SciMedCentral

Annals of Public Health and Research

Research Article

Effect of Shift Work on Sleep Quality and Functional Outcome among Nurses in Governmental Hospitals

Hussain A Al-Yousif[1], Sultan T Al-Otaibi[2]* and Marwan Behisi[3]

[1]*Occupational Health Department, Dammam Medical complex, Ministry of Health, Saudi Arabia*

[2]*Associate Professor of Public Health, Imam Abdulrahman Bin Faisal University, Department of Family and Community Medicine, College of Medicine, Saudi Arabia*

[3]*Occupational Medicine Specialist, Johns Hopkins Aramco Healthcare, Saudi Arabia*

***Corresponding author**

Sultan T Al-Otaib, Associate Professor of Public Health, Imam Abdulrahman Bin Faisal University, Department of Family and Community Medicine, College of Medicine, Po Box 1982, Dammam 31441, Telephone: 00-966-504914199, Fax: 00-966-13-8645612, Saudi Arabia

Submitted: 11 March, 2025
Accepted: 03 April, 2025
Published: 07 April 2025

Keywords

- Nurse
- Shift Work
- Sleep Quality
- Functional Outcome of Sleep

Abstract

Background: Shift work has been reported as a burden for nurses worldwide. Nurses involved in irregular shift work are more likely to suffer from insomnia and sleep disturbances.

Aims: To assess the effect of shift work on perceived sleep quality among nurses at governmental hospitals and to investigate the risk factors for poor sleep quality among those nurses.

Methods: A comparative cross-sectional survey study among nurses from two randomly selected governmental hospitals during the period from January 2023 to June 2023 in Dammam. Data were collected using a self-administered questionnaire incorporating demographic information, the Pittsburgh Sleep Quality Index (PSQI), and the Functional Outcomes of Sleep Questionnaire (FOSQ).

Results: A total of 400 nurses participated in this study, and 293 (73.30%) were doing shift work. The global PSQI mean (±SD) score was 9.88 (±4.51), being statistically significant ($p = 0.013$) higher in the shift work group at 10.22 (±4.53) than the morning shift only at 8.97 (±4.38). There were statistically significant differences in PSQI for age, nationality, educational level, and use of sedative or stimulant medications. For FOSQ, the mean of the overall score was 9.58 (±3.23). The score did not differ significantly by the type of work.

Conclusions: Shift work significantly lowered sleep quality, causing sleep disturbance that impairs functional outcomes for studied nurses. Understanding the interactions between shift work and sleep quality is crucial for further recommendations regarding shift work scheduling to minimize adverse effects.

INTRODUCTION

Sleep is defined as "a spontaneous and recurring state of altered consciousness, reduced muscle tension, increased reflex threshold, and inhibited perception of surrounding stimuli" [1]. It is divided traditionally into two phases: Non-Rapid Eye Movement (NREM) and Rapid Eye Movement (REM). The Suprachiasmatic Nucleus (SCN) (biological clock), determines with environmental cues the waking and sleeping cycle of the day, and it regulates the phases of sleep [1]. Night shifts significantly interfere with this biological clock, causing various physical and psychological disorders [2,3]. Shift work has been reported as a burden for nurses worldwide. Nurses involved in irregular shift work are more likely to suffer from insomnia and sleep disturbances. Low sleep quality is associated with deteriorating health and chronic diseases. Furthermore, it affects the quality of patients' care [4-6].

Shift work is defined as work outside the traditional morning-to-evening schedule. Shift work can be classified as rotating shift, split shift, night shift, afternoon shift, swing shift, extended hours, overtime, or irregular shifts, based on the work's timing and requirements [7]. Shift work has been defined by the International Labor Organization as a method to organize working time in which workers succeed one another at the workplace, allowing the establishment to operate longer than the working hours of individual workers. Thus, we can define shift work as a series of periods (shifts) in which workers sequentially cover 24 hours [1-3].

Irregular shifts and night shifts have been reported to be associated with poor sleep quality in nurses.8, 9 Poor sleep quality negatively affects the endocrine, digestive, and immune systems [7,10]. It is associated with cancer, cardiovascular problems, and psychological disturbances

[11]. Furthermore, nurses on night shifts commit more medical errors and fail to provide the same quality of care as other nurses. Sleep disorders from shift work have driven many nurses to quit their jobs [12-14]. For these reasons, it is crucial to further investigate this interaction.

