



Original Article

Determination of sleep quality, fatigue, and concentration in nurses according to their shifts and chronotype*

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Abstract

Objectives: The aim of the present study was to determine sleep quality, fatigue, and concentration in nurses according to their shifts and chronotype.

Methods: This was a descriptive and cross-sectional study including 276 of the 331 nurses working at a foundation university hospital in Ankara. The Demographic Characteristics Questionnaire, Pittsburgh Sleep Quality Index (PSQI), and Morningness–Eveningness Questionnaire were used as data forms. Descriptive statistics, t-test, ANOVA and chi-square test were used to analyze the data.

Results: A total of 73.7% of nurses were ‘intermediate-type’ and 21.4% were ‘near morning-type’; 29.9% of nurses who worked during the day and 20% of those who worked rotating shifts were ‘morning-type’ ($\chi^2=11.699$, $p=0.003$). The total PSQI scores were 9.07 ± 3.98 for ‘evening-type’, 8.19 ± 3.76 for ‘intermediate-type’, and 6.57 ± 3.76 for ‘morning-type’ ($F=5.536$, $p=0.004$). A total of 77.2% of nurses who had sleep disturbances and 60.1% of those who had no sleep disturbances reported work-related accidents ($\chi^2=9.131$, $p=0.002$); 7.3% of nurses who worked during the day and 17.6% of those who worked in rotating shifts had made a medical error in the previous year ($\chi^2=6.797$, $p=0.007$). The fatigue level was severe in 58.3% of the nurses who had made a medical error and in 37.9% of those who had not made a medical error in the previous year ($\chi^2=6.529$, $p=0.038$). There was no statistically significant difference between these variables according to the chronotype of the nurses.

Conclusion: Chronotype and shift work affect sleep quality in nurses and lead to problems related to patient and employee safety. These results should be considered with respect to the working conditions for nurses.

Keywords: Circadian rhythm; fatigue; nursing staff; sleep disorders.

Sleep is a neurobehavioral and repetitive status that includes temporary unresponsiveness and disconnection from the environment.^[1] It is an active period that covers one third of an individual’s life and is important for refreshing mental and physical health every day.^[2]

Sleep and wakefulness are regulated by homeostatic and circadian processes.^[1] Circadian rhythms are biological processes that involve physiological and behavioral changes within an organism in about 24 hours;^[3] therefore, circadian cycles are affected by social, physical, and environmental factors (such as light and dark).^[4] Chronotype, which is related to chrono-

biology that investigates the rhythmic elements in biological incidents, indicates an individual’s circadian phases, which show when physical activity, hormone levels, body temperature, cognitive ability, and eating and sleep patterns are active during the day.^[5] Individuals have different chronotypes in terms of biological and behavioral rhythms, such as sleep–wakefulness cycle, body temperature, and cortisol and melatonin release.^[6]

Chronotype classifies individuals as morning- or evening-type based on their physiological and genetic characteristics.^[7] In this regard, chronotype is related to an individual’s sleep

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What is known on this subject?

- Chronotype is related to an individual's sleep–wakefulness cycle, and working in shifts may disrupt this cycle, causing sleep problems and fatigue. Fatigue affects productivity by causing attention deficit and impaired problem-solving and decision-making abilities, increasing the risk of accidents, malpractice, and injury.

What is the contribution of this paper?

- The intermediate- and evening-type nurses were found to have poorer sleep quality than the morning-type nurses. In addition, it was determined that working in shifts increases the severity of fatigue and decreases concentration, which may increase the possibility of workplace accidents and medical errors.

What is its contribution to the practice?

