*Original Research*

# Assessment of the Relationship between Sleep Disorders and Circadian Type in Nurses with Shift and Daytime Work

Lahya Afshari Saleh[1], Amir Rezaei Ardani[2], Ehsan Rafeemanesh[1], Pegah Kheradmand[1*]

[1.] *Department of Occupational Medicine, Division of Sleep Medicine, Psychiatry and Behavioral Sciences Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*
[2.] *Psychiatry and Behavioral Sciences Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*

## Abstract

**Background and Objective:** Chronotypes vary in different people, and the daily function outside of the framework of this rhythm can affect the quality of work. This study aimed to investigate the association between sleep disorders and chronotypes among the shift and day work nurses.

**Materials and Methods:** This cross-sectional study was performed among nurses in two teaching hospitals in Mashhad, Iran, during 2016-2017. A total of 180 randomly-selected nurses were divided into shift work and day work groups. Participants completed demographic information form, Circadian Type Inventory (CTI), Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), Beck Anxiety Inventory (BAI), and Beck Depression Inventory (BDI).

**Results:** A total of 180 female nurses (90 participants in each group) with a mean age of $35.62 \pm 4.07$ years were studied. The prevalence of rigid circadian rhythm in the day work group (93.3%) was significantly ($P = 0.004$) higher than shift work group (78.9%). However, the groups did not show any significant difference regarding the languid/vigorous (LV) index of the CTI ($P = 0.080$). There was a significant difference in the mean score of CTI between individuals with rigid and flexible circadian rhythms in the shift work group ($P = 0.021$).

**Conclusion:** In the present study, although there was no association between circadian type and sleep problems including insomnia and daytime sleepiness in shift work nurses, we observed the capability of coping with working in the rotating shifts in nurses with flexible circadian rhythms.

## Introduction

Shift working, defined as working outside the regular daytime hours of 8 A.M. to 2 P.M. on weekdays (1), accounts for about 20.0% of the world's employed population (2). Shift working can be associated with various health outcomes including cardiovascular disease (CVD), digestive problems, diabetes, metabolic disorders, stroke, breast cancer, exacerbations of underlying diseases, adverse pregnancy outcomes such as low birth weight, overweight and obesity, fatigue, loss of performance, and occurrence of errors (3-7).

Individuals are different in their ability to tolerate shift work schedules. Age, sex, morning chronotype, flexibility in overcoming insomnia, vigorousness versus sleepiness, proper psychological status, internal control, and some genetic status are impressive factors in tolerating shift work (8).

People with flexible circadian rhythms are flexible to sudden changes in their internal rhythms, such as staying awake at night. On the contrary, rigid individuals are inflexible against sudden changes in internal rhythms. People with circadian rhythms of the languid type are incapable of overcoming sleepiness caused by insomnia or sleep deprivation, while the vigorous ones are resilient to sleepiness and remain juicy (9).

A study in Norway in 2012 showed a statisti-

* *Corresponding author*: *P. Kheradmand, Department of Occupational Medicine, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran*
*Tel: +98 915 408 0849, Fax: 051 36088918*
*Email: pegahkheradmand@yahoo.com*

cally reverse relationship between flexibility and shift work-related sleep disorders and a direct association between languidness and sleep disorders (10). In addition, in another study in Iran in 2015, the authors showed that the flexibility of circadian rhythm, occupational stress, and sleepiness were efficient in the shift workers' quality of sleep (11).

Assuming the relationship between flexible/rigid (FR) and insomnia as well as languid/vigorous (LV) and daytime sleepiness, suitable shift workers could be identified among sensitive occupations that require effective work in rotating and night shifts. One of these critical occupational groups is healthcare workers whose physical and mental health has an intense impact on job performance. Therefore, we studied the relationship between sleep disorders including nighttime insomnia and daytime sleepiness and the chronotypes of circadian rhythm in shift work and day work nurses.