Many studies have assessed sleep quality in nurses [4,15-19]. Most have found that nurses working longer hours and night shifts have far lower quality of sleep than do other nurses. They have also found that female nurses are at greater risk for compromised sleep quality. Stressful conditions and diseases additionally increase the risk of low-quality sleep [5-7,16-21]. Enhancing the quality of sleep in nurses thus enhances the quality of health care [10].

Health care is facing a challenge of declining manpower, and nurses are no exception as they seek decreased hours, transfer to other jobs, or resignation, with impaired productivity as a result. To help address the issue, this study assesses the effect of shift work on perceived sleep quality among nurses at governmental hospitals and to investigate the risk factors for poor sleep quality among those nurses.

METHODS

This was a cross-sectional study conducted among 400 nurses in Dammam Medical Complex and King Fahad Specialist Hospital, governmental hospitals in Dammam City, located in the Eastern Province of Saudi Arabia. Inclusion criteria include: Nurses currently working full-time in governmental hospitals in Dammam, of all ages and qualifications, regardless the gender and nationality. While nurses having been employed less than one year and trainee nurses were excluded.

This cross-sectional study was conducted using simple random sampling which was a single step with each participant selected independently of the other members of total nurses through random number table. We collected data from shift nurses recruited from two randomly selected governmental hospitals (proportion of the sampling in the hospitals was 1:1) within Dammam during the period from January 2023 to June 2023.

The sample size was estimated based on reports of poor sleep among shift nurses; the lowest prevalence of sleep disturbance among shift workers in a recent study was 29.2% [22]. A minimum sample size of 400 participants was required for a 95% confidence interval with 5% margin of error for the expected level of poor sleep among the studied nurses. There were 400 questionnaires distributed and completed by nurses in two governmental hospitals.

The study protocol was approved by the Institutional review Board of Imam Abdulrahman bin Faisal University (IRB-UGS-2023-03-156), and written consent was obtained from each participant. All personal data were kept confidential and used only for the purposes of the study. Data confidentiality were maintained during this study. The participation in this study was voluntary. All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Participants were asked to fill out a modified and validated self-administered English questionnaire incorporating demographic and occupational information, the Pittsburgh Sleep Quality Index (PSQI) [23,24] and the Functional Outcomes of Sleep Questionnaire (FOSQ) [25]. The questions were both binary and multiple-choice.

The Questionnaire Comprised the Following

Demographic and personal characteristics: This section covered age, sex, nationality, marital status, academic degree, type of work, department, years of work experience, duration of work, smoking and use of sedatives or stimulants, and medical history.

PSQI: This is a set of criteria used to determine a person's level of sleep disturbance. It differentiates "poor" sleep from "good" by measuring seven areas over a one-month period: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The participant self-rates each of these aspects of sleep on a Likert scale from 0 to 3 scale, with 3 reflecting negative extremes. A global sum of 5 or greater indicates a "poor" sleeper. The validity of this questionnaire has been measured using Cronbach's alpha, with a result of 0.72. Also, test-retest reliability was measured to determine the internal consistency of this tool and it was adequate with an interclass correlation coefficient of 0.68.

FOSQ: This set of 30 questions measures the functional outcomes resulting from sleep demand, concerning activity level, vigilance, intimacy and sexual relationships, general productivity, and social outcomes. Respondents were asked to rate the difficulty of performing given activities on a four-point Likert scale (ranging from no difficulty to extreme difficulty). And for scoring mean-weighted item score for each subscale; subscale scores are added to produce a global score. Lower scores were associated

with greater dysfunction. For reliability and validity, test-retest reproducibility and internal consistency were well-reported. Content validity reported, seven judges rated clinical relevance. The validity of the questionnaire was reported using Cronbach's alpha, with a result of 0.70.

After the necessary approvals were granted for the study, a meeting with hospital managers was arranged to explain to them the study's objectives. The researchers then met with all nursing department heads and gave them an overview of the study to obtain their cooperation. The researchers selected the hospitals randomly from a list. Questionnaires were then given to the participating nurses to be completed with their written consent. They were asked to complete the questionnaire without leaving any items blank.

