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Patthrarawalai Sirinara

Nitt Hanprathet

Krit Pongpirul

Wiroj Jiamjarasrangsi

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Original article

Impact of shift work on sleep quality among nursing staff

Patthrarawalai Sirinara[a*], Nitt Hanprathet[b], Krit Pongpirul[b,c], Wiroj Jiamjarasrangsi[b]

[a]Department of Preventive and Social Medicine, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok, Thailand
[b]Department of Preventive and Social Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand
[c]Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Background: Shift work is common among nurses because health care is the industry that covers 24 hours a day, 7 days a week. How a healthcare organization alters staffing patterns to reduce fatigue among nursing staff is challenging. This study aimed to understand whether poor sleep quality persisted in nursing staff who did shift work and whether there were any specific risk factors for poor sleep quality among nursing staff. The study used a validated tool called the Pittsburgh Sleep Quality Index (PSQI) in Thai version for sleep quality assessment.
Methods: This study was a cross-sectional study. Semi-structured questionnaires were used to interview nursing staff who were currently employed at a large tertiary-care hospital in Bangkok, Thailand between January 2016 and January 2017. Associations between sleep quality and independent variables based on demographic data, shift work status, and work patterns were investigated. Sleep quality was measured using the Thai version of Pittsburgh Sleep Quality Index.
Results: A total of 2,765 nurses participated; the response rate was 86.5%. The prevalence of poor sleep quality (PSQI ≥ 5) in shift working nurses was 67.6%. The prevalence of poor sleep quality in non-shift working nurses was 32.4%. After adjusting for other potential confounders, poor sleep quality was significantly associated with shift working nurses compared with non-shift working nurses, adjusted odds ratio (aOR) = 1.369, $P < 0.001$ (95% CI 1.270 – 1.479). Having at least one medical condition (aOR = 1.229; 95% CI 1.026 - 1.473), decreased total number of years worked as a nurse (aOR = 0.985; 95% CI 0.978 - 0.993), increased number of working hours a day (aOR = 1.061; 95% CI 1.033 - 1.090), and decreased number of vacation days a week (aOR = 0.881; 95% CI 0.780 - 0.995) were more likely to have poor sleep quality among nursing staff.
Conclusions: Doing shift work, long working hours, having decreased number of vacation days a week, and having at least one medical condition have been found to be associated with poor sleep quality among nursing staff. Understanding these variables can assist managers/ policy makers to consider the risks of shift work among nursing staff and arrange shiftwork schedules accordingly.

Keywords: PSQI, sleep quality, nursing staff, shift work.

"Normal" hours of work generally refers to a working day with hours left for recreation and rest. Rest is a night time activity and work is a daytime activity.[1] The CDC defines the term "shift work" as working outside the normal daylight hours. That is, outside the hours of around 7 a.m. to 6 p.m. Similarly, the International Labor Organization (ILO) 1990 defines working in shifts as "a method of organization of working time in which workers succeed one another at the workplace so that the establishment can operate longer than the hours of work of individual workers."

Shift work is known to be a type of health hazard at the workplace. Working in shifts disrupts circadian rhythms. That is, shift work disrupts the 24-hour human body clock which tells the body when to sleep, rise, and eat. As a result, shift work causes sleep insufficiency, chronic fatigue, burnout, and psychological symptoms among healthcare workers.[2-6] Other health effects of shift work include

***Correspondence to: Patthrarawalai Sirinara**, Department of Preventive and Social Medicine, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok10300, Thailand.
Email: pphichalai@mail.harvard.edu
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gastrointestinal and cardiovascular symptoms, such as peptic ulcers, irritable bowel syndrome, functional bowel disorders, and coronary heart disease.[7 – 11] In addition, in October 2017 the International Agency for Research on Cancer (IARC) classified shift work that involves circadian disruption as class "2A" (a probable human carcinogen). This means that some shift patterns that disrupts circadian rhythms place as high human carcinogenic risks as substances like acrylamide, inorganic lead compounds, and vinyl bromide.