- It is suggested that determining the factors that negatively affect nurses' sleep quality and creating programs to increase it will contribute to the literature.

habits; while some individuals choose to sleep and wake up early, others prefer to sleep and wake up late.^[5] Morning-type individuals sleep and wake up early, feeling energetic without intake of a stimulant such as caffeine. On the other hand, evening-type individuals sleep late at night and have difficulty in waking up in the morning; they become stimulated at the highest level in the afternoon, and therefore show better performance during the afternoon and evening hours.^[7]

Under normal conditions, there is a synchronization between the homeostatic process and circadian systems in the sleep–wakefulness cycle. This synchronization is necessary for restful sleep and daytime functionality; however, in many sectors, individuals may be required to work during different hours (shifts).^[8] Circadian rhythm sleep–wakefulness disorders mean the changes in the circadian time-keeping system, the irregularities in the mechanism, or the disorders caused by the misalignment between the external environment and endogenous circadian rhythm.^[9] Working in shifts is among the factors that cause circadian sleep–wakefulness disorders. The sleep disorders called as working in shift disorders may lead to significant mental, physical, social, occupational, educational, or other problems due to working in night shifts or various shifts that contradict with the routine sleep time.^[9]

In the circadian rhythm sleep–wakefulness disorders, the sleep–wakefulness rhythm may be disrupted due to an imbalance between the internal and external cycles, as well as the effects of environmental and social conditions. Continuous and repetitive interruption of the sleep–wakefulness rhythm results in functional losses by causing insomnia, excessive sleepiness, or both.^[10] Sleep problems reduce the quality of life and impair individuals' health,^[2] and working in shifts has been reported to increase mortality and lead to coronary heart disease, metabolic syndrome, diabetes, impaired glucose metabolism, and accidents.^[1] In addition, working in night shifts increases fatigue, which results in clear negative effects on wakefulness, attention, judgment, and mood, which may lead to accidents, malpractice, and injury. Fatigue is known to negatively affect productivity and performance by causing impaired memory, problem-solving skills, and decision-making abilities.^[8] It has also been highlighted that sleep disorders

negatively affect long- and short-term memory, immunity (proinflammatory cytokines, IL-6 rhythmicity), hormone levels (GH, melatonin, cortisol, TSH), and metabolism (leptin, ghrelin, insulin sensitivity, glucose sensitivity).^[11]

Nurses are among the occupational groups who should serve for 24 hours a day and therefore work in shifts. It has been reported that nurses have more difficulty in working, reduced sleep quality, and problems such as sleep disorders, fatigue, attention deficit, and reduced productivity in problem-solving,^[12–15] which may increase the possibility of errors.

Sleep health is a multi-directional sleep–wakefulness pattern that supports physical and mental wellness and is adapted to the individual's social and environmental demands. A healthy sleep is characterized by subjective satisfaction during wakefulness, appropriate timing, sufficient duration, high efficiency, and continuous wakefulness.^[1] Nurses should work in shifts due to the nature of their profession; however, this is known to cause an interrupted sleep pattern and certain health problems. Although studies have been conducted in recent years regarding shift work and sleep problems based on nurses' chronotype characteristics, a limited number of studies was found in the literature. Considering the current situation, determining sleep quality, fatigue, and attention in nurses according to their shifts and chronotype characteristics may contribute to reducing problems related to productivity, employee safety, and medical errors.

Materials and Method

Study Design

This descriptive study aimed to determine sleep quality, fatigue, and attention in nurses according to their chronotype characteristics and the shifts they work.

Study Population and Sample

The study population consisted of 331 nurses working in a foundation university in Ankara, Turkey. Of these 331 nurses, the study sample constituted 285 (86%) nurses who voluntarily participated and were not on (sick) leave while the study was conducted (between June and July, 2018). The hospital where the study was conducted had 330 beds and the nurses worked for 48 hours a week in the shifts from 8 a.m. to 4 p.m., from 8 a.m. to 8 p.m., and from 8 p.m. to 8 a.m. The supervisor nurses worked from 8 a.m. to 5 p.m., and the nurses in the interventional radiology and angiography units worked from 8 a.m. to 2:30 p.m.

Data Collection Tools

Three data collection tools were used in the present study:

1. *Nurses' Introductory Information Form*: This form includes 12 questions regarding the participants' introductory information (age, gender, education level, marital status, the shift they work, etc.) and 18 questions related to their characteristics of

sleep, fatigue, and attention (working before the shift, working after the shift, fatigue level, medical errors, work accidents, etc.). The fatigue level was measured using a Visual Analog Scale (VAS) between 0 and 10.

