

Prevalence of Sleep Disorders and Sleep Deprivation Symptoms in Nurses and Paramedics: A Cross-sectional Analytic-descriptive Study

Nasrin Galehdar¹, Abouzar Mohammadi^{2*}, Shirin Hasanvand¹, Fateme Goudarzi¹,
Mohammad Gholami³

¹*Social Determinants of Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran*

²*Kashan University of Medical Sciences, Kashan, Iran*

³*School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran*

ABSTRACT

Background: The shift works cause sleep disorders and sleeps deprivation symptoms and noticeably affects human function. This study was designed to evaluate the prevalence of sleep disorders and sleep deprivation symptoms in nurses and paramedics (N & Ps).

Methods: In this descriptive-analytical study, 850 nurses and paramedical staff on shift work of Lorestan University of Medical Sciences were studied by simple sampling. The inclusion criteria were willingness to engage and work at the time of study. Data collection tools were demographic data and Pittsburgh Sleep Quality Index. After obtaining consent and completing the questionnaire, the data were analyzed by descriptive and analytic statistics using SPSS software version 16 via Kruskal-Wallis. Moreover, correlations were assessed using Spearman correlation.

Results: Current findings demonstrated that subjects with different shifts had sleep disorders in 98.8% of cases, while remains had 1 to 29 items of sleep ones. Disorders of initiating sleep and fatigue and weakness after waking up were observed in 67.5% and 64.9% of N & Ps, respectively. Subjects in 72.8% of cases preferred to stay at the bed in the morning and 28.9% had night terrors and Rapid Eye Movement behavior disorder. In terms of physical symptoms, fatigue and weakness had the maximum frequency (29.9%). Physical, mental, and emotional symptoms were observed in 96.7%, 94.8%, and 95.5%, respectively. The maximum frequency (38.4%) was correlated to inhibition of study.

Conclusion: Present findings demonstrated that subjects have sleep disorders and sleep deprivation symptoms in different severities. As for N & Ps are key individuals in the healthcare system and on the other hand are as potential patients in the future, paying special attention to them is necessary.

Key words: Nurses, Paramedics, Shifts, Sleep deprivation, Sleep disorders, Sleep

HOW TO CITE THIS ARTICLE: Nasrin Galehdar, Abouzar Mohammadi, Shirin Hasanvand, Fateme Goudarzi, Mohammad Gholami, Prevalence of sleep disorders and sleep deprivation symptoms in nurses and paramedics: A cross-sectional analytic-descriptive study, J Res Med Dent Sci, 2019, 7(2): 11-19

Corresponding authors: Abouzar Mohammadi
e-mail ✉: ukstudy2008@live.com
Received: 07/01/2019
Accepted: 01/03/2019

INTRODUCTION

In the United States of America, at least 40 million people annually suffer from chronic, long-term sleep disorders, and an additional 20 million experience occasional sleeping problems. These disorders and the resulting sleep deprivation symptoms interfere with daily and social activities. Also, they account for an estimated \$16 billion in medical costs annually, while the indirect costs due to lost productivity and other factors are probably much greater [1].

A sleep-restricted state called sleep deprivation can cause fatigue, daytime sleepiness, clumsiness, and weight loss or weight gain [2]; it adversely affects the brain and cognitive function [3-5]. However, in a subset of cases sleep deprivation can paradoxically lead to increased energy and alertness and enhanced mood; it has even been used to synchronize and consolidate circadian rhythms and as a treatment of depression [6-8]. Sleep deprivation noticeably affects human function, also the mood is more influenced by sleep deprivation than either cognitive or motor performance and that partial sleep deprivation has a more profound effect on functioning than either long-term or short-term sleep deprivation [9].

The negative effects of sleep deprivation on alertness and cognitive performance demonstrate declinations in the activity and function of the brain [10,11]. Also, sleep and

circadian problems represent common non-motor features of Parkinson and Huntington diseases, and attention-deficit hyperactivity disorder [11,12].

Undesirable and night shift schedule results in sleep-wake disturbances, alterations of sleep duration, chronic sleep restriction and excessive sleepiness, alterations in sleep architecture, sleep fragmentation, circadian rhythm disorders, and disruption and obstructive sleep apnea causing sleepiness during night shifts and reducing sleep length and quality in daytime sleep after the night shift. In its serious form, it is also called shift work sleep disorder [13,14].

