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RESEARCH ARTICLE

Morningness-Eveningness Chronotypes, Sleep Quality, and Sleepiness Among Nurses

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Abstract:

Background:

Poor sleep quality and sleepiness is a common problem in nurses. The morningness-eveningness preference of nurses may affect their sleep quality.

Objective:

The objectives of this study were (1) to describe the quality of sleep in a group of hospital nurses and (2) to analyze the effect of shift work and morningness-eveningness on the sleep quality of nurses.

Methods:

In this cross-sectional study, 120 nurses completed the survey in a university hospital in Iran. The study tools were Pittsburgh Sleep Quality Questionnaire (PSQI), Epworth Sleepiness Scale (ESS), and Morningness-Eveningness Questionnaire (MEQ). Nurses with PSQI>5 and ESS≥10 were considered having poor sleep quality and excessive daytime sleepiness. Nurses were subdivided into morning-, intermediate- and evening-types according to MEQ. Data were analyzed by chi-square, Mann–Whitney U-test, logistic regression, and analysis of covariance (ANCOVA) tests.

Results:

The mean (±SD) of PSQI and ESS was 6.88(2.18) and 9.5(±3.9), respectively. About 74% of nurses reported poor sleep quality, and near 40% of the nurses had excessive daytime sleepiness. Sixty percent of nurses were intermediate-type, and the remaining was morning (24.2%) and evening (15.8%) types. The sleep quality and daytime sleepiness had a significant relation with shift work. The mean PSQI was significantly different between shift work and non-shift work nurses. The mean PSQI of three main chronotypes was statistically different.

Conclusion:

Poor sleep quality was prevalent in the nurses and was significantly associated with shift work and chronotype. The sleep preference of nurses would be considered as an important factor in the assignment of shift work by hospital managers.

Keywords: Sleep disorders, Chronotype, Nurses, Hospitals, Sleepiness, Adult.

1. INTRODUCTION

Sleep is one of the basic requirements of humans, which is included in the physiological needs category of Maslow's hierarchy of needs. When the pattern of sleep and wakefulness is disrupted, other physiological functions of the body may change. Night shift workers, such as nurses, mostly have an irregular sleep-wakefulness pattern. Therefore, poor sleep quality is a common and serious problem in nurses [1].

Hospital nurses work in extended and rotating shifts. Consequently, they may lose the quantity and quality of their sleep and have prolonged sleep impairment [2]. Sleep deprivation is detrimental to the judgment and performance of nurses and could result in errors and accidents [3]. The sleep disorders of nurses have been reported as a risk factor for patient safety [4]. Nurses also are prone to work-related

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fatigue, and therefore, suffer from excessive daytime fatigue [5]. Poor sleep quality is prevalent among nurses from different countries. For example, in Turkey, 62% of nurses [6], in the UK, 78% of nurses [7], in Norway, 70% of nurses [8], and in Korea, 79.8% of nurses [1] reported the poor sleep quality.

Circadian rhythms are endogenous rhythms with a periodicity of approximately 24 hours and present in all living organisms. Physiological functions, such as sleep and wake cycles exhibit circadian rhythmicity [9]. Misalignment of the central circadian clock in the suprachiasmatic nucleus (SCN) with the sleep-wake cycle can lead to various health risks [10]. The disruption of the circadian system even could be carcinogenic [11]. Chronotype (individual typology) is an attribute of human beings that reflects their circadian phase, such as body temperature, hormone levels, and eating and sleeping patterns [12].

There are some inter-individual differences in the circadian phases. Three main circadian types have been noted in human beings; Morning-type, Evening-type, and Intermediate type. Morning-types have a relatively early circadian phase and go to sleep early and wake up early, while evening-types have a relatively late circadian phase and are active during the night and cannot get up early [13, 14]. Evening-type people are at risk of sleep disorders due to imbalances in their biological and social time [15]. It is reported that evening-type nurses had significantly poor sleep quality compared to two other types [13, 14]. Therefore, in shift workers, especially nurses, the chronotype as an individual factor may influence the quality of sleep.