2. Pittsburgh Sleep Quality Index: This index was developed by Buysse et al.^[1] in 1989 and tested by Ağargün et al.^[16] for validity and reliability in Turkish in 1999. It is a quantitative measurement of sleep quality to identify good and poor sleep, and consists of 27 questions, 19 of which are self-assessment questions and 5 are answered by the partner or a friend of the participant. The questions answered by the partner or a friend of the participant are not included in the calculation of the index score. Self-assessment questions include various items regarding sleep quality, including sleep duration, sleep latency, and the frequency and severity of the problems specific to sleep. These 18 items are classified under 7 component scores; some of these components include only one item, while others include a few items. Each item is scored between 0 and 3. These components are subjective sleep quality, sleep latency, sleep duration, routine sleep activity, sleep disorders, use of sleeping pills, and daytime dysfunction; the sum of the scores from these components yields the total index score. The total score is between 0 and 21, and higher total scores indicate poorer sleep quality. This index does not show the existence of a sleep disorder or the prevalence of sleep disorders.

3. The Morningness–Eveningness Questionnaire (Annex 3): This questionnaire was adapted to Turkish Pündük et al.^[17] (2005) from the Self Assessment Questionnaire to Determine Morningness–Eveningness in Human Circadian Rhythms, which was developed by Horne and Öztberg^[18] in 1976. This Likert-type questionnaire includes 19 questions with 4 choices of answer. Each answer is clearly schematized. A time scale is used in the 1st, 2nd, and 10th questions, which is divided into 7-hour time frames and 15-minute sub-frames. The choices of answer to the other questions are prepared in boxes. The participants obtained a score between 1 and 4 on items 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, and 16, between 1 and 5 on items 1, 2, 10, 17, and 18, between 0 and 6 on items 11 and 19, and between 0 and 5 on item 12. Based on the total score for the 19 items, 5 different circadian types were determined: 70–86 = definitely morning-type, 59–69 = near morning-type, 42–58 = intermediate-type, 31–41 = near evening-type, and 16–30 = definitely evening-type.

Pilot Study

The pilot study was conducted with 10 nurses working at the same hospital. No changes were made to the data collection forms based on the pilot study results, and the participants of the pilot study were included in the study sample.

Implementation of the Study

After the necessary permission had been obtained and the researchers had explained the aim of the study to the nurses,

the forms were distributed to those who voluntarily participated in the study. The nurses were asked to fill out the forms and were informed that the forms would be taken back in one week. The forms were filled out in 15 minutes.

Ethical Consideration and Permissions

The researchers obtained approval from the Research and Ethics Committee of the university (KA18/192) and permission was given by the head physician of the hospital where the study was conducted. Written and oral consent was obtained from the nurses.

Data Analysis

The data were analyzed using descriptive statistics (percent-age, mean, standard deviation), the chi-square test, independent samples t-test, and variance analysis in SPSS Version 17.0 (SPSS for Windows, Chicago, IL, USA, September 2012; License Number:1093910). Non-parametric tests were used in cases where parametric test assumptions were not met. The results were interpreted at a significance level of 0.05; $p < 0.05$ showed a significant relationship, while $p < 0.05$ showed a non-significant relationship. The correlation test was used to determine the relationship between the variables.

Results

The nurses' average age was 27.94 years (SD=7.76), and of them, 91.2% (n=260) were female, 45.6% (n=130) had graduated from university, 62.8% (n=179) were single, and 29.1% (n=83) had children. Of the participants, 25.3% (n=72) worked in intensive care units, 37.5% (n=107) worked in polyclinics and operating rooms, 37.2% (n=106) worked in other inpatient clinics, 55.8% (n=159) had sleep problems, and 49.8% (n=142) reported that their sleep problem affected their daily living.