Data were analyzed with IBM SPSS Statistics for Windows, version 25 (IBM Corp. Armonk, N.Y., USA). Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. The statistical tests used in this study included Student t-test and Chi-Square. Furthermore, ANOVA test was used for continuous variables with parametric data. The Shapiro-Wilk test was used to assess the normality of the data. A p-value below 0.05 was considered statistically significant.

RESULTS

Of the 400 participating nurses, 293 (73.32%) worked shift work, and 107 (26.78%) worked day work. The results were presented in three main sections. The first part presented the characteristics of the study group, the second described sleep patterns and sleeping disorders among participants, and the last part showed functional outcome of sleep quality.

The characteristics of the shift work nurses were shown in (Table 1). Three quarters (74.74%) of these nurses were female, and more than half (56.31%) were between 30 and 39 years old (mean age 33.54±4.30). Majorities were Saudi nationals (74.06%) and married (73.04%), and more than half (54.27%) of these participants had a bachelor's degree. The largest proportions of the participants were from emergency departments (21.84%) and intensive care (21.16%). Majority of the shift work nurses (51.88%) had a duration of experience between one and five years (mean 5.13 ± 3.49). Of these nurses 84.30% did not take any sedative or stimulant medications. Sleep and psychiatric disorders were present in 14.33% of participants, followed by hypertension (7.17%) and diabetes mellitus (4.10%). 84.3% of shift workers were nonsmokers.

Table 1: The characteristics of shift work nurses.

Variable	Characteristics	Number	Prevalence (%)
Over all		**293**	**73.32**
Age	20-29y	97	33.10
	30-39y	165	56.31
	40-49y	18	6.14
	>=50y	13	4.45
Gender	Male	74	25.26
	Female	219	74.74
Nationality	Saudi	217	74.06
	Non-Saudi	76	25.94
Marital Status	Single	72	24.57
	Married	214	73.04
	Divorced &Widow	7	2.39
Academic Degree	Diploma	117	39.93
	Bachelor	159	54.27
	Master & PhD	17	5.80
Department	Intensive care	62	21.16
	Internal Medicine	39	13.31
	Surgery	46	15.70
	Paediatrics	31	10.58
	Obstetrics/ Gynaecology	38	12.97
	Out - Patient	13	4.44
	ER	64	21.84
Duration of work in years	1-5y	152	51.88
	6-10y	98	33.45
	11-15y	29	9.90
	>15y	14	4.77
Taking any sedative or stimulant medications	Yes	46	15.70
	No	247	84.30
Past medical history	Diabetes mellitus	12	4.10
	Hypertension	21	7.17
	Depression	14	4.78
	Bronchial asthma	10	3.41
	Any sleep disorders of psychiatric illness	42	14.33
	Other	39	13.31
	No	155	52.90
Smoking cigarettes or water pipe daily	Yes	47	15.70
	No	246	84.30

The mean score for the components and global PSQI questionnaire by work status were shown in (Table 2). The global PSQI mean (±SD) score was 9.88 (±4.51), being significantly (p = 0.013) higher in the shift work group, at 10.22 (±4.53), than in the day shift working group, at 8.97 (±4.38), indicating worse sleep quality in the shift working group. For the component scores of the global PSQI, only three out of the seven components showed statistically significant difference between the shift work group and the day group ($p < 0.05$). These three components were the subjective sleep quality, sleep latency, and sleep duration. Mean values for Subjective sleep quality for total, shift and day work were as following: 1.65 (±0.98), 1.73 (±1.00), 1.43 (±0.90) which occurs in the area between fairly good and fairly bad, the second (sleep latency): 1.77 (±0.96), 1.84 (±0.97), 1.57 (±0.91), and the third (sleep duration):

Table 2: Mean score[$] for the Components and Global PSQI questionnaire by work status.