The objectives of this study were to: (1) Describe the self-reported sleep quality and daytime sleepiness of nursing staff, (2) Test the relationship between demographic variables of the nurses and their sleep quality and daytime sleepiness, and (3) Analyze the effect of chronotype on sleep quality and daytime sleepiness. The result may serve as a reference to hospital managers or researchers for further studies.

2. METHODS

The present study was a cross-sectional study, which was carried out in a hospital in Iran in 2018. The study population was all nurses working in different wards of the hospital. Before data collection, nurses were informed about the study. Informed consent was obtained from all participants. Data were collected through three questionnaires including Pittsburgh Sleep Quality Questionnaire (PSQI), Epworth Sleepiness Scale (ESS) and the Morningness-Eveningness Questionnaire (MEQ).

Pittsburgh Sleep Quality Index (PSQI) is a self-assessment questionnaire that examines the quality of sleep during the past month. The instrument contains 19 questions in 7 sections (sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction). The total score of the questionnaire is 0-21, with higher scores indicating low sleep quality. The PSQI score of >5 was considered as "poor sleep quality." PSQI was developed by Buysse *et al.* [16], and the validity and reliability of the Persian version were confirmed by Farrokhi Moghadam *et al.* [17].

Epworth sleepiness scale (ESS) is a simple and widely used measure for subjective evaluation of daytime sleepiness during various activities over the past month. The questionnaire contains eight questions and asks the respondents to rate their sleepiness from 0 to 3, giving a total score of 0 (no daytime sleepiness) to 24 (the most excessive daytime sleepiness). The cut-off point for this questionnaire is 10, and people with a score of ≥10 have excessive daytime sleepiness. This questionnaire was designed by Johns [18], and the Persian version was provided by Sadeghniiat Haghighi *et al.* [19].

Morningness-Eveningness Questionnaire (MEQ) was used for assessing self-rated morningness/eveningness preference. This questionnaire was developed originally by Horne and Ostberg [20]. MEQ establishes five behavioral categories; definitively morning type (score=70-86), moderately morning type (score=59-69), neither type (score=42-58), moderately evening type (score=31-41), and definitively evening type (score=16- 30). In the present study, we adopted the simpler classification; morning-type (score=59-86), neither-type (score=42-58) and evening-type (score=16-41) [14].

SPSS software version 16 was employed to analyze data. The normality of data was evaluated by the Kolmogorov-Smirnov test prior to analysis. Descriptive statistics was used to describe the demographic information and scores of the questionnaires. A Chi-squared analysis (95% level of confidence) was conducted to compare proportions. Mann-Whitney U-test was used to compare the sub-scores of PSQI between fixed and rotating shift workers. A logistic regression was used to determine which factors were independently associated with outcomes. Analysis of covariance (ANCOVA) was used for statistical comparison of the PSQI and ESS scores among chronotypes while controlling the effect of demographic and job variables as covariates. The term significant indicates a Pvalue<0.05

3. RESULTS

A total of 120 nurses completed the survey for an overall response rate of 91%. The characteristics of nurses, as well as their sleep quality, daytime sleepiness, and chronotype, are summarized in Table **1**. As a summary, most of the nurses were women, married, and worked in the rotating shifts. About 74% of nurses had poor sleep quality, and near 40% of the nurses reported daytime sleepiness. According to the MEQ, 60% of nurses were classified as intermediate chronotype, while morning and evening types were 24.2% and 15.8% of nurses, respectively. The mean (±SD) score obtained from the Epworth Sleepiness Scale was 9.5 (±3.9).

The relation of demographic and job variables with sleep quality and sleepiness was analyzed using chi-squared (Table **2**). As can be seen, the quality of sleep was statistically different between the nurses with fixed and rotating shift works (Pvalue<0.05). The sleepiness of nurses had a significant relation with shift works and marital status (Pvalue<0.05).