The participants' PSQI mean score was 7.87 (SD=3.82). Of the nurses, 68.4% had poor sleep quality; 56.6% of those working during the day and 79.5% of those working in shifts had poor sleep quality ($\chi^2=16.997$, $p < 0.001$). The nurses' PSQI mean scores were compared according to their demographic and occupational characteristics (Table 1). The PSQI mean scores were higher and the sleep quality was poorer among the participants who were single (mean=8.42, SD=3.69) compared to those who were married (mean=6.97, SD=3.90) ($t=3.121$; $p=0.002$); underweight participants (mean=9.81, SD=3.48) compared to normal weight (mean=7.64, SD=3.85) and overweight participants (mean=7.80, SD=3.84) ($F=3.787$, $p=0.027$); those without children (mean=8.28, SD=3.75) compared to those with children (mean=6.95, SD=3.89) ($t=2.661$; $p=0.008$); those who worked at night (mean=8.83, SD=3.54) compared to those who worked during the day (mean=6.86, SD=3.86) ($t=4.462$, $p < 0.001$); those who had sleep problems (mean=9.05, SD=3.79) compared to those who did not

Table 1. PSQI scores according to demographic and occupational characteristics

Variable	PSQI scores		
	n	Mean (SD)	Test, P
Gender			
Male	25	8.68 (4.7)	t=-1.085
Female	260	7.81 (3.73)	p>0.05
Marital status			
Married	106	6.97 (3.90)	t=-3.121
Single	179	8.42 (3.69)	p=0.002
Body mass index			
Underweight	27	9.81 (3.48)	F=3.787
Normal weight	176	7.64 (3.85)	p=0.027
≥Preobesity	68	7.80 (3.84)	
Have children			
Yes	83	6.95 (3.89)	t=-2.661
No	200	8.28 (3.75)	p=0.008
Working time			
Daytime	137	6.86 (3.86)	t=-4.462
Shifts	148	8.83 (3.54)	p<0.001
Time worked as a nurse			
<1	72	7.46 (3.30)	F=8.301
1–5 y	93	9.19 (3.63)	p<0.001
>5 y	113	7.15 (4.02)	
Sleep problems			
Yes	159	9.05 (3.79)	t=6.074
No	126	6.42 (3.35)	p<0.001
Fatigue while working			
Mild	13	6.83 (3.97)	X ² =10.234
Moderate	157	7.32 (3.63)	p=0.006
Severe	115	8.78 (3.92)	
Concentration			
Always good	113	7.08 (3.45)	X ² =10.575
Sometimes good	165	8.34 (3.95)	p=0.005
Poor	4	11.75 (3.50)	
Work accidents			
Yes	93	8.26 (4.13)	t=1.150
No	192	7.70 (3.67)	p>0.05
Medical errors			
Yes	36	7.34 (3.65)	t=0.936
No	249	7.96 (3.85)	p>0.05

PSQI: Pittsburgh Sleep Quality Index; SD: Standard deviation; t: Student's t-test; F: One way ANOVA.

(mean=6.42, SD=3.35) (t=6.074; p<0.001); those with severe fatigue (mean=8.78, SD=3.92) compared to those with moderate (mean=7.32, SD=3.63) and mild fatigue (mean=6.83, SD=3.97) ($\chi^2=10.234$; p=0.006); and those who reported permanent poor concentration (mean=11.75, SD=3.50) compared to those who reported occasional poor concentration

(mean=8.34, SD=3.95) and permanent good concentration (mean=7.08, SD=3.45) ($\chi^2=10.575$; p=0.005). The PSQI scores were not found to be significantly related to experiencing a work accident or making a medical error. On the other hand, although not indicated in the Table 1, 68.6% (n=64) of those with sleep problems and 31.2% (n=29) of those without sleep problems reported experiencing a work accident, and the difference was statistically significant ($\chi^2=9.499$; p=0.001).