Sleep disorders, physical and mental problems, job dissatisfaction, diminished performance at work and social isolation have been reported in some 88% of the American and Canadian shift-workers [15]. More recent studies; nevertheless, have demonstrated that the 12-hour shifts favored by many nurses and frequent overtime are associated with difficulties staying awake on duty, reduced sleep times, and nearly triple the risk of making an error [16-18].

Based on the 2006 Survey of Labour and Income Dynamics conducted by Statistics Canada, about 11% of employed Canadians work rotating shifts, while 6% work regular evenings and 2% work regular night shifts. The prevalence of both rotating and evening work is much higher among people under 30 than at elder ages. The number of women working evening, night, and especially, rotating shifts has dramatically increased over the last 10 years [19].

Poor sleep quality; misalignment of circadian rhythms, and subsequent sleepiness and sleep-related performance deficits among nurses and especially night-shift workers is a critical issue for the healthcare system. It not only leads to health problems of the nurses but also associates with lower work performance and a higher risk of medical errors, which may jeopardize the patient's safety [20,21].

Hence, the present research was designed to evaluate the prevalence of sleep disorders and sleep deprivation symptoms in nurses and paramedics occupying in Khorramabad city training hospitals, Lorestan province, Iran in 2014.

MATERIALS AND METHODS

A cross-sectional analytic-descriptive study was conducted from March 1st, 2014 to September 1st, 2014. The research population was all nurses and paramedical staff (n=1586) working in educational hospitals in Khorramabad.

The research sample included 936 people who were enrolled in current study by means of simple sampling method. Of the 936 subjects, 850 ones returned filled questionnaires (Its response rate is more than 90%).

Table 1: Demographics of the subjects

After obtaining nurses' and paramedics' agreement to participate, the researchers introduced themselves to them, explained the trial's objectives and assured the participants that their information would confidentially be kept, without mentioning their names. Then, necessary explanations were provided concerning the questionnaires. Afterward, consent forms were signed by the subjects.

Demographics (gender, age, marital status, degree, experience, and hours of time, occupational status, and wards) were collected and questionnaires were distributed among them (Table 1).

Sleep disorders and sleep deprivation symptoms were measured by the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-report basis on a 5-point Likert scale assessing sleep quality and disturbances over a 1-month time interval. It differentiates "poor" from "good" sleep by measuring 7 areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the last month. Scoring of answers is based on a 0 to 4 scale; whereby "3", reflects the negative extreme on the Likert Scale. It ranges 0 to 21 scores. A global sum of "6" or greater indicates a "poor" sleeper. It has internal consistency and a reliability coefficient (Cronbach's alpha) of 0.83 for its 7 components [22].

The validity and reliability of the PSQI was previously confirmed by several studies [23-25]. Inclusion criteria were willingness to engage, not-taking anxiolytic and narcotic medications, not-taking alcohol and caffeine, having no apparent physical and mental disorder(s), occupying in a current shift for at least 1 month, and absence of a critical condition in recent 1 month.

The aforementioned questionnaires were distributed among selected samples and filled out with the help of researchers. Then, documented data were extracted. The findings obtained were finally analyzed by descriptive and analytic statistics using SPSS software version 16 *via* Kruskal-Wallis and Spearman correlation.

Ethical considerations

The protocol was designed in accordance with the ethical principles of the Helsinki Declaration [26]. Lorestan University of Medical Sciences and Health Services' Ethics Committee considered the project to fall outside its mandate. The nurses and paramedics were given a verbal lecture and written information about the goals and approach of the project, and then they declared to help the researchers to perform the study.

RESULTS

Demographics

Table 1 shows the demographic data of the subjects studied.