Component	All		Shift work		Day work		*P* value
	Mean	SD	Mean	SD	Mean	SD	
Subjective sleep quality	1.65	0.98	1.73	1.00	1.43	0.90	0.004*
Sleep latency	1.77	0.96	1.84	0.97	1.57	0.91	0.010*
Sleep duration	1.80	0.92	1.87	0.90	1.60	0.92	0.007*
Sleep efficiency	0.71	0.98	0.75	1.03	0.61	0.86	0.435
Sleep disturbance	1.64	0.83	1.64	0.84	1.64	0.79	0.634
Use of sleep medication	0.65	1.04	0.68	1.08	0.58	0.93	0.770
Daytime dysfunction	1.67	1.04	1.71	1.06	1.54	0.99	0.149
Global PSQI score	9.88	4.51	10.22	4.53	8.97	4.38	0.013*

* Significant p value
$ Higher scores indicate worse sleep quality
SD = Standard Deviation

1.80 (±0.92) 1.87 (±0.90) 1.60 (±0.92) which occurs on the area between 6-7 hours and 5-6 hours. On the other hand, the day shift group showed statistically insignificantly (p > 0.05) lower mean scores in three components (sleep efficiency, use of sleep medications, and daytime dysfunction) and an equal mean score in one component (sleep disturbance).

Table 3 showed a statistically significant difference in the PSQI score by age, nurses aged 30-39 showing the worst sleep quality, with a score of 10.17 (±4.61). Saudi nurses showed significantly worse sleep quality than non-Saudi, with respective mean scores of 10.79 and 6.57 (p < 0.001). The highest PSQI scores were reported by nurses with diplomas (p = 0.040) and those working in the ER, followed by those in the surgery department (p < 0.05). Furthermore, a highly statically significant (p < 0.001) incidence of poor sleep quality was shown in nurses who reported taking sedative or stimulating medications, with a score of 14, compared to those who were not, at 9.13. Nurses with depression had the highest PSQI score of 13.93 (±4.48). Post hoc test (Tukey test), showed that there was a significant difference in the means for sleep quality of nurses between age group 30-39 years and 40-49 years (p = 0.014).

Also, there was a significant difference in the means for sleep quality of nurses between age group 30-39 years and > 50 years (p = 0.024), The means of sleep quality for nurses holding diploma's degree was statistically significant compared to the means of sleep quality for nurses holding bachelor's degree (p = 0.013). There was a significant difference for the means of sleep quality for nurses working in intensive care and those working Emergency Room (ER) (p < 0.001), and also for the mean of sleep quality for those working in out-patient and nurses working in ER (p =0.024).

Table 3: Mean score[$] of PSQI by characteristics of the participants.

Variable	Outcome	Mean	SD	*P* value
Age	20-29y	10.19	4.22	0.035*
	30-39y	10.17	4.61	
	40-49y	8.28	4.11	
	>=50y	7.65	4.89	
Gender	Male	9.26	4.11	0.169
	Female	10.08	4.63	
Nationality	Saudi	10.79	4.32	<0.001*
	Non-Saudi	6.57	3.58	
Marital Status	Single	9.89	4.38	0.261
	Married	9.84	4.58	
	Divorced & Widow	10.42	3.76	
Academic Degree	Diploma	10.59	4.90	0.040*
	Bachelor	9.39	4.12	
	Master & PhD	9.01	4.25	
Department	Intensive care	8.49	3.79	0.005*
	Internal Medicine	9.87	4.24	
	Surgery	10.59	4.76	
	Paediatrics	8.97	4.66	
	Obstetrics/ Gynaecology	9.67	5.09	
	Out – Patient	9.78	4.13	
	ER	11.58	4.79	
Duration of work in years	1-5y	10.53	4.57	0.055
	6-10y	10.21	4.64	
	11-15y	10.03	4.28	
	>15y	8.50	4.11	
Taking any sedative or stimulant medications	Yes	14.00	3.22	<0.001*
	No	9.13	4.31	
Past medical history	Diabetes mellitus	10.58	4.07	0.001*
	Hypertension	9.39	4.04	
	Depression	13.93	4.48	
	Bronchial asthma	10.27	5.15	
	Any sleep disorders of psychiatric illness	13.07	3.55	
	Other	11.70	4.17	
	No	8.16	4.04	
Smoking cigarettes or water pipe daily	Yes	9.79	4.20	0.945
	No	9.90	4.57	