Because health care is an industry that covers 24 hours a day, 7 days a week, night work is an integral part of the healthcare working system. Shift work is common among nurses. The Labor Protection Act 2008 (2551 B.E.) of Thai Government Section 23.14 stated that a worker shall not exceed eight hours in one day and the daily working period shall not exceed 9 hours and the total working period in each week shall not exceed 48 hours. Based on the Labor Protection Act 2008 (2551 B.E.), how a healthcare organization alters staffing patterns to reduce fatigue among nursing staff is challenging.

Improvement of staff's health and well-being provides many benefits, including reduced costs of sickness absence, increased productivity, lowered spending on staff turnover, and uplifted key dimensions of patients' service quality which are patient safety, patient experience, and the effectiveness of patient care. [12] In Thailand, there is a paucity of research on sleep quality, fatigue, daytime sleepiness from occupation among nursing staff. To our knowledge, the association between shift patterns, especially night shifts, and sleep quality index has not been well addressed in Thailand. Therefore, this study included a validated international tool called the Pittsburgh Sleep Quality Index (PSQI) translated into a Thai version for sleep quality assessment.

This study aimed to understand whether poor sleep quality persisted in nursing staff who did shift work and whether there were any specific risk factors for poor sleep quality among nursing staff.

Methods

Study population

This study was a cross-sectional study. Questionnaires were used for interviewing nursing staff who were currently employed at a large tertiary-care Hospital in Bangkok, Thailand from January 2016 to January 2017. The ethical and trust sponsorship was approved in 2016 by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University.

Inclusion criteria were shift working nursing staff and non-shift working nursing staff, aged 19 - 60 years, who signed their consent form for participation in the research study and had been working at the hospital for at least one year.

Exclusion criteria were those who did not complete all the required items in the questionnaire or who were not willing to participate in the study or who left the job during the study period.

A sample size of 303 was required to ensure an acceptable margin of error within 5.0%. The formula applied was $n = 1.962 \times p \times (1-p)/(0.05)^2$, where $P = 0.73$ was the reported prevalence of poor sleep quality among nursing staffs in Thailand 13; 0.05 indicated the acceptable margin of error (5.0%).

Data collection

The questionnaire was anonymous and comprised a mixture of closed and open (semi-structured) questionnaires. The questionnaire was divided into six sections comprising of factors that may affect sleep quality in healthcare workers according to review literature. The first section focused on demographics, the second section on medical conditions, the third section on family or genetic history, the fourth section on their health lifestyles, and the fifth section on shift patterns. The final section was sleep quality assessment using a validated tool called the Pittsburgh Sleep Quality Index (PSQI) in Thai version. We used face-to-face interviews for the first to fifth sections of the questionnaire and used self-reported method for the final section of sleep quality assessment.

The age of subjects were grouped into < 30, 30 - 40, 40 - 50, > 50 years old age groups (years old). Subjects were stratified into the following body mass index (BMI) categories according to the World Health Organization (WHO) classification: Category 1, underweight (BMI < 18.5 kg/m^2); Category 2, normal range (BMI 18.5 - 24.9 kg/m^2); Category 3, overweight (BMI 25 - 29.9 kg/m^2); and Category 4, obese (BMI ≥ 30.0 kg/m^2).

Work patterns in this study included shift worker status (shift working nurses vs non-shift working nurses), overtime (OT) work (OT work *vs*. no OT work), total number of years working as a nurse, number of working hours a day, number of the rest interval hours a day, and number of vacation days a week.

The Pittsburgh Sleep Quality Index (PSQI) consists of 19 items grouped in seven domains. The domains are sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness, overall sleep quality, sleep efficiency, and dependency on medicine to sleep. Each domain's scores were summed to produce a global measure of sleep quality and the scores ranged from 0 to 21. A total score of equal to or above five is defined as 'poor' sleep quality. A higher score indicates poorer quality of sleep. A high degree of internal consistency was observed among the PSQI domains; those with Cronbach α of 0.83 were reported.[14]