A multivariate logistic regression was performed to identify those variables independently associated with sleep quality and daytime sleepiness (Table **3**). The multivariate logistic regression analysis confirmed the results of the univariate analysis. As can be seen, nurses working in rotating shifts were significantly more likely to have poor sleep quality

than those who work in fixed shifts [OR=4.00 (95%CI= 1.66-9.65), P-value=0.002]. A similar result was obtained for daytime sleepiness; shift workers had significantly more daytime sleepiness than non-shift workers [OR=3.02 (95%CI=1.21-7.56), P-value=0.01].

Both global score and seven PSQI sub-scores in nurses with fixed and rotating work shifts are given in Table **4**. The global PSQI in the studied nurses was 6.88(2.18). Based on the Mann–Whitney U-test, the PSQI score was significantly different between nurses who work in fixed [5.62 (1.56)] and rotating [7.44 (2.18)] shifts (P-value=0.001). Subjective sleep quality, sleep disturbances, and daytime dysfunction were statistically different between fixed and rotating shift workers (P-value=0.001).

Table 1. The characteristics of nurses, sleep quality and chronotypes.

Variables	Mean(SD)	N (%)
Age	33.09 (6.89)	
Years of employment	9.89 (6.46)	
Gender		
Male		23 (19.2)
Female		97 (80.8)
Marital status		
Single		28 (23.3)
Married		92 (76.7)
Shift work		
Rotating		83 (69.2)
Fixed		37 (30.8)
Sleep quality		
Good		31 (25.8)
Poor		89 (74.2)
Daytime sleepiness		
Yes		47 (39.2)
No		73 (60.8)
Chronotype		
Morning type		29 (24.2)
Evening type		19 (15.8)
Intermediate type		72 (60)

Table 2. The relation of demographic and job variables with sleep quality and daytime sleepiness of nurses.

Variables	Sleep quality		Statistics	Daytime sleepiness		Statistics
	Good	Poor		No	Yes	
Age						
Less than 30 yrs	14	41	X^2=0.008 *P-value=0.93	34	21	X^2=0.04 *P-value=0.83
More than 30 yrs	17	48		39	26	
Years of employment						
Less than 10 yrs	17	56	X^2=0.63 *P-value=0.42	44	29	X^2=0.02 *P-value=0.87
More than 10 yrs	14	33		29	18	
Gender						
Male	6	17	X^2=0.001 *P-value=0.97	15	8	X^2=0.23 *P-value=0.63
Female	25	72		58	39	
Marital status						
Single	10	18	X^2=1.8 *P-value=0.17	23	5	X^2=6.9 *P-value=0.008
Married	21	71		50	42	
Shift work						
Rotating	14	69	X^2=11.29 *P-value=0.001	44	39	X^2=6.9 *P-value=0.009
Fixed	17	20		29	8	

Data are presented as absolute numbers. *Chi-squared test

Table 3. Multivariate logistic regression analysis of variables associated with poor sleep quality and daytime sleepiness.

Influence Factors	Variables	Sleep quality		Daytime sleepiness	
		OR (95% CI)*	P-value	OR (95% CI)	P-value
Age (yr)		1.16 (0.87-1.54)	0.30	1.04 (0.81-1.33)	0.73
Years of employment (yr)		0.83 (0.62-1.12)	0.24	0.96 (0.74-1.24)	0.75
Gender	Male	Reference	0.86	Reference	0.77
	Female	1.11 (0.33-3.72)		1.17 (0.39-3.49)	
Marital status	Single	Reference	0.32	Reference	0.02
	Married	0.59 (0.20-1.70)		0.26(0.08-0.81)	
Shift work	Rotating	Reference	0.002	Reference	0.01
	Fixed	4.00 (1.66-9.65)		3.02 (1.21-7.56)	

* Odds Ratio (Confidence Interval of 95%)

Table 4. Pittsburgh sleep quality index scores in nurses with fixed and rotating work shifts.