*Significant p value
$Higher scores indicate worse sleep quality

FOSQ results were given in Table 4, with the mean of the overall score being 9.58 (±3.23). The score did not differ significantly by type of work, being 10.02 for day shift and 9.43 for shift work (p = 0.075). Similarly, marital status did not significantly correlate with FOSQ score. By contrast, other characteristics showed statistically significant difference. Among those were age, for which the best FOSQ scores were reported by nurses aged 40-49, at 11.00 (±3.46), nationality, in which non-Saudis showed better results at 12.15 (compared to 8.88 for Saudis), and academic degree, wherein the best scores were from nurses with master's degrees (10.19). Nurses working in the ER had the lowest functional score of 8.39 (±2.76) with a p-value of 0.004. In all of these cases, p-values were below 0.05. Moreover, nurses who were taking sedatives

Table 4: Mean score[$] of FOSQ by of the participants.

Variable	Outcome	Mean	SD	*P* value
Type of Work	Shift work	9.43	3.14	0.075
	Morning (day) shift	10.02	3.43	
Age	20-29y	9.33	3.08	0.018*
	30-39y	9.44	3.21	
	40-49y	11.00	3.46	
	>=50y	10.06	3.25	
Gender	Male	10.60	2.95	<0.001*
	Female	9.26	3.25	
Nationality	Saudi	8.88	3.05	<0.001*
	Non-Saudi	12.15	2.49	
Marital Status	Single	9.86	3.30	0.551
	Married	9.50	3.22	
	Divorced & Widow	10.27	3.12	
Academic Degree	Diploma	9.01	3.32	0.008*
	Bachelor	9.98	3.14	
	Master & PhD	10.41	2.77	
Department	Intensive care	10.52	3.25	0.004*
	Internal Medicine	9.34	3.23	
	Surgery	9.90	3.31	
	Paediatrics	10.41	3.24	
	Obstetrics/ Gynaecology	9.95	3.38	
	Out – Patient	9.20	3.19	
	ER	8.39	2.76	
Duration of work in years	1-5y	9.38	3.12	0.010*
	6-10y	9.34	3.13	
	11-15y	9.27	2.95	
	>15y	11.23	3.12	
Taking any sedative or stimulant medications	Yes	7.47	2.16	<0.001*
	No	9.97	3.24	
Past medical history	Diabetes mellitus	10.11	3.40	<0.001*
	Hypertension	10.07	2.81	
	Depression	7.60	1.35	
	Bronchial asthma	10.80	3.26	
	Sleep disorders of psychiatric illness	8.13	2.51	
	Other	8.00	2.98	
	No	10.37	3.28	
Smoking cigarettes or water pipe daily	Yes	9.62	3.34	0.945
	No	9.58	3.21	
All		9.58	3.23	

*Significant p value
$Higher score indicating better functional status

or stimulants showed higher functional status than those not taking such medications, with respective mean scores of 9.97 (±3.24) and 7.47 (±2.16) ($p < 0.001$). Nurses with depression showed the lowest functional status, at 7.60 (±1.35) ($p < 0.001$).

Post hoc test (Tukey test), showed that there was a significant difference in the means for functional status of sleep for nurses between age group 20-29 years and 40-49 years ($p = 0.004$). Also, there was a significant difference in the means for functional status of sleep for nurses between age group 30-39 years and > 50 years ($p = 0.003$). The means of sleep functional status for nurses holding diploma's degree was statistically significant compared to the means of sleep functional status for nurses holding bachelor's degree ($p = 0.003$). There was a significant difference for the means of sleep functional status between nurses working in intensive care and those working ER ($p < 0.001$), and also for the means of sleep functional status between those working in intensive care and the means of nurses working in out-patient ($p =0.014$) and also between the means of sleep functional status for nurses working in intensive care and those working in internal medicine ($p =0.030$). Furthermore, there was a significant difference between the means of sleep functional status for nurses with work experience of 1-5 years compare to > 15 years ($p =0.010$).

DISCUSSION

The principal findings of this study were that sleep quality was poor in the shift work group of nurses.