Demographics	Number of subjects
Gender	-
Male	248 (29.2%)
Female	602 (70.8%)
Age (years)	-
21-30	376 (44.5%)
30-41	362 (42.6%)
41-50	100 (11.7%)
50-65	10 (1.2%)
Over 65	0 (0%)
Marital status	-
Single	262 (30.8%)
Married	588 (69.2%)
Groups	-
Nurse	532 (62.6%)
Nurse's aide	110 (12.9%)
Surgical technologist	58 (6.8%)
Anaesthesiology technologist	40 (4.7%)
Midwife	66 (7.8%)
Radiology technologist	8 (1%)
Laboratory technologist	36 (4.2%)
Degree	-
Associate Degree	298 (35.1%)
Bachelor of Science	360 (42.4%)
Master of Science	192 (22.5%)
Experience (year)	-
1-10	538 (63.3%)
10-21	248 (29.2%)
21-30	64 (7.5%)
Hours of overtime (hours)	-
None	282 (32.3%)
1-50	166 (19.5%)
50-100	266 (31.3%)
100-150	110 (12.9%)
150-200	26 (3.1%)
Occupational status	-
Employed	486 (57.2%)
Contractual	192 (22.6%)
Subjects with overtime shifting	88 (10.4%)
Staffing plan	84 (9.8%)
Wards	-
Operating theatre	110 (12.9%)

Surgery	158 (18.6%)
ICU	45 (5.3%)
CCU	30 (3.5%)
NICU	41 (4.8%)
Medicine	215 (25.3%)
Internal	207 (24.4%)
Radiology	8 (1%)
Laboratory	36 (4.2%)

Sleep disorders

Based on current findings, only 20.9% of subjects did not have a disorder in initiating sleep. The maximum disorder in initiating sleep after half an hour was observed in 67.5% of the subjects (Table 2). The frequency of subjects with 1, 2, and 3 disorder(s) was

28.9%, 42.4%, and 7.8%, respectively. The maximum frequency (87.1%) of sleep maintenance disorder was concerned fatigue during the day. Totally, only 2.4% of the subjects did not have any problem in terms of sleep maintenance.

Table 2: Absolute and relative frequency distribution of sleep disorders in N & Ps

Sleep disorders	Questions	Positive reply	Negative reply
Disorder in initiating sleep	Does it take more than half an hour to sleep?	574 (67.5%)	276 (32.5%)
	Do aggressive thoughts come to your mind when you are trying to sleep?	476 (56%)	374 (44%)
	Do you sleep better when you are out of your bed?	118 (13.9%)	732 (86.1%)
Disorder in maintaining sleep	Do you frequently wake up in the middle of the night or early morning?	434 (51.1%)	416 (48.9%)
	Do you lately go to bed after waking up at the night?	498 (58.6%)	352 (41.4%)
	Do you feel fatigue during the day?	740 (87.1%)	110 (12.9%)
	Do you feel apnoea when you are asleep?	144 (16.9%)	706 (83.1%)
	Do you wake up with mild noises?	600 (70.6%)	250 (29.4%)
	Do you snore when you are asleep?	170 (20.0%)	680 (80%)
	Do you wake up by muscular twitching?	386 (45.4%)	464 (54.6%)
Disorder in waking up	Do you wake up 2 to 3 hours earlier than normal time?	320 (37.6%)	530 (62.4%)
	Do you feel fatigue and weakness after waking up?	552 (64.9%)	298 (35.1%)
	Do you feel provocation and absence of concentration during the day?	478 (55.5%)	372 (44.5%)
Excessive sleepiness	Are you attacked by sleep irresistible attacks during the day?	320 (37.6%)	530 (62.4%)
	Do you nap during the day?	384 (45.2%)	466 (54.8%)
	Do you feel episodes of disorientation or confusion and movement disorder?	218 (25.6%)	632 (74.4%)
	Do you want to stay in bed more than normal time in the morning?	618 (72.7%)	232 (27.3%)
Parasomnia	Do you feel drowsiness/sleepiness during the day?	496 (58.4%)	354 (41.6%)
	Do you have night terrors and rapid eye movement behavior disorder?	246 (28.9%)	604 (71.1%)
	Do you feel restless leg syndrome before and after waking up?	180 (21.2%)	670 (78.8%)
	Do you gnash when you are asleep?	82 (9.6%)	768 (90.4%)
	Do you walk when you are asleep?	24 (2.8%)	826 (97.2%)
	Do you talk when you are asleep?	156 (18.4%)	694 (81.6%)

The maximum frequency (64.9%) was for weakness and fatigue after waking up. The frequency of subjects with 1, 2, and 3 disorder(s) in waking up stage was 25.2%, 36%, and 20.7%, respectively. The excessive sleepiness was

observed in 72.8% of N & Ps with 5 disorders. Moreover, the most parasomnia (28.9%) was indicated as night terrors and Rapid Eye Movement behavior disorder. In 98.8% of the subjects, 1 to 29 items of sleep disorders

were observed. In this between, the maximum frequency was concerning who recorded 9 scores (of 21) of sleep disorders (Table 3).