The participants' Morningness–Eveningness Questionnaire (MEQ) mean score was 53.03 (SD=6.69); and of them, 21.4% (n=61) were morning-type, 73.7% (n=201) were intermediate-type, and 4.9% (n=14) were evening-type. The MEQ scores of the nurses were compared according to their demographic characteristics (Table 2). Of the married participants, 34.9% (n=37) were morning-type and 1.9% (n=2) were evening-type, and of the single participants, 13.4% (n=24) were morning-type and 6.7% (n=12) were evening-type; the difference was statistically significant (p<0.0001). Similarly, 41% (n=34) of the nurses with children, 12.5% (n=25) of the nurses without children (p<0.0001), 29.9% (n=41) of the nurses who worked during the day, 13.5% (n=20) of the nurses who worked in shifts (p=0.003), 26.2% (n=33) of the nurses without sleep problems, and 17.6% (n=28) of the nurses with sleep problems (p=0.044) were morning-type (Table 2).

The PSQI mean score was 6.57 (SD=3.76) for morning-type, 8.19 (SD=3.76) for intermediate-type, and 9.07 (SD=3.98) for evening-type (F=15.037; p=0.007) (Table 3).

Although not indicated in Table 3, a weak but significant negative relationship was found between the MEQ and PSQI mean scores (r=-0.25, p<0.001), a weak but significant positive relationship was found between age and the PSQI mean score (r=0.19, p=0.001), and a moderate but significant positive relationship was found between age and the MEQ mean score (r=0.36, p<0.001).

Discussion

Poor sleep quality is a common health problem among nurses.^[19] The present study analyzed sleep quality in nurses according to their chronotype and the shifts they work. More than half of the nurses had poor sleep quality, and those who worked in shifts had poorer sleep quality than those who worked during the day ($\chi^2=16.997$, p<0.001). These results are in accordance with those reported in the literature, which show that 65% to 79% of nurses have poor sleep quality and those who work in shifts have poorer sleep quality than those who work during the day.^[20–24]

In the present study, the PSQI mean score of the nurses was found to be 7.87 (SD=3.82), which is in accordance with the literature; studies conducted in different countries report nurses' PSQI mean scores to be between 6.29 and 8.30.^[21,25,26] Han et al. (2016)^[25] conducted a study with 860 nurses and found their mean score to be 7.26 (SD=3.56). Cui et al. (2017)^[26] conducted a study with 253 nurses and found their mean

Table 2. Chronotypes according to demographic and occupational characteristics

Variable	Morning-type	Intermediate-type	Evening-type	Test, p
	Number (%) [*] / (%) ^{**}	Number (%) [*] / (%) ^{**}	Number (%) [*] / (%) ^{**}	
Gender				
Male	2 (8.0) / (3.3)	22 (88.0) / (10.5)	1 (4.0) / (7.1)	X ² =3.109 p>0.05
Female	59 (22.7) / (96.7)	188 (72.3) / (89.5)	13 (5.0) / (92.9)	
Marital status				
Married	37 (34.9) / (60.7)	67 (63.2) / (31.9)	2 (1.9) / (14.3)	X ² =20.034 p<0.0001
Single	24 (13.4) / (39.3)	143 (79.9) / (68.1)	12 (6.7) / (85.7)	
Have children				
Yes	34 (41.0) / (57.6)	49 (59.0) / (23.3)	0 (0.0) / (0.0)	X ² =32.247 p<0.0001
No	25 (12.5) / (42.4)	161 (80.5) / (76.7)	14 (7.0) / (100)	
Working time				
Daytime	41 (29.9) / (67.2)	91 (66.4) / (43.3)	5 (3.6) / (35.7)	X ² =11.699 p=0.003
Shifts	20 (13.5) / (32.8)	119 (80.4) / (56.7)	9 (6.1) / (64.3)	
Time worked as a nurse				
<1 y	11 (15.3) / (18.0)	57 (79.2) / (27.9)	4 (5.6) / (30.8)	X ² =13.887 p=0.008
1–5 y	13 (14.0) / (21.3)	74 (79.6) / (36.3)	6 (6.5) / (46.2)	
>5 y	37 (32.7) / (60.7)	73 (64.6) / (35.8)	3 (2.7) / (23.1)	
Preferred working time				
Daytime	52 (25.5) / (85.2)	145 (71.1) / (69.0)	7 (3.4) / (50.0)	X ² =9.467 p=0.009
Shifts	9 (11.1) / (14.8)	65 (80.2) / (31.0)	7 (8.6) / (50.0)	
Sleep problems				
Yes	28 (17.6) / (45.9)	121 (76.1) / (57.6)	10 (6.3) / (71.4)	X ² =4.091 p=0.044
No	33 (26.2) / (54.1)	89 (70.6) / (42.4)	4 (3.2) / (28.6)	
Fatigue while working				
Mild	3 (23.1) / (4.9)	10 (76.9) / (4.8)	0 (0.0) / (0.0)	X ² =6.853 p=0.020
Moderate	40 (25.5) / (65.6)	112 (71.3) / (53.3)	5 (3.2) / (35.7)	
Severe	18 (15.7) / (29.5)	88 (76.5) / (41.9)	9 (7.8) / (64.3)	
Work accidents in the previous year				
Yes	18 (19.4) / (29.5)	70 (75.3) / (33.3)	5 (5.4) / (35.7)	X ² =0.378 p>0.05
No	43 (22.4) / (70.5)	140 (72.9) / (66.7)	9 (4.7) / (64.3)	
Medical errors in the previous year				
Yes	6 (16.47) / (9.8)	27 (75.0) / (12.9)	3 (8.3) / (21.4)	X ² =1.423 p>0.05
No	55 (22.1) / (90.2)	183 (73.5) / (87.1)	11 (4.4) / (78.6)	