In agreement with our results, a study by Ferri P. et al, [26]. Showed that nurses engaged in rotating night shifts were significantly younger, more frequently single, and typically holders of bachelor's and master's degrees in nursing. The demographic and professional characteristics of the two groups of nurses differed, reflecting a work organization that assigns shift work to younger and single nurses, a division also reported in previous similar studies [27,28] Additionally, in agreement with other authors [29]. This unequal distribution of work scheduling could represent a natural selection of professionals based on their health and social and marital status or a sort of apprenticeship for younger workers, quite common in health care settings worldwide. The higher percentage of nurses with bachelor's degrees in the shift working group was probably related to both their younger age and the growing availability of local university pertinent programs.

Overall, the sleep quality among the studied nurses was poor (PSQI > 5), and the comparison between the two groups highlighted that shift-working nurses reported lower sleep quality. Such findings are in line with previous similar studies [30-33] assessing sleep quality among nurses. Additionally, previous studies have reported poor sleep quality among all health care workers [33,34] Poor sleep quality and disruption of circadian rhythm may cause fatigue, insomnia, and daytime sleepiness, reducing work performance and increasing the risks of medical errors jeopardizing patient safety [34]. Almost all parameters of the PSQI were higher in the shift work group, and this was in line with the results of a previous Saudi local study [34].

In this study, age showed a significant influence on the quality of sleep. This contrasts with existing literature,

since previous studies found no significant relationship between age and quality of sleep [35,36] Moreover, the younger nurses showed the worst sleep quality scores, in disagreement with the findings of previous study [35]. The reported poor sleep quality was associated with older age among nurses. The difference was possibly due to cultural differences and the larger number of younger shift-working nurses in our study.

A highly significant poor sleep quality was shown in nurses who reported taking sedative or stimulating medications. Such findings were similar to those of a study by White et al, that showed poor sleep quality in 100% of nurses who used medications to sleep [36]. The use of medications to sleep may lead to side effects that include drowsiness and fatigue in the first hours of the morning, which represented a great risk for safety issues, leading to serious consequences, such as driving and working under the influence of medications. Moreover, the characteristics of primary sleep disturbance in the subjects who used medications to sleep include difficulty in falling asleep and constant wakefulness at night, which harmfully affect the sleep-wake cycle [37].

Circadian rhythms were associated with both mental and physical performance. In line with this, our study indicates a significant correlation between a history of psychiatric problems (depression) and poor sleep quality. Similar findings were reported in a study by Park, et al [38]. The FOSQ indicated that participants had difficulty carrying out certain activities due to drowsiness or fatigue. The FOSQ scores indicated little difficulty for the day work group and moderate difficulty among the shift work one; however, the difference was not statistically significant. In this regard, a study conducted on the effects of shift work on sleep quality, workers showed that the total FOSQ score was significantly higher in shift workers than in day workers [39]. Overall, in accordance with previous studies [37,39] the present study found that shift-working nurses had poorer sleep quality and consequently impaired functional outcomes.

STUDY LIMITATIONS

This study implemented a cross-sectional design in which the cause-specific relationship cannot be definitively established between shift work and poor sleep quality among nurses. The healthy worker effect should be considered in the interpretation. However, the current authors attempted to minimize this effect by selecting the daytime nurse group from the same hospital as a comparison group for the shift workers.

The study was limited to general hospitals. Nevertheless, the findings have implications for other health care facilities as well. The study design failed to exclude cases with already diagnosed and under treatment sleep disorders or at least indicate its prevalence in both groups. In this cross-sectional study, both shift work and sleep quality were measured concurrently. Future longitudinal studies for this association would provide clearer answers.

CONCLUSIONS

This study showed that shift work significantly lowered sleep quality, causing sleep disturbance that impaired functional outcomes for studied nurses. Understanding the association between shift work and sleep problems was essential for further recommendations regarding preventive measures including but not limited to shift work scheduling to minimize adverse effects.

RECOMMENDATIONS

Health promotion programs to educate about proper sleep hygiene and implementation of preventive measures should be considered by the studied hospitals to assess its effectiveness in improving sleep quality among nurses. Further studies should be carried out to identify the effect of shift work on sleep quality, work performance and other clinical end points e.g., mental, cardiovascular and social among other relevant outcomes of disturbed sleep-wake cycle. Other health care workers, should be considered in a multi-centre studies.