## Materials and Methods

### Participants and data collection

This cross-sectional study was conducted among shift work and fixed morning shift nurses in two teaching hospitals in Mashhad, Iran, in 2016-2017. The study population was female nurses working in two major hospitals of Mashhad University of Medical Sciences. Inclusion criteria were female gender and working experience as a nurse for at least one year. Exclusion criteria were a history of psychological disorders of anxiety and depression, taking sedative medications, hypnotics, and antidepressants, the occurrence of any sudden event during the last six months that affected the individual, as well as migration, death, and unwillingness to participate in the study.

The participants were divided to shift work and day work groups according to the type of work schedule and were selected randomly from each group by random digit table. The shift work was defined as working outside the regular daytime hours of 8 A.M. to 3 P.M. on weekdays.

A trained person measured the blood pressure (BP), height, weight, and neck circumference of all study participants based on standard criteria, including checking the BP from the right arm using a calibrated sphygmomanometer after five minutes of rest and at an interval of two hours after heavy meal, and measuring the weight by a calibrated scale in all cases. Subsequently, each participant received a package containing six

questionnaires including the demographic questionnaire, Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), Circadian Type Inventory (CTI), Beck Anxiety Inventory (BAI), and the 13-item Beck Depression Inventory (BDI) and completed them.

### Instruments

The study package containing six questionnaires was provided to the participants and it was requested to complete them carefully. These questionnaires included:

*Demographic information questionnaire:* This questionnaire included age, marital status, number of children, having a child under two years, employment duration, educational level, number and type of work shifts within the last year, smoking, experience of bad events during the last six months, history of diseases related to chronic nightly pain, anxiety, and depression diagnosed by a neurologist, and taking sedatives and antidepressants.

*Circadian Type Inventory (CTI):* The CTI questionnaire was used to evaluate the chronotypes of the circadian rhythm. The questionnaire consists of 11 questions about the sleep habits and the awakening of people in daily life, containing five-item FR and six-item LV scales. This questionnaire covers two factors associated with the chronotypes of circadian rhythm. The first factor consists of five questions called FR scale representing the stability of the circadian rhythm. Those who earn higher scores are flexible and can work in the shift work system with the capability of staying awake at night times. The second factor consists of six questions called LV representing the circadian rhythm range. Each question consists of five points, which are scored on a Likert scale from 1 to 5. In Jafari Roodbandi et al.'s study, the validity and reliability of the questionnaire were 0.94 and 0.76, respectively (12).

*Insomnia Severity Index (ISI)*: The ISI questionnaire examines the severity and negative impacts of insomnia on the individual's life in the last two weeks. The questionnaire consists of 7 domains including: the difficulty in sleep onset, difficulty staying asleep, early morning wakening problems, sleep difficulties, interference of sleep problems with daytime functioning, distress leading to sleep problems, and noticeability of sleep dissatisfaction by others. Each question is scored with a five-point Likert scale from zero to four, and the total score of the questionnaire, obtained from the sum of scores, is from 0 to 28. The higher score in this questionnaire indicates more se-

vere insomnia such that a score of 0-7 suggests no insomnia, a score of 8-14 is insomnia below the clinical threshold, 15-21 indicates moderate insomnia, and a score of 22-28 portends severe insomnia. The Cronbach's alpha was 0.78 in Sadeghniiat-Haghighi et al.'s study (13).

*Epworth Sleepiness Scale (ESS):* To assess the daytime sleepiness, we used the Persian version of the ESS questionnaire. The questionnaire includes eight questions that examine the probability and severity of a person's nap in different daily situations and the options for each question are scored from 0 to 3. 0 indicates the improbability of nap and 3 indicates the high probability of nap. The total score is between 0 and 24, and the score over 8 represents unusual daily sleepiness. Cronbach's alpha score of reliability was calculated 0.81 in the Sadeghniiat-Haghighi et al.'s study (14).

