M, et al. Sleep quality among health care workers. Arch Iran Med 2013; 16: 100-3.
2. Mathew JJ, Joseph M, Britto M, et al. Shift work disorder and its related factors among health-care workers in a Tertiary Care Hospital in Bangalore, India. Pak J Med Sci 2018; 34: 1076-81.
3. Sateia MJ. International classification of sleep disorders-third edition: Highlights and modifications. Chest 2014; 146: 1387-94.
4. Di ML, Waage S, Pallesen S, et al. Shift work disorder in a random population sample--prevalence and comorbidities. PLoS One 2013; 8: e55306.
5. Burch JB, Alexander M, Balte P, et al. Shift work and heart rate variability coherence: Pilot study among nurses. Appl Psychophysiol Biofeedback 2019; 44: 21-30.
6. Muecke S. Effects of rotating night shifts: literature review. J Adv Nurs 2005; 50: 433-9.
7. Bastien CH, Vallieres A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. Sleep Med 2001; 2: 297-307.
8. Yazdi Z, Sadeghniiat-Haghighi K, Zohal MA, et al. Validity and reliability of the Iranian version of the insomnia severity index. Malays J Med Sci 2012; 19: 31-6.
9. Buysse DJ, Reynolds CF, III, Monk TH, et al. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res 1989; 28: 193-213.
10. Farrahi MJ, Nakhaee N, Sheibani V, et al. Reliability and validity of the Persian version of the Pittsburgh Sleep Quality Index (PSQI-P). Sleep Breath 2012; 16: 79-82.
11. Krupp LB, LaRocca NG, Muir-Nash J, et al. The fatigue severity scale. Application to patients with multiple sclerosis and systemic lupus erythematosus. Arch Neurol 1989; 46: 1121-3.
12. Fereshtehnejad SM, Hadizadeh H, Farhadi F, et al. Reliability and validity of the Persian version of the fatigue severity scale in idiopathic Parkinson's disease patients. Parkinsons Dis 2013; 2013: 935429.
13. Harvey AG, Stinson K, Whitaker KL, et al. The subjective meaning of sleep quality: A comparison of individuals with and without insomnia. Sleep 2008; 31: 383-93.
14. Chan MF. Factors associated with perceived sleep quality of nurses working on rotating shifts. J Clin Nurs 2009; 18: 285-93.
15. Flo E, Pallesen S, Mageroy N, et al. Shift work disorder in nurses--assessment, prevalence and related health problems. PLoS One 2012; 7: e33981.
16. Doi Y, Minowa M. Gender differences in excessive daytime sleepiness among Japanese workers. Soc Sci Med 2003; 56: 883-94.
17. Tang J, Liao Y, Kelly BC, et al. Gender and regional differences in sleep quality and insomnia: A general population-based study in Hunan Province of China. Sci Rep 2017; 7: 43690.
18. Wu Y, Zhai L, Zhang D. Sleep duration and obesity among adults: A meta-analysis of prospective studies. Sleep Med 2014; 15: 1456-62.
19. Vargas PA. The link between inadequate sleep and obesity in young adults. Curr Obes Rep 2016; 5: 38-50.
20. Elder BL, Ammar EM, Pile D. Sleep Duration, activity levels, and measures of obesity in adults. Public Health Nurs 2016; 33: 200-5.
21. Ogilvie RP, Patel SR. The epidemiology of sleep and obesity. Sleep Health 2017; 3: 383-8.
22. Rahe C, Czira ME, Teismann H, et al. Associations between poor sleep quality and different measures of obesity. Sleep Med 2015; 16: 1225-8.
23. Chang P, Friedenberg F. Obesity and GERD. Gastroenterol Clin North Am 2014; 43: 161-73.
24. Pickering ME, Chapurlat R, Kocher L, et al. Sleep disturbances and osteoarthritis. Pain Pract 2016; 16: 237-44.
25. Brumpton B, Langhammer A, Romundstad P, et al. General and abdominal obesity and incident asthma in adults: the HUNT study. Eur Respir J 2013; 41: 323-9.
26. Anbazhagan S, Ramesh N, Nisha C, et al. Shift work disorder and related health problems among nurses working in a tertiary care hospital, Bangalore, South India. Indian J Occup Environ Med 2016; 20: 35-8.
27. Akerstedt T, Wright KP. Sleep loss and fatigue in shift work and shift work disorder. Sleep Med Clin 2009; 4: 257-71.
28. Lockley SW, Cronin JW, Evans EE, et al. Effect of reducing interns' weekly work hours on sleep and attentional failures. N Engl J Med 2004; 351: 1829-37.
29. Luckhaupt SE, Tak S, Calvert GM. The prevalence of short sleep duration by industry and occupation in the National Health Interview Survey. Sleep 2010; 33: 149-59.
30. Pilcher JJ, Lambert BJ, Huffcutt AI. Differential effects of permanent and rotating shifts on self-report sleep length: A meta-analytic review. Sleep 2000; 23: 155-63.
31. Patterson PD, Runyon MS, Higgins JS, et al. Shorter versus longer shift durations to mitigate fatigue and

fatigue-related risks in emergency medical services personnel and related shift workers: A systematic review. Prehosp Emerg Care 2018; 22: 28-36.
32. Haluza D, Blasche G. Fatigue and insufficient leisure opportunities in older employees. J Occup Environ Med 2016; 58: e268-e274.
33. Corfield EC, Martin NG, Nyholt DR. Co-occurrence and symptomatology of fatigue and depression. Compr Psychiatry 2016; 71: 1-10.
34. Madsen IEH, Nyberg ST, Magnusson Hanson LL, et al. Job strain as a risk factor for clinical depression: Systematic review and meta-analysis with additional individual participant data. Psychol Med 2017; 47: 1342-56.
35. Centers for Disease Control and Prevention (CDC). Short sleep duration among workers--United States, 2010. MMWR Morb Mortal Wkly Rep 2012; 61: 281-5.
36. Shockey TM, Wheaton AG. Short sleep duration by occupation group - 29 states, 2013-2014. MMWR Morb Mortal Wkly Rep 2017; 66: 207-13.
37. Bolster L, Rourke L. The effect of restricting residents' duty hours on patient safety, resident well-being, and resident education: An updated systematic review. J Grad Med Educ 2015; 7: 349-63.