Table 3: Absolute and relative frequency distribution in N & Ps according to a total score of sleep disorders

Sleep disorders score	Number of subjects with sleep disorders
None (without problem)	10 (1.2%)
Mild (scores between 1-7)	286 (33.6%)
Moderate (scores between 7-14)	418 (49.2%)
Severe (scores between 14-21)	136 (16%)

Sleep deprivation symptoms

Sleep deprivation symptoms are presented in Table 4. In terms of physical symptoms, the maximum frequency belonged to weakness and fatigue, and headache with the values of 29.9% and 24.5%, respectively. In total, 96.7% of subjects with noticeable problems recorded scores in the range of 1 to 40. Generally, the score 26 was the mode for sleep deprivation symptoms. The maximum mental symptoms were related to indisposition feeling, and

aggression and irritability with the frequency of 24.7% and 23.8%, respectively. Totally, 24 scores were allocated to mental symptoms; it showed that 94.8% of subjects recorded scores in the range of 1 to 24. Moreover, 95.5% of them with emotional symptoms recorded scores in the range of 1 to 36. The maximum frequency was related to inhibition of study and fun with the amounts of 38.4% and 36.2%, respectively. There were sleep deprivation symptoms in 97.9% with the scores from 2 to 99.

Table 4: Relative frequency distribution of sleep deprivation symptoms in N & Ps

Symptoms	Problems	Level					Total
		Too much	Much	Low	Very low	I did not have	
Physical symptoms	Sleep disorder	23.5	27.3	22.1	11.8	15.3	100
	Malnutrition	22.6	27.8	21.4	12.5	15.8	100
	Impaired vision	10.6	13.6	21.9	15.1	38.8	100
	Decreased libido	11.1	10.1	13.9	8.5	56.5	100
	Tachycardia	8	23.5	23.8	10.1	34.6	100
	Shivering	4.9	10.6	20.7	14.6	49.2	100
	Headache	24.5	30.8	21.2	10.6	12.9	100
	Decreased vigilance	13.2	22.8	29.4	16.2	18.4	100
	Frequent naps during the day	16.5	18.1	25.6	14.6	25.2	100
	Frequent yawning during the day	19.1	25.2	21.9	16	17.9	100
Mental and emotional symptoms	Aggression and irritability	23.8	24	25.2	12.9	14.1	100
	Loss of affection and love	14.8	20	28.2	12.9	24	100
	Loss of confidence	11.8	15.8	26.6	14.6	31.3	100
	Reduced tolerance to problems	18.6	26.8	22.4	12.2	20	100
	Impaired memory and concentration	15.8	24.7	23.5	15.8	20.2	100
	Impairment of tasks to the spouse and/or family	15.7	24.2	18.4	12.9	28.7	100
	Impairment of tasks to the children and/or relatives	16.9	21.6	20	13.5	28.9	100
	Inhibition of fun	36.2	31.8	12.9	6.8	12.2	100
	Inhibition of study	38.4	33.9	12	6.1	9.6	100
	Social isolation	13.6	19.3	19.3	13.4	34.4	100

Findings analyzed based on Spearman correlation

Correlations based on Spearman ratio (r) among demographics and sleep deprivation symptoms are

presented in Table 5. Correlations between experience with sleep maintenance disorder and physical symptoms were positive and significant (0.20 and 0.12,

respectively). The positive and significant correlation was obtained between hours of overtime with excessive sleepiness and total sleep disorders (0.11 and 0.10, respectively).