ACKNOWLEDGMENTS

The authors would like to thank Mr. Ahmad H. Al – Sharqawi, from the Biostatistics Department, Prince Naif Health Research Centre, King Saud University, Riyadh, who actively participated in the statistical analysis of this study. Our deepest gratitude to Ms. Heba M. Ibrahim for editing the manuscript. We also extend thanks to Scribendi Editing Services for English language editing.

REFERENCES

1. Aakash K Pate, Vamsi Reddy, Karlie R Shumway, John F Araujo, “Physiology, Sleep Stages”. 2024.
2. James SM, Honn KA, Gaddameedhi S, Van Dongen HPA. Shift Work: Disrupted Circadian Rhythms and Sleep-Implications for Health and Well-Being. Curr Sleep Med Rep. 2017; 3: 104-112.
3. Moreno CRC, Marqueze EC, Sargent C, Wright Jr KP Jr, Ferguson SA, Tucker P.Working Time Society consensus statements: Evidence-based effects of shift work on physical and mental health. Ind Health. 2019; 57: 139-157.
4. McDowall K, Murphy E, Anderson K, The impact of shift work on sleep quality among nurses, Occupa Med. 2017; 67: 621-625.
5. Ki J, Ryu J, Baek J, Huh I, Choi-Kwon S, Association between Health Problems and Turnover Intention in Shift Work Nurses: Health Problem Clustering. Int. J. Environ. Res. Public Health. 2020; 17: 4532.

6. Niu SF, Miao NF, Liao YM, Chi MJ, Chung MH, Chou KR. Sleep Quality Associated With Different Work Schedules: A Longitudinal Study of Nursing Staff. Biol Res Nurs. 2017; 19: 375-381.

7. Saksvik-Lehouillier I, Pallesen S, Bjorvatn B, Magerøy N, Folkard S. Towards a more comprehensive definition of shift work tolerance. Industrial health. 2017; 53: 69-77.

8. Books C, Coody LC, Kauffman R, Abraham S. Night Shift Work and Its Health Effects on Nurses. Health Care Manag (Frederick). 2020; 39:122-127.

9. Sun Q, Ji X, Zhou W and Liu J. Sleep problems in shift nurses: A brief review and recommendations at both individual and institutional levels. J Nurs Manag. 2019; 27: 10-18.

10. Khalil M, Power N, Graham E, Deschênes SS, Schmitz N. The association between sleep and diabetes outcomes - A systematic review. Diabetes Res Clin Pract. 2020;161:108035.

11. Rosa D, Terzoni S, Dellafiore F, Destrebecq A. Systematic review of shift work and nurses' health. Occup Med (Lond). 2019; 69: 237-243.

12. Min A, Min H, Hong HC. Work schedule characteristics and fatigue among rotating shift nurses in hospital setting: An integrative review. J Nurs Manag. 2019; 27: 884-895.

13. Galanis P, Katsiroumpa A, Vraka I, Siskou O, Konstantakopoulou O, Katsoulas T, et al. Nurses quietly quit their job more often than other healthcare workers: An alarming issue for healthcare services. Int Nurs Rev. 2024; 74: 850-859.

14. Chaiard J, Deeluea J, Suksatit B, Songkham W, Inta N, Stone TE. Sleep disturbances and related factors among nurses. Nurs Health Sci. 2019; 21: 470-478.

15. Kang J, Noh W, Lee Y. Sleep quality among shift-work nurses: A systematic review and meta-analysis. Appl Nurs Res. 2020; 52: 151227.

16. Dong H, Zhang Q, Sun Z, Sang F, Xu Y. Sleep disturbances among Chinese clinical nurses in general hospitals and its influencing factors. BMC Psychiatry. 2017; 17: 241.

17. Sepehrmanesh Z, Mousavi G, Saberi H, Saei R. Sleep quality and related factors among the nurses of the hospital of Kashan University of Medical Sciences, Iran. Int Arch Health Sci. 2017; 4: 17-21.

18. Imes CC, Chasens ER. Rotating Shifts Negatively Impacts Health and Wellness Among Intensive Care Nurses.Workplace Health Saf. 2019; 67: 241-249.

19. Beebe D, Chang JJ, Kress K and Mattfeldt-Beman M. Diet quality and sleep quality among day and night shift nurses. J nurs manag. 2017; 25: 549-557.