*STOP-BANG questionnaire*: The STOP-BANG questionnaire was used to assess the risk of obstructive sleep apnea (OSA). The questionnaire consists of two parts. In the first part, there are four yes/no questions about snoring at night, fatigue during the day, observation of stopped breathing or choking/gasping by surrounding people, and high BP. The second part consists of four parameters of body mass index (BMI), age, neck circumference, and gender, measured by trained technicians. In the first part, yes, and in the second part, the BMI higher than 35 kg/m$^2$, age over 50 years, neck circumference over 40 cm, and male gender were scored as positive. The total positive scores more than 3 were considered to be high risk for OSA. Current results showed 72.0% for sensitivity, 33.3% for specificity, and 75.0% and 30.0% for positive predictive value (PPV) and negative predictive value (NPV), respectively. Cronbach's alpha was 0.92 (15).

*Beck Anxiety Inventory (BAI)*: BAI containing 21 four-option items was used to assess the anxiety level in the study participants. Each question reflects one of the symptoms of anxiety that can usually be experienced by people who are anxious clinically or those who are in situations of anxiety. Participants rate their resentment of anxiety symptoms over the past week in front of each question. The method of scoring is never (1), mild (1), moderate (2), and severe (3). Internal consistency, validity, and reliability were 0.92, 0.83, and 0.72, respectively (16).

*BDI-13:* The probability and severity of depression in the present subjects were evaluated by BDI-13 that contains 13 self-report terms to express the specific symptoms of depression. Each sentence contains a four-point scale scoring from 0 to 3. The BDI-13 has been developed for measuring different symptoms of depression such as emotional, cognitive, motivational, and physiological depression (17). In Dadfar and Kalibatseva's study, 0.85 was calculated for Cronbach's alpha (18).

*Statistical analysis:* The data collected through the questionnaires were analyzed using the SPSS software (version 21, IBM Corporation, Armonk, NY, USA). Independent t-test, chi-square test, and relevant nonparametric tests were used to investigate the relationship between sleep disorders and the chronotypes of circadian rhythm. The significant level was considered less than 0.05.

## Results

Each study group (shift work and day work groups) consisted of 90 female nurses with the mean age of 33.8 ± 5.8 and 37.6 ± 6.2 years, respectively. As shown in table 1, there was no statistically significant difference in the demographic characteristics between the two groups (P > 0.05).

**Table 1.** Comparison of demographic and personal data between groups

| Variables | Groups[*] | | P-value |
|---|---|---|---|
| | Shift work | Day work | |
| Age (year) | 33.80 ± 5.80 | 37.60 ± 6.20 | 0.230 |
| Work experience (year) | 9.10 ± 4.90 | 13.10 ± 6.00 | 0.520 |
| Height (cm) | 1.60 ± 0.05 | 1.60 ± 0.06 | 0.620 |
| Weight (kg) | 63.70 ± 9.10 | 65.90 ± 11.20 | 0.160 |
| BMI (kg/m$^2$) | 24.60 ± 3.50 | 25.30 ± 3.90 | 0.260 |
| Smoking | 1 (0.01) | 2 (0.02) | 0.560 |
| Taking medication | 62 (68.89) | 56 (62.22) | 0.310 |
| Being married | 70 (77.77) | 69 (76.77) | 0.859 |
| Having child under 2 years old | 11 (12.22) | 18 (20.00) | 0.156 |
| Bad events | 16 (17.78) | 16 (17.78) | > 0.999 |

[*]Values are shown as mean ± standard deviation (SD) for quantitative variables and as number and percentage for qualitative variables; independent samples t-test for quantitative variables and chi-square test for qualitative variables were used.

BMI: Body mass index

The mean scores obtained from ESS, STOP-BANG, ISI, CTI (LV), CTI (FR), BAI, and BDI questionnaires were not significantly different between the two groups of shift workers and day workers. Table 2 shows the detailed comparison of scores in various indices between groups.