Table 5: Spearman correlations between demographics and sleep deprivation symptoms

Variables	Experience	Age (years)	Hours of overtime	Disorder in initiating sleep	Disorder in maintaining sleep	Disorder in waking up	Excessive sleepiness	Parasomnia	Total sleep disorders	Physical symptoms	Mental symptoms	Emotional symptoms
Experience	1	0.93	ns	ns	0.2	ns	ns	ns	0.1	0.12	ns	ns
Age (years)	0.93	1	ns	ns	0.2	ns	ns	ns	ns	ns	ns	ns
Hours of overtime	ns	ns	1	ns	ns	ns	0.1	ns	0.1	ns	ns	ns
Disorder in initiating sleep	ns	ns	ns	1	0.39	0.32	0.3	0.28	0.58	0.38	0.28	0.35
Disorder in maintaining sleep	0.2	0.2	ns	0.39	1	0.54	0.38	0.41	0.79	0.48	0.37	0.4
Disorder in waking up	ns	ns	ns	0.32	0.54	1	0.44	0.37	0.72	0.47	0.44	0.42
Excessive sleepiness	ns	ns	0.11	0.3	0.38	0.44	1	0.42	0.73	0.44	0.45	0.47
Parasomnia	ns	ns	ns	0.28	0.41	0.37	0.42	1	0.64	0.5	0.47	0.44
Total sleep disorders	0.1	ns	0.1	0.58	0.79	0.72	0.73	0.64	1	0.62	0.56	0.57
Physical symptoms	0.12	ns	ns	0.38	0.48	0.47	0.44	0.5	0.62	1	0.77	0.73
Mental symptoms	ns	ns	ns	0.28	0.37	0.44	0.45	0.47	0.56	0.77	1	0.79
Emotional symptoms	ns	ns	ns	0.35	0.4	0.42	0.47	0.44	0.57	0.73	0.79	1

Significant level at p<0.05, ns: Non significant

Findings analyzed based on the Kruskal-Wallis test

Cora relations based on the Kruskal-Wallis test (λ^2) among demographics and sleep deprivation symptoms are shown in Table 6. Correlation between degree of study and sleep deprivation symptoms were ranged from 7 to 26.1 for total sleep disorders and emotional symptoms, respectively. A significant correlation was

obtained between occupational status with initiating sleep, excessive sleepiness, and mental, emotional, physical, and total symptoms of sleep deprivation being 19.4, 13, 16.2, 26.6, 16.4, and 21.8, respectively. Concerning wards wherein subjects occupied, correlations were ranged from 23.3 to 62.3 for initiating sleep and emotional symptoms of sleep deprivation.

Table 6: Correlations between demographics with sleep deprivation symptoms based on Kruskal-Wallis test

Variables	Disorder in initiating sleep	Excessive sleepiness	Total Sleep disorders	Physical symptoms	Mental symptoms	Emotional symptoms	Total sleep deprivation symptoms	Parasomnia	Disorder in maintaining sleep
Degree	0.017	0.025	0.03	0.004	0.001	0.001	0.001	ns	ns
Shift	0.02	0.009	ns	ns	0.029	0.019	0.04	ns	ns
Occupational status	0.001	0.023	ns	0.006	0.006	0.001	0.001	ns	ns
Wards	0.016	0.004	0.013	0.001	0.001	0.001	0.001	0.001	ns
Employing conditions	ns	ns	0.05	0.007	ns	ns	ns	0.014	0.01

Significant level at p<0.05, ns: Non significant

STUDY LIMITATIONS

Study limitation includes cultural characteristics of research sample, voluntary entry to study and self-declaration.

DISCUSSION

Based on current findings, misalignment between shift schedule and hours of sleep caused disorders in sleep initiation and maintenance of 67.5% and 87.1% of the shift-workers. Present findings were consistent with the study of Gamaldo *et al.*, Jensen *et al.*, and Shiffer *et al.* They reported that being of misalignment between the sleep pattern and the desired sleep schedule causing difficulty in initiating sleep, maintaining sleep, and/or experiencing poor quality sleep predisposing people to insomnia or excessive sleepiness [27-29]. Current statistics of the subjects with the disorder in sleep maintenance was noticeably significant. Vallières *et al.* reported that difficulties in falling and maintaining sleep experienced by shift workers exacerbates certain physical and mental problems and impairs their life quality. The report was compatible with current findings [30].