We included the PSQI for sleep quality measurement in this study because the PSQI was found to be a valid instrument. The PSQI's validity was supported by polysomnographic findings. [14, 15] Furthermore, overall test-retest reliability of the PSQI global score was high, with a reliability of 0.90 two days after administration, and 0.87 on an average of 45. [16]

Statistical analysis

The main outcome, sleep quality, was determined according to the individual PSQI score. Subjects were categorized into three groups based on their PSQI score: the 'good' sleep group (Global PSQI score < 5), the 'poor' sleep group (Global PSQI score 5-7), and the 'very poor' sleep group (Global PSQI score ≥ 8). When we analyzed the associations between variables with logistic regression models, we grouped their PSQI scores into two groups: the 'good' sleep group (Global PSQI score < 5), the 'poor' sleep group (Global PSQI score ≥ 5).

Associations between sleep quality and independent variables based on demographic data and work patterns were investigated using logistic regression models. The odds ratio (OR), 95% CI for OR and its significance value were calculated to identify the explanatory factors for sleep quality.

A double entry verification method was used to reduce data entry error. STATA version 14.1 (StataCorp.2015. Stata Statistical Software: release 14.1, College Station, TX: StataCorp LP.) was used for statistical analysis. A $P < 0.05$ was considered statistically significant.

Results

Subjects with an incomplete PSQI or ≥ 15 day's absence during the study period were excluded from the complete data analysis. 2,765 nursing staff completed 19 items of the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The overall complete response rate for data analysis was 86.5% (2,765/3,198). Table 1 shows that a larger proportion of the study population were female with mean age 41.1 (± 13.5) years old, did shiftwork (61.7%), single or never married without children, and had achieved a university degree (mostly bachelor's degree). The majority of the study population had no medical conditions and had monthly incomes around 20000-30000 Thai baht a month. The mean body mass index (BMI) of the participants was 23.1 (± 4.1) (kg/m^2) and mean waist circumference was 76.8 (± 10.2) cm, which means that most of them were in normal shape. The mean global PSQI score of all nursing staff was 5.4 (± 2.6). This means that the majority of the participants had 'poor' sleep quality.

Univariate logistic regression models were constructed with poor sleep quality defined as PSQI ≥ 5 as the dependent variable to analyze for many independent variables that may impact on determining the outcome of sleep quality. The prevalence of poor sleep quality (PSQI ≥ 5) in shift working nurses was 67.6%. The prevalence of poor sleep quality in non-shift working nurses was 32.4%. A univariate logistic regression demonstrated a significant result regarding poor sleep quality in shift working nurses compared with non-shift working nurses, OR 1.46, $P < 0.001$ (95% CI 1.38 - 1.55), in higher age > 50 years old compared with < 30 years old, $P < 0.001$. This may be because nurses with older ages undertook less shift work as the older nurses were promoted to supervisor levels. A univariate logistic regression also showed that poor sleep quality was significantly associated with nurses who had higher BMI ≥ 30 kg/m^2 compared with BMI < 18.5 kg/m^2, $P < 0.001$. This finding might be explained in that people with higher BMI had high risks of developing obstructive sleep apnea (OSA), the condition that the airways were obstructed during sleep at night in obese people, resulting in poor sleep quality.

There is a significant difference in the median (IQR) of total number of years worked as a nurse between good and poor sleep quality groups, 18 (5,27) years *versus* 14 (3,24) years, $P < 0.001$, the mean (SD) number of working hours a day between good and poor sleep quality groups (9.92 ± 2.83 hours *versus* 10.8 ± 3.37 hours, $P < 0.001$), and the mean (SD) number of vacation days a week between good and poor sleep quality groups (1.54 ± 0.69 days *versus* 1.46 ± 0.69 days, $P = 0.001$).