**Table 1.** Comparison of results of questionnaires between groups

| Variables | Groups* | | P-value |
|---|---|---|---|
| | Shift work | Day work | |
| ESS | 8.37 ± 4.28 | 7.72 ± 3.62 | 0.293 |
| STOP-BANG | 1.11 ± 0.62 | 1.04 ± 0.87 | 0.249 |
| ISI | 10.50 ± 4.70 | 9.90 ± 4.51 | 0.404 |
| CTI (LV) | 19.46 ± 3.81 | 18.58 ± 3.41 | 0.081 |
| CTI (FR) | 14.00 ± 4.71 | 13.22 ± 3.82 | 0.313 |
| BAI | 11.91 ± 11.09 | 9.80 ± 8.49 | 0.413 |
| BDI | 5.21 ± 5.38 | 3.79 ± 4.68 | 0.057 |

*Independent samples t-test was used
ESS: Epworth Sleepiness Scale; ISI: Insomnia Severity Index; CTI: Circadian Type Inventory; LV: Languid/vigorous; FR: Flexible/rigid; BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory

According to the CTI questionnaire, 71 (78.9%) participants in the shift work group and 84 (93.3%) participants in the day work group were classified as rigid (Figure 1). There was a significant difference between the groups in this regard (P = 0.004). However, the groups did not show any significant difference regarding the LV index of the CTI (P = 0.080).
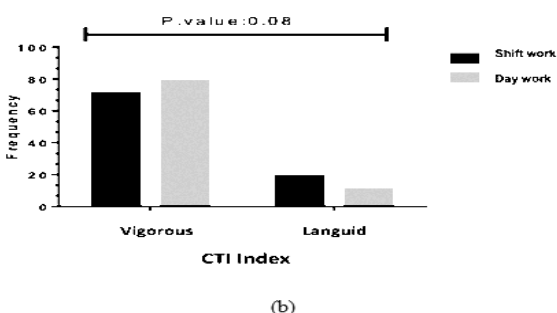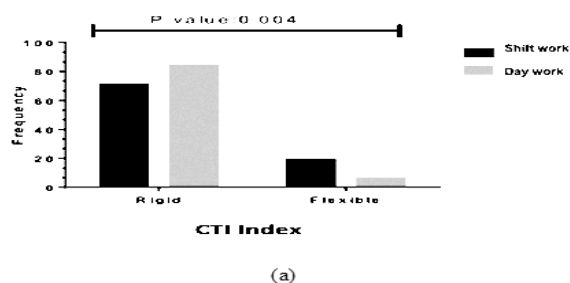


**Figure 1.** The frequency of flexible/rigid (FR) (a) and languid/vigorous (LV) (b) individuals compared between shift and day work groups based on Circadian Type Inventory (CTI). Shift (night) work and day work were demonstrated by blue and red bar charts.

We classified the participants in each group based on the result of CTI (FR) index into rigid and flexible, and compared different indices between them in each group (Figure 2). As the figure shows, there was a significant difference in the mean score of CTI (LV) between rigid and flexible individuals in the shift work group (P = 0.021). Whereas, the only indices that had significantly different scores between rigid and flexible individuals in the day work group were BAI and BDI-13 (P = 0.042 and P = 0.014, respectively).
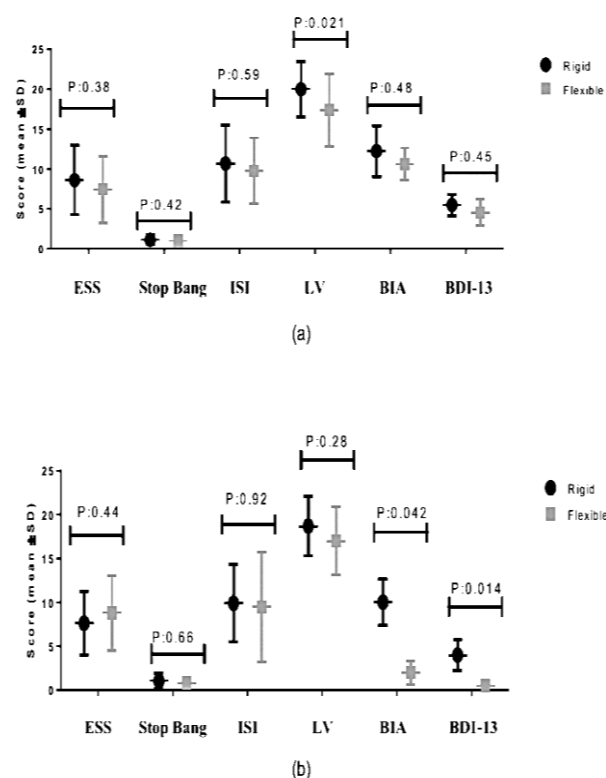