20. Tarhan M, Aydin A, Ersoy E, Dalar L. The sleep quality of nurses and its influencing factors. Eurasian J Pulmonol. 2018; 20: 78-84.

21. Sun Q, Ji X, Zhou W, Liu J. Sleep problems in shift nurses: A brief review and recommendations at both individual and institutional levels. J Nurs Manag. 2019; 27: 10-18.

22. Zhang Y, Murphy J, Lammers-van der Holst HM, Barger LK, Lai YJ, Duffy JF. Interventions to improve the sleep of nurses: A systematic review. Res Nurs Health. 2023; 46: 462-484.

23. Buysse DJ, Reynolds CF, Monk TH, Berman SR and Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28:193-213.

24. Ørskov PT, Norup A. Validity and reliability of the Danish version of the Pittsburgh Sleep Quality Index. Scand J Public Health. 2023; 51: 1182-1188.

25. Chasens ER, Ratcliffe SJ and Weaver TE. Development of the FOSQ-10: a short version of the Functional Outcomes of Sleep Questionnaire. Sleep. 2009; 32: 915-919.

26. Ferri P, Guadi M, Marcheselli L, Balduzzi S, Magnani D, Di Lorenzo R. The impact of shift work on the psychological and physical health of nurses in a general hospital: a comparison between rotating night shifts and day shifts. Risk Manag Healthc Policy. 2016; 9: 203-211.

27. Perry L, Xu X, Gallagher R, Nicholls R, Sibbritt D, Duffield C. Lifestyle Health Behaviors of Nurses and Midwives: The 'Fit for the Future' Study Int. J. Environ. Res. Public Health. 2018; 15: 945.

28. Anbazhagan S, Ramesh N, Nisha C, Joseph B. 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: 35-38.

29. Books C, Coody LC, Kauffman R, Abraham S. Night Shift Work and Its Health Effects on Nurses. Health Care Manag (Frederick). 2020; 39: 122-127.

30. Aliyu I, Ibrahim ZF, Teslim LO, Okhiwu H, Peter ID, Michael GC. Sleep quality among nurses in a tertiary hospital in North-West Nigeria. Niger Postgrad Med J. 2017; 24: 168-73.

31. Lim S Han K, Cho H, Baek H. Shift-work nurses' work environments and health-promoting behaviours in relation to sleep disturbance: A cross-sectional secondary data analysis. J Clin Nurs. 2019; 28: 1538-1545.

32. Alshahrani SM, Baqays AA, Alenazi AA, AlAngari AM, AlHadi AN. Impact of shift work on sleep and daytime performance among health care professionals. Saudi Med J. 2017; 38: 846-851.

33. AlSaif HI. Prevalence of and risk factors for poor sleep quality among residents in training in KSA. J Taibah Univ Med Sci. 2019; 14: 52-59.

34. Olawale OO, Taiwo OA, Hesham A. Quality of sleep and well-being of health workers in Najran, Saudi Arabia. Indian J Psychiatry. 2019; 59: 347.

35. Bazrafshan MR, Moravveji F, Soleymaninejad N, Zare F, Rahimpoor R, Zolghadr R. Prevalence and effects of sleep disorders among shift-working nurse. Ann Trop Med Public Health. 2018; 11: 13-8

36. White AJ, Kresovich JK, Xu Z, Sandler DP, Taylor JA. Shift work, DNA methylation and epigenetic age. Int J Epidemiol. 2019; 48: 1536-1544.

37. Futenma K, Asaoka S, Takaesu Y, Komada Y, Ishikawa J, Murakoshi A, et al. Impact of hypnotics use on daytime function and factors associated with usage by female shift work nurses. Sleep Med. 2015; 16: 604-11.

38. Park CH, Bang M, Ahn KJ, Kim WJ, Shin NY. Sleep disturbance-related depressive symptom and brain volume reduction in shift-working nurses. Sci Rep. 2020; 10: 9100.

39. Shresth S, Shrestha S, Sharma L, Shrivastava T, Mahaseth, R, Neopane A. Assessing quality of sleep, its functional outcome and excessive day time sleepiness in shift workers and non-shift workers. J Adva Int Med. 2019; 8: 9-14.