PSQI item	Global score Mean (SD)	Shift work		*P-value
		Fixed	Rotating	
Item 1: Subjective sleep quality	1.30 (0.63)	0.99(0.53)	1.43 (0.62)	0.001
Item 2: Sleep latency	1.29 (0.68)	1.10 (0.59)	1.37 (0.71)	0.06
Item 3: Sleep duration	0.86(0.80)	0.65 (0.23)	0.94 (0.86)	0.19
Item 4: Habitual sleep efficiency	0.80 (0.57)	0.65 (0.23)	0.86(0.66)	0.08
Item 5: Sleep disturbances	1.17(0.48)	0.94 (0.44)	1.28 (0.47)	0.001
Item 6: Use of sleeping medication	0.46 (0.31)	0.45 (0.23)	0.47 (0.34)	0.91
Item 7: Daytime dysfunction	0.98(0.71)	0.77(0.57)	1.07 (0.74)	0.04
Global score (sum of items)	6.88(2.18)	5.62 (1.56)	7.44 (2.18)	0.001

*Mann–Whitney U-test

Table 5. The effect of chronotype on sleep quality and daytime sleepiness of nurses.

-	Chronotypes			ANCOVA	
	Morning type	Intermediate type	Evening type	F-test	P-value
PSQI score Mean (SE)	5.22 (0.29)	6.90 (0.18)	9.31 (0.36)	38.79	0.001
ESS score Mean (SE)	9.09 (0.76)	9.14 (0.48)	11.31 (0.95)	2.21	0.11

The effect of chronotype on sleep quality and daytime sleepiness of nurses were analyzed using ANCOVA (Table **5**). As can be seen, after controlling the effect of demographic and job factors presented in Table **2**, the mean score of PSQI was statistically different between the three main chronotypes. Tukey's posthoc revealed that the mean PSQI of three chronotypes was statistically different (P-value=0.001).

4. DISCUSSION

This study set out to describe the sleep quality of nurses in a hospital in Iran and to determine the effect of nurses' chronotypes on their sleep quality and sleepiness. Seventy-four percent of nurses reported poor sleep quality, and 40% of them had sleepiness during daily activities. Intermediate chronotype was prevalent among the nurses, and evening type nurses had higher scores (worse sleep) on both PSQI and ESS questionnaires.

Sleep disturbances are common among adults. For example, over 25% of adult German residents reported poor sleep quality, and about 10% of the population in western industrialized nations has problems falling or staying asleep

[21]. Therefore, it would be expected that poor sleep quality is prevalent in occupations with irregular sleep-wake schedules such as nurses. In our study, the global PSQI score of nurses was 6.88, which was similar to the PSQI score of nurses (Mean=6.8) in the study of Gómez-García *et al.* [22]. A PSQI total score of >5 indicates poor sleep quality. Therefore, in the current study, about 74% of nurses self-reported poor sleep quality. In agreement with our result, Zhang *et al.* reported that 72.1% of Chinese nurses had poor sleep quality [23]. Other studies similarly reported poor sleep quality in 62% [6], 78% [7], 70% [8], and 79.8% [1] of the nurses. It could be concluded that in different countries, the majority of nurses had poor sleep quality.

Sleep quality may have a relationship with demographic and job factors. According to the univariate (Chi-squared test) and multivariate regression analyses, a significant relation was only found between shift work and quality of sleep. In other words, in rotating shift nurses, the number of cases with poor sleep quality was significantly more than the cases with good sleep quality when compared with fixed shift nurses. In line with our results, Zencirci and Arslan found that most of the socio-demographic variables did not affect sleep quality [14]

and in Nigerian nurses, the sleep quality of the shift workers was poorer than that of non-shift workers [24]. In contrast with our findings, Yazdi *et al.* did not find any significant association between the shift types and sleep quality of nurses [13]. It could be inferred that working in rotating shifts decreases the quality of sleep of nurses.

In our study, the PSQI score of nurses in the fixed shifts was significantly lower than those in rotating shifts (5.62 *vs.* 7.44). Similar results were reported in the literature. For example, Alshahrani *et al.* found the PSQI scores of 6.27 and 7.40 for non-shift workers and shift workers, respectively. They explained that the relatively higher score of non-shift nurses (PSQI=6.27) might be due to the prior exposure to shift work, which could be creating their current sleep disorders [25]. Gómez-García *et al.* calculated the PSQI of 6.38, 6.78, and 7.93 for nurses working in the day, rotating, and night shifts, respectively. They analyzed the scores among different work shifts and found a statistically significant difference (Pvalue= 0.017) [22]. In summary, shift-working nurses had poor sleep quality because of the mean PSQI score of about 7.