Present findings showed that some two-thirds of the subjects with circadian sleep disorders suffered from fatigue. Saleh *et al.* reported similar findings [31]. Other studies indicated that sleep disorders and sleep deprivation in night-shift workers might cause high levels of fatigue [28,29]. Ferreira *et al.* In their study showed that Subjects with excessive sleepiness in 72.8% of cases showed disorders such as sleep irresistible attacks, naps during the day, episodes of disorientation or confusion and movement disorder, staying at bed more than normal time, and drowsiness [32]. Inconsistency, Boivin *et al.* reported that vigilance, performance, health, and safety of shift-workers are significantly influenced by excessive sleepiness [15]. Findings obtained showed that undesirable shift schedule of N & Ps contributes to sleep disorders and following work impairment. Congruently, Swanson *et al.* reported that sleep disorders considerably increases the possibility of negative outcomes of shift-workers [33]. In the current study, the frequency of physical, mental, and emotional symptoms of sleep deprivation was remarkably significant being 96.7%, 94.8%, and 95.5%, respectively. Inconsistent with the several reports, obtained findings demonstrated that undesirable shift schedule affect circadian rhythms [34] causing mentioned symptoms, which may lead to occupational error [35], leave them at higher risk of daily and social aspects [36], and have a negative effect on attention [37], daily performance [38], and working memory [39].

Furthermore, several reports demonstrated that sleep deprivation, alteration, and disruption of the circadian rhythms influence physical, mental and emotional aspects and have a deleterious effect on fine motor coordination in healthcare providers and may differentially impair processing of more-detailed visual information [40-44]. Conversely, Scherer *et al.* indicated

that sleep deprivation does not affect dynamic visual acuity [45]. Also, no significant decrease was shown in the performance of sleep-deprived healthcare providers in the study of O'Brien *et al.* [46].

Current findings showed a direct association between hours of overtime with excessive sleepiness. In the agreement, Pikovsky *et al.* and van Leeuwen *et al.* reported that hours of overtime among healthcare providers are associated with increased sleepiness significantly leads to excessive sleepiness [47,48]. Scott *et al.* reported a direct correlation between hours of overtime with decreased vigilance and increased risk of errors in nurses [18]. Moreover, over time shifting adversely influences the health and safety of shift-workers [49].

In the current study, the correlation between excessive sleepiness and gender was significant. Similarly, Fatani *et al.* reported a significant correlation between excessive sleepiness and gender in shift-workers with the undesirable sleep-wake schedule [50]. In contrast to the present study, they reported that being married in sleep-deprived shift-workers is a protective factor against excessive sleepiness. In the current findings, the correlation was significant between occupational status with sleep disorders and symptoms of sleep deprivation.

There were no reports, to our knowledge, to compare with current findings in terms of the degree of study and occupational status with sleep deprivation symptoms. Only verified report was available from the Centres for Disease Control and Prevention in terms of sleep duration among shift-workers indicated a high prevalence of short sleep duration in healthcare providers with night shifts [51]. In conclusion, decreased performance and vigilance in nurses and paramedics with sleep deprivation symptoms may result in decreased safety and health of the patients.

CONCLUSION

Current findings indicated that nurses and paramedics have disorders in initiating and maintaining sleep and physical, mental, and emotional symptoms of sleep deprivation in differently impressive severities. Also, there were significant correlations between gender, marital status, experience, and hours of overtime with sleep disorders and symptoms of sleep deprivation. As for nurses and paramedics are key individuals in the healthcare system, and unfortunately as potential patients in the future mainly owing to undesirable and heavy shifts, paying special attention to them is necessary.

RECOMMENDATIONS

As for heavy shifts of nurses and paramedics, we suggest favorable and desirable shift schedule for them also investigating their sleep quality in regular intervals, arranging favorable shift schedule as they can do their daily activities and do meditation and exercises to get more comfortability and more energy.

ACKNOWLEDGMENT

This research project (No: 948) was sponsored by Deputy of Research and Technology of Lorestan University of Medical Sciences. Authors appreciate nurses and paramedics of teaching hospitals affiliated to Lorestan University of Medical Sciences who contributed to the research project.