*Line percentage; **Column percentage; X²: Chi square.

Table 3. PSQI scores according to chronotypes

Variable	PSQI score (7.87±3.82, Min=0, Max=21)		
	n (%)	Mean (SD)	Test, p-value
Chronotype (53.03±6.69)			
Morning-type	61 (21.4)	6.57 (3.76)	F=15.037 p=0.007
Intermediate-type	207 (73.7)	8.19 (3.76)	
Evening-type	14 (4.9)	9.07 (3.98)	

PSQI: Pittsburgh Sleep Quality Index; SD: Standard deviation; Min: Minimum; Maks: Maximum.

score to be 7.76 (SD=3.53). Park et al. (2018)^[23] conducted a study with 188 nurses in South Korea and found the mean

score to be 7.96 (SD=3.42) for those who worked in the night shift and 6.29 (SD=2.82) for those who worked in the day shift.

McDowall et al. (2017)^[22] conducted a study with 888 nurses in England and found the PSQI mean score to be 8.30 for those who worked in shifts and 6.72 for those who did not.

In the present study, sleep quality was found to be statistically significantly poorer among those who were single, were underweight, had no children, worked at night, reported having sleep problems, and had severe fatigue, and among those who had worked for 1 to 5 years compared to those who had worked for a shorter or longer time. On the contrary, McDowall et al. (2017)^[22] found no statistically significant relationship between sleep quality and age, gender, body mass index (BMI), time worked as a nurse, or the number of children at home. Single nurses and those with no children may have more active social and night lives and may work in shifts more frequently compared to married nurses and those with children, which may have affected their sleep quality. Although the literature highlights that obesity negatively affects sleep quality,^[27,28] no results were found to indicate that underweight individuals have poorer sleep quality than normal weight or obese individuals.^[29-32] Shockat et al. (2016)^[32] conducted a study with 719 adults aged 70 years and older and found that obese individuals had a shorter sleep duration and poorer sleep efficacy compared to normal weight and underweight individuals. A study conducted with 137 nurses in Taiwan indicated that increased age and time worked in the profession significantly reduces the risk of poor sleep quality.^[33] In the present study, the nurses who had worked for 1 to 5 years had poorer sleep quality than those who had worked for a shorter or longer period. This may be because those who had worked for 1 to 5 years had more responsibilities than those who had worked for a shorter period, were also responsible for the nurses with less experience, and worked in the day shift less frequently than those who had worked for a longer period. No statistically significant difference was found between genders in terms of sleep quality in the present study; however, Giorgi et al. (2017)^[34] found that females had more problems regarding sleep quality than males in their study with 315 shift nurses working in a hospital in Italy. The fact that no difference was found between genders in the present study may be attributed to the low number of male nurses. In addition, the nurses who reported having severe fatigue and poor concentration were also found to have poor sleep quality. Poor sleep quality may increase fatigue and reduce concentration while working, and fatigue may negatively affect sleep. Although no statistically significant difference was found in the present study, it is suggested that this may lead to medical errors or work accidents.^[35,36]