**Figure 2.** Mean scores of different indices compared between rigid and flexible individuals based on Circadian Type Inventory (CTI) in participants of shift work (a) and day work (b) groups. Results of comparison of rigid and flexible individuals are shown based on six questionnaires including Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI), CTI [languid/vigorous (LV)], Beck Anxiety Inventory (BAI), and Beck Depression Inventory (BDI).

We classified the participants in each group based on the result of CTI (LV) index into vigorous and languid, and compared different indices between them in each group (Figure 3). As shown in the figure, there was no significant difference between vigorous and languid subjects in terms of ESS, STOP-BANG, ISI, CTI (FR), BAI, and BDI-13 indices in neither of the two groups.
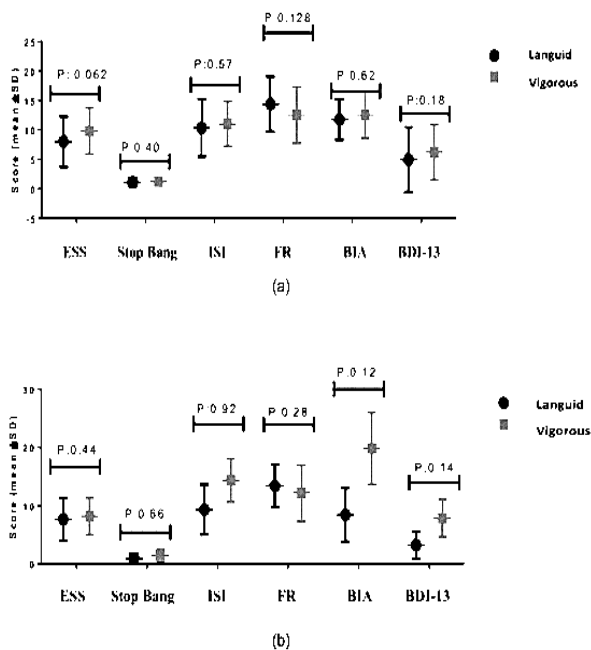
**Figure 3.** Mean scores of different indices compared between languid and vigorous individuals based on Circadian Type Inventory (CTI) in participants of shift work (a) and day work (b) groups. Results of comparison of languid and vigorous individuals are shown based on six questionnaires including Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI), CTI [languid/vigorous (LV)], Beck Anxiety Inventory (BAI), and Beck Depression Inventory (BDI).

## Discussion

Based on the results of this study, 21 nurses in the shift work group compared with 13 subjects in the day work group had clinical insomnia, indicating the likelihood of shift work effects on the sleep health regarding the ISI index, but the association was not significant. One of the results obtained from the present study is a statistically significant difference in the frequency of flexible people in the shift work group as compared to the day work nurses, which can be shown as somewhat non-significant difference between the two groups for insomnia, according to the results of previous studies. This may suggest natural selection process to attract more people better adapted to shift work-related sleep changes; however, further studies are needed to determine the casualty of mentioned results. The other considerable point was the higher relative frequency of moderate to severe anxiety and mild to moderate depression in the shift work group compared to the day work group. Although this association was not statistically significant, this finding shows the need for further attention to the mental health of the nurses.