Excessive daytime sleepiness, as a primary symptom of sleep disorders, could be a risk factor for different physical and mental disorders. This symptom is associated with low productivity and various traffic and industrial accidents and is an important occupational health concern in nurses [26]. In the current study, the mean of ESS was 9.5. In Nigerian nurses, the mean of ESS was 7.3 [24] while in the Norwegian nurses, the mean was 7.7 for nurses without shift work disorder (SWD) and 9.5 for nurses with SWD [27]. Our analysis showed that about 40% of the nurses, with a score of ≥10, had excessive daytime sleepiness. Suzuki *et al.*, in a cross-sectional study on 4407 Japanese nurses in eight large general hospitals, found that 26% of nurses had excessive daytime sleepiness [26]. The prevalence of daytime sleepiness in nurses of intensive care units was 25%, which was higher than Norwegian norm groups [8]. Chaiard *et al.* reported that 49.5% of Thai nurses experienced excessive daytime sleepiness [28]. According to the results of Table 2, we could say that most of the nurses with daytime sleepiness worked in rotating shifts (39 *vs.* 8). Surani *et al.* found that nurses working night shifts have a pathologic degree of sleepiness [29]. It could be concluded that sleepiness is prevalent in nurses, importantly, in shift working nurses.

The 19 questions in PSQI questionnaire are combined into seven clinically-derived component scores. Among these seven components, the scores of "subjective sleep quality," "sleep disturbance," and "daytime dysfunction" were statistically different between shift workers and non-shift workers. In other words, nurses working in rotating shifts had noticeable problems in the three mentioned components. This finding was in agreement with that of Alshahrani *et al.* in which Saudi Arabia shift nurses significantly reported a higher score for these three components [25]. The poor sleep quality of ICU nurses was related to the "Sleep latency" and "Daytime dysfunction" [30]. Daytime dysfunction and sleep disturbances could make contribution to daily disturbances. Hence, this condition may have a negative effect on the safety of both nurses and patients.

The effect of chronotype on sleep quality has been investigated in previous studies [2, 13, 31]. In this study, evening type nurses had significantly higher scores in PSQI and ESS. In other words, these nurses had more chance of poor sleep quality and daytime sleepiness. In line with this finding, Yazdi *et al.* suggest that nurses who had a morning sleep preference had better sleep quality [13]. This finding also was reported in female dormitory residents [15]. Lee *et al.* found that chronotype and insomnia vulnerability increase susceptibility of shift-working nurses to sleep disturbances [31].It could be said that the chronotype of nurses would be considered as a personal factor in the assignment of shift works by hospital managers. However, there is a limited number of studies exploring the interaction of chronotype and shift work. In a study by Gamble *et al.*, they found that morning chronotypes generally had higher adaptation for day-shift and lower ones for nightshift, whereas evening types had intermediate adaptation levels for both day and night-shifts [32].

Our study had some limitations. Compared to some of the previous studies, our sample size was relatively small, and studies with a larger number of participants from different hospitals are proposed for future studies. The tools used in the current study, PSQI and ESS, are self-report-based. Thus, objective methods besides these tools could improve the findings of the study.

CONCLUSION

As conclusion, this study indicated that the majority of nurses experienced poor sleep quality. Compared with fixed shift nurses, the number of cases with poor sleep quality and daily sleepiness was higher in rotating shift nurses. Evening type nurses had poorer sleep quality and more daytime sleepiness.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

In this study, there were not any invasive practices for humans or animals. Therefore, the ethics committee did not require ethical approval for the study.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Before the study, the investigators explained the purpose of the study to the chief nurse of each ward and obtained verbal permission.

AVAILABILITY OF DATA AND MATERIALS

Due to confidentiality issues, it is not permitted to share the data.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest, financial or otherwise.

participated in this study.

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