The present study also analyzed the chronotype characteristics of the nurses. The nurses' MEQ mean score was 53.03 (SD=6.69) and the majority of them were intermediate-type, while evening-type nurses constituted the group with the lowest number of individuals. Other studies conducted on this subject have reported conflicting results. Silva et al. (2017)^[37] reported that among the 270 nurses, nursing aides, and technicians working in surgery clinics in Brazil, the interme-

diated-type constituted the group with the highest number of individuals (41.5%), while the evening-type constituted the group with the lowest number of individuals (21.6%). Another study reported that the majority of nurses (65.0%) were intermediate-type, while those who were definitely morning-type constituted the group with the lowest number of individuals (1.8%).^[20] Different from the present study, Zhang et al. (2018)^[31] reported that of the 397 nurses in their study, 49.5% were morning-type, 29.1% were evening-type, and 21.4% were intermediate-type. Similarly, a study conducted with 96 intensive care nurses in the Netherlands reported that 64% of the participants were morning-type.^[14] In another study conducted with 390 nurses working in 6 hospitals in Spain, the highest number of nurses were morning-type (35.1%) and the lowest number of nurses were intermediate-type (30.8%).^[38] By the nature of biological rhythm, nurses are expected to prefer working in the daytime shift; however, they may choose to work in different shifts, due not only to their different chronotype characteristics but also variables such as age and time having worked in a particular shift.

In the present study, the chronotypes of nurses were compared according to their demographic and occupational characteristics. As expected, the rate of morning-type nurses was higher among those who were married, had children, worked during the day, preferred working during the day, and had worked for 5 years or longer compared to the nurses who were single, had no children, worked in shifts, preferred working in shifts, and had worked for 1 to 5 years. The rates of intermediate- and evening-type nurses were higher among those who reported sleep problems compared to those who did not. In addition, fatigue severity was higher among evening-type nurses compared to morning-type nurses. Although the relevant literature includes a limited number of studies, Ruzafa Martínez et al. (2013)^[38] found that the rate of morning-type nurses was higher among those who were older and had more experience, while Reinke et al. (2015)^[14] indicated that nurses' parental responsibilities may reduce their tolerance to working in shifts and reported that sleep quality decreased most significantly following a night shift.

In the present study, the nurses' sleep quality showed a statistically significant difference according to their chronotype characteristics. Morning-type nurses were found to have poorer sleep quality compared to intermediate- and evening-type nurses; however, other studies have reported no statistically significant difference between nurses' chronotype characteristics and their sleep quality.^[14,21]

Conclusion

The present study found that nurses generally had poor sleep quality, working in shifts negatively affected sleep quality, increased age and time worked as a nurse affected the preference of working in the daytime shift, and working in shifts increased the severity of fatigue and reduced concentration while working, which may increase the possibility of work ac-

cidents and medical errors; however, further studies should be conducted on this subject. Considering that nurses who had sleep problems and worked in shifts had poorer sleep quality, it is recommended that the underlying causes be determined, programs be created to increase sleep quality, and the relationship of sleep quality with fatigue and low concentration be addressed more comprehensively.

Study Limitations

The participants may have not truthfully answered the question "Have you made a medical error in the previous year? If yes, what?" due to their concern that people would learn about their unreported errors, if any. This may have affected the results regarding the relationship of making medical errors with fatigue and sleep quality. The study results are based on participants' self-reports; no observations or monitoring were carried out.

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