A significant positive correlation also was found between the mean LV scale and the depression index among all participants in the study. This indicates a higher prevalence of depression in languid people compared with vigorous people. Higher prevalence of depression in languid people shows the importance of a special look at the characteristics of individuals in sensitive occupational groups such as nurses and other healthcare workers.

According to circadian rhythm classification, the shift work group was more flexible than the day work group. The frequency of abnormal ESS in the shift work group was more than the day work group, albeit the association was not significant.

The comparison of the mean score of BDI between the shift work and the day work groups revealed a large statistical difference close to the significance level between the two groups, indicating a higher relative frequency of depression in the shift work group. Furthermore, the frequency of classified anxiety index obtained by the BAI, despite the insignificant difference between two groups, showed that moderate and severe anxiety states were higher among shift work group (30.0%) compared to the daily work group (23.0%). Also, concerning the BDI, the overall prevalence of mild to moderate depression was higher among the shift work group than the day work group though there was no significant difference between the two groups regarding overall frequency. The rigid subjects in the day work group had higher mean scores for anxiety and depression scales. There was a significant positive correlation between LV scale (languidness and vigorousness of people versus sleepiness) and BDI in studying the relationship between circadian types and anxiety and depression scales among all participants in this study, indicating a direct association between them.

Jafari Roodbandi et al. in Iran showed that the flexibility of circadian rhythm, occupational stress, and sleepiness affected the shift workers' quality of sleep, but we did not notice this result, which can be somewhat due to the type of questionnaire used in evaluating the sleep disorder by Jafari Roodbandi et al. They assessed the sleep quality of the participants by Pittsburgh Sleep Quality Index (PSQI) (11), while we used the ISI to evaluate prevalence and severity of insomnia in the participants.

In a study by Storemark et al., the results showed a statistically significant association between flexibility and sleep-related shift work tol-

erance, including insomnia and daytime sleepiness, as well as a significant negative relationship between languidness relative to sleepiness and sleep-related shift work tolerance (19). This relationship was not revealed in our study, which can be due to two factors: the low number of flexible and languid individuals in the shift work group and the higher relative frequency of flexible people among the shift work nurses in our study.

In addition, Natvik et al. argued that flexibility in interacting with the type of shift work was significantly associated with insomnia, which indicated that the flexibility for the three-shift workers had a significant reverse relationship with shift work-related sleep disorders, but there was not any relationship among the two-shift workers. The languidness trait was also associated with higher levels of sleepiness and symptoms of depression and anxiety, with none of the results consistent with our study. This difference in results can be attributed to the greater accuracy of the recent study on the shift work schedule, the difference in the study tools of circadian pattern survey, and the high sample size in the study of Natvik et al. This study, in line with the present study, reported a relationship between flexibility and languidness with mood and anxiety (2).

In another study by Flo et al. in Norway, 1968 nurses were examined. The researchers observed a statistically reverse relationship between flexibility and shift work-related sleep disorders and a direct association between languidness and sleep disorders. The difference between the results of this study and ours can be due to the difference in the definition of the dependent variable. Recent research has looked at shift work-related sleep disorders with precise detection of shift work and night work schedules (10).

In a study by Saksvik-Lehouillier et al., the sleep-related shift work tolerance of inexperienced night nursing staff was related inversely to languidness, working hours per week, and caffeine consumption, and directly to flexibility (20), while these associations were not confirmed in our study. In the present study, the number of night work personnel was lower than that could attenuate the night work effect on sleep disorder.

In a study conducted by Akerstedt et al., more than 45 years of age, female gender, higher BMI, and no history of physical activities were identified as indicators of lifestyle/underlying risk associated with the sleep disorder (21). In our study,

none of the demographic characteristics had a relationship with shift-work sleep disorders such as nighttime insomnia and daytime sleepiness, which can be due to the difference in the mean age and work experience of the participants as well as sample size.

The strengths of the present study were using multiple sleep-related questionnaires, investigation