AUTHORS' CONTRIBUTIONS

NG: designed, collected and analyzed data; AM: written the manuscript; FG: data collection; MG: data collection; SH: data analysis

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

REFERENCES

- National Institute of Neurological Disorders and Stroke. Basics B. Understanding Sleep. NINDS, US National Institutes of Health 2017.
- Taheri S, Lin L, Austin D, et al. Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index. *PLoS Med* 2004; 1:e62.
- Alhola P, Polo-Kantola P. Sleep deprivation: Impact on cognitive performance. *Neuropsychiatr Dis Treat* 2007; 3:553-67.
- Chuah L, Chee M. Functional neuroimaging of sleep deprived healthy volunteers and persons with sleep disorders: A brief review. *Ann Acad Med Singapore* 2008; 37:689-94.
- Gianfredi V, Nucci D, Tonzani A, et al. Sleep disorder, mediterranean diet and learning performance among nursing students: Insomnia, a cross-sectional study. *Ann Ig* 2018; 30:470-81.
- Bromundt V. Disorders of the sleep-wake cycle in psychiatric disorders. *Ther Umsch* 2014; 71:663-370.
- Riemann D, Berger M, Voderholzer U. Sleep and depression-Results from psychobiological studies: An overview. *Biol Psychol* 2001; 57:67-103.
- Vitiello MV. The interrelationship of sleep and depression: New answers but many questions remain. Elsevier 2018.
- Pilcher JJ, Huffcutt AI. Effects of sleep deprivation on performance: A meta-analysis. *Sleep* 1996; 19:318-26.
- Thomas ML, Sing HC, Belenky G, et al. Neural basis of alertness and cognitive performance impairments during sleepiness II. Effects of 48 and 72 h of sleep deprivation on waking human regional brain activity. *Thalamus Relat Syst* 2003; 2:199-229.
- Videnovic A, Lazar AS, Barker RA, et al. 'The clocks that time us'-Circadian rhythms in neurodegenerative disorders. *Nat Rev Neurol* 2014; 10:683.
- Hvolby A. Associations of sleep disturbance with ADHD: Implications for treatment. *Atten Defic Hyperact Disord* 2015; 7:1-18.
- Liira J, Verbeek JH, Costa G, et al. Pharmacological interventions for sleepiness and sleep disturbances caused by shift work. *Cochrane Database Syst Rev* 2014.
- Koren D, O'Sullivan KL, Mokhlesi B. Metabolic and glycemic sequelae of sleep disturbances in children and adults. *Curr Diab Rep* 2015; 15:562.
- Boivin D, Boudreau P. Impacts of shift work on sleep and circadian rhythms. *Pathol Biol* 2014; 62:292-301.
- 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; 351:1838-48.
- Rogers AE, Hwang WT, Scott LD, et al. The working hours of hospital staff nurses and patient safety. *Health Aff* 2004; 23:202-12.
- Scott LD, Rogers AE, Hwang WT, et al. Effects of critical care nurses' work hours on vigilance and patients' safety. *Am J Crit Care* 2006; 15:30-7.
- www.statcan.gc.ca/eng/start
- Gaba DM, Howard SK. Fatigue among clinicians and the safety of patients. *N Engl J Med* 2002; 347:1249-55.
- Ruggiero JS, Redeker NS. Effects of napping on sleepiness and sleep-related performance deficits in night-shift workers: A systematic review. *Biol Res Nurs* 2014; 16:134-42.
- Passos MH, Silva HA, Pitanguí AC, et al. Reliability and validity of the Brazilian version of the Pittsburgh sleep quality index in adolescents. *J Pediatr (Rio J)* 2017; 93:200-6.
- Chen CJ, McHugh G, Campbell M, et al. Subjective and objective sleep quality in individuals with osteoarthritis in Taiwan. *Musculoskeletal Care* 2015; 13:148-59.
- Duarte J, Nelas P, Chaves C, et al. Sleep-wake patterns and their influence on school performance in Portuguese adolescents. *Aten Primaria* 2014; 46:160-4.
- Allen GA, Ruivo MD, Meia-Via AM, et al. Basic SCALE ON INSOMNIA complaints and quality of sleep (BaSIQS): Reliability, initial validity and normative scores in higher education students. *Chronobiol Int* 2015; 32:428-40.
- World Medical Association. World medical association declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA* 2013; 310:2191-4.
- Gamaldo CE, Chung Y, Kang YM, et al. Tick-tock-tick-tock: The impact of circadian rhythm