Table 1. Summary of participant characteristics (n = 2,765)

Characteristic	n (%) or mean (± SD)
Gender	
Female	2,616 (94.6%)
Male	149 (5.4%)
Age (years) (continuous variable)	41.1 (± 13.5)
Body mass insdex (kg/m^2) (continuous variable)	23.1 (± 4.1)
Waist circumference (cm)	76.8 (± 10.2)
Medical condition	
Has at least one medical condition	1,028 (37.2%)
No medical condition	1,737 (62.8%)
Marital Status	
Single	1,571 (56.8%)
Married	1,023 (37.0%)
Divorced	164 (5.9%)
Children	
Have children	1,023 (37.0%)
No children	1,734 (62.7%)
Education Level	
High school	477 (17.3%)
Postsecondary (certificate/diploma)	193 (7.0%)
Bachelor's degree	1,635 (59.1%)
Master's degree or above	392 (14.2%)
Monthly income (Thai Baht; THB)	
< 10,000 THB	35 (1.3%)
10,001 – 20,000 THB	603 (21.8%)
20,000 – 30,000 THB	1,169 (42.3%)
30,001 – 50,000 THB	848 (30.7%)
> 50,000 THB	107 (3.9%)
Shift worker status (non-shift workers)	1,058 (38.3%)
Shift worker status (shift workers)	1,707 (61.7%)
Global Pittsburgh Sleep Quality Index (PSQI)	5.4 (± 2.6)

There was no statistically significant association between poor sleep and gender, overtime (OT) work, and number of the rest interval hours a day, as shown in Table 2.

Multivariate logistic regression models were constructed with poor sleep quality defined as PSQI scores equal to or more than 5 as the dependent variable, as shown in Table 3.

Stepwise regression was performed and the most noticeable points from Table 3 demonstrated that having at least one medical condition, undertaking non-shift work (only regular daytime work), decreased number of years worked as a nurse, increased working hours a day, and decreased number of vacation days a week were associated with poor sleep quality when controlling for the other variables of the presence of medical condition, shift worker status, number of years worked, number of working hours a day, and number of vacation days a week.

The output of the fully adjusted models shows that poor sleep from having at least one medical condition were increased by 23%, in comparison with no medical condition (adjusted OR (aOR) = 1.229; 95% CI 1.026 - 1.473) and that poor sleep from shift workers were increased by 37%, in comparison with 'non' shift workers (adjusted OR (aOR) = 1.369; 95% CI 1.270 – 1.479).

Table 2. Univariate logistic regression models for poor sleep quality by various factors in all of the nursing staff.

Variables	Group good sleep quality (Global PSQI score < 5) (n = 1,104)	Group poor sleep quality (Global PSQI score 5 - 12) (n = 1,661)	OR (95% CI)	*P* - value
Gender, n (%)				
Male	75 (6.8%)	74 (4.5%)	Reference	1
Female	1029 (93.2%)	1587 (95.5%)	1.02 (0.72, 1.42)	0.930
Age (years), n (%)				
< 30	247 (22.4%)	527 (31.7%)	Reference	1
30 - 40	233 (21.1%)	391 (23.5%)	0.79 (0.63, 0.98)	0.034
40 - 50	283 (25.6%)	403 (24.3%)	0.67 (0.54, 0.83)	< 0.001
> 50	341 (30.9%)	340 (20.5%)	0.47 (0.38, 0.58)	< 0.001
Body mass index (kg/m^2), n (%)				
< 18.5	77 (7%)	172 (10.4%)	Reference	1
18.5 - 24.9	687 (62.2%)	1073 (64.6%)	0.7 (0.53, 0.93)	0.014
25 - 29.9	251 (22.7%)	303 (18.3%)	0.54 (0.39, 0.74)	< 0.001
≥ 30	89 (8.1%)	112 (6.7%)	0.56 (0.38, 0.83)	0.004
Shift working nurses (*versus* non-shiftworking nurses), n (%)	584 (52.9%)	1123 (67.6%)	1.46 (1.38, 1.55)	< 0.001
Overtime (OT) work (versus no OT work), n%	461 (41.8%)	754 (45.5%)	1.16 (0.99, 1.35)	0.059
Total number of years worked as a nurse, median (IQR)	18 (5,27)	14 (3,24)	0.98 (0.97, 0.99)	< 0.001
Number of working hours a day, mean (± SD)	9.92 ± 2.83	10.8 ± 3.37	1.09 (1.07, 1.12)	< 0.001
Number of the rest interval hours a day, mean (± SD)	1.12 ± 1.16	1.19 ± 1.31	1.05 (0.99, 1.12)	0.114
Number of vacation days a week, mean (± SD)	1.54 ± 0.69	1.46 ± 0.69	0.83 (0.74, 0.93)	0.001

Table 3. Multivariate logistic regression analyses in all of the nursing staff for poor sleep quality by various factors.

	Adjusted OR	95% CI	*P* - value
Has at least one medical condition (versus no medical condition)	1.229	1.026 - 1.473	0.025
Shift workers (versus 'non' shift workers)	1.369	1.270 – 1.479	< 0.001
Total number of years worked as a nurse	0.985	0.978 - 0.993	< 0.001
Number of working hours a day	1.061	1.033 - 1.090	< 0.001
Number of vacation days a week	0.881	0.780 - 0.995	< 0.001

Discussion

Principal findings in this study were that shift work, long working hours a day, low number of years worked as a nurse, and shortened number of vacation days a week were associated with significant increases in 'poor' sleep, even after we adjusted for potential confounding factors.

In our study, cross-sectional associations were found for shift work and poor sleep quality. This finding is similar to McDowall K, *et al*. [17] It is possible that shift work disrupts the circadian rhythms which causes sleep insufficiency and chronic fatigue among nursing staff, corresponding with other research findings.[2–6]

Total number of years worked as a nurse in the poor sleep group was significantly less than the good sleep group and median years differed significantly ($P < 0.001$). This difference persisted in multivariate logistic regression, adjusting for other potential confounders (adjusted OR (aOR) = 0.985; 95% CI 0.978 - 0.993). Perhaps the 'healthy worker effect' [18] is relevant here, as older workers experiencing poor sleep quality might be more likely to stop working or to stop working shifts. If this were the case, then the total number of years worked as a nurse may also be inversely associated with poor sleep quality.

The mean working hours a day in the poor sleep group was significantly longer than the good sleep group ($P < 0.001$) while the mean number of vacation days a week in the poor sleep group was significantly less than the good sleep group ($P = 0.001$). These differences persisted in multivariate logistic regression, adjusting for other potential confounders. Our findings correspond with earlier research suggesting an association between long working hours and sleeping problems.[19-21] An explanation for why long working hours is related to poor sleep quality may be due to stress from long working hours at work. A study showed that stress is closely related to impaired sleep in cross-sectional studies. In particular, the anticipation of effort the next day seems important. Sleep recordings show that stress is associated with shortened sleep, fragmentation, and possibly a reduction in sleep stages 3 and 4. [22]

A strength of this study is a large sample size. Secondly, the Pittsburg Sleep Quality Index (PSQI) is included in this study, as it is a reliable, valid, standardized measure of sleep quality, which discriminates 'good' and 'poor' sleepers by using a PSQI ≥ 5 as the cut-off. Thirdly, statistical adjustment for potential confounding adds weight to the study findings.

The cross-sectional nature of this study limits the assessment of causality. Furthermore, this study relied on one-time, self-reported sleep data, which may be subjected to recall bias. Work-related factors such as psychological stress, job description, and clinical duties were not assessed, and neither were non-work-related factors such as alcohol intake and smoking status. The decision was taken to keep the data as efficient as possible, so as to maximize the response rate and to look at the factors previously described as disrupting sleep quality. Hence, such factors may be residual cofounders. Because the low number of male nurse respondents limits the generalizability of the data to males, subgroup analysis of the male nurse group is recommended for further study.

Conclusion

Understanding these variables can assist managers and policy makers to consider the risks of shift work in nurses and arrange shiftwork schedules accordingly. Because night shifts are unavoidable among nurses, more research studies are needed to clarify the conclusive impact of night shift patterns (clockwise rotating shifts versus counter-clockwise rotating shifts versus fixed shifts in nights) on sleep quality among nurses in Thailand. In addition, appropriate number of night shifts a month for nurses should be further studied to prevent possible negative health outcomes and adverse events to nurses' health.

Conflict of interest

The authors, hereby, declare no conflict of interest.

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