- disorders on cardiovascular health and wellness. *J Am Soc Hypertens* 2014; 8:921-9.
28. Jensen HI, Larsen JW, Thomsen TD. The impact of shift work on intensive care nurses' lives outside work: A cross-sectional study. *J Clin Nurs* 2018; 27:e703-e9.
 29. Shiffer D, Minonzio M, Dipaola F, et al. Effects of clockwise and counterclockwise job shift work rotation on sleep and work-life balance on hospital nurses. *Int J Environ Res Public Health* 2018; 15:2038.
 30. Vallières A, Azaiez A, Moreau V, et al. Insomnia in shift work. *Sleep Med* 2014; 15:1440-8.
 31. Saleh AM, Awadalla NJ, El-Masri YM, et al. Impacts of nurses' circadian rhythm sleep disorders, fatigue, and depression on medication administration errors. *Egypt J Chest Dis Tuberc* 2014; 63:145-53.
 32. Ferreira LRC, Martino MMFD. Sleep patterns and fatigue of nursing students who work. *Rev Esc Enferm USP* 2012; 46:1178-83.
 33. Swanson LM, Arnedt JT, Rosekind MR, et al. Sleep disorders and work performance: Findings from the 2008 national sleep foundation sleep in America poll. *J Sleep Res* 2011; 20:487-94.
 34. Amirian I. The impact of sleep deprivation on surgeons' performance during night shifts. *Dan Med J* 2014; 61:B4912.
 35. Johnson AL, Jung L, Brown KC, et al. Sleep deprivation and error in nurses who work the night shift. *J Nurs Adm* 2014; 44:17-22.
 36. Louca M, Short MA. The effect of one night's sleep deprivation on adolescent neurobehavioral performance. *Sleep* 2014; 37:1799-807.
 37. Pérez-Olmos I, Ibáñez-Pinilla M. Night shifts, sleep deprivation, and attention performance in medical students. *Int J Med Educ* 2014; 5:56.
 38. Liberalesso PBN, D'Andrea KFK, Cordeiro ML, et al. Effects of sleep deprivation on central auditory processing. *BMC Neurosci* 2012; 13:83.
 39. Joo EY, Yoon CW, Koo DL, et al. Adverse effects of 24 hours of sleep deprivation on cognition and stress hormones. *J Clin Neurol* 2012; 8:146-50.
 40. Okura T, Higaki J. Metabolic syndrome. *Nihon Rinsho Jpn J Clin Med* 2014; 72:1424-8.
 41. Whitney P, Hinson JM, Jackson ML, et al. Feedback blunting: Total sleep deprivation impairs decision making that requires updating based on feedback. *Sleep* 2015; 38:745-54.
 42. Ayalon RD, Friedman Jr F. The effect of sleep deprivation on fine motor coordination in obstetrics and gynecology residents. *Am J Obstet Gynecol* 2008; 199:576e1-e5.
 43. Jackson ML, Croft RJ, Owens K, et al. The effect of acute sleep deprivation on visual evoked potentials in professional drivers. *Sleep* 2008; 31:1261-9.
 44. Hemamalini R, Krishnamurthy N, Saravanan A. Influence of rotating shift work on visual reaction time and visual evoked potential. *J Clin Diagn Res* 2014; 8:BC04.
 45. Scherer MR, Claro PJ, Heaton KJ. Sleep deprivation has no effect on dynamic visual acuity in military service members who are healthy. *Physical Therapy* 2013; 93:1185-96.
 46. O'brien MJ, O'toole RV, Newell MZ, et al. Does sleep deprivation impair orthopaedic surgeons' cognitive and psychomotor performance? *JBJS* 2012; 94:1975-81.
 47. Pikovsky O, Oron M, Shiyovich A, et al. The impact of sleep deprivation on sleepiness, risk factors and professional performance of medical residents. *IMAJ* 2013; 2:18.
 48. van Leeuwen WM, Kircher A, Dahlgren A, et al. Sleep, sleepiness, and neurobehavioral performance while on watch in a simulated 4 hours on/8 hours off maritime watch system. *Chronobiol Int* 2013; 30:1108-15.
 49. Parkes KR. Work environment, overtime and sleep among offshore personnel. *Accid Anal Prev* 2017; 99:383-8.
 50. Fatani A, Al-Rouqi K, Al Towairky J, et al. Effect of age and gender in the prevalence of excessive daytime sleepiness among a sample of the Saudi population. *J Epidemiol Glob Health* 2015; 5:S59-S66.
 51. Control CfD, Prevention. Short sleep duration among workers--United States, 2010. *MMWR Morb Mortal Wkly Rep* 2012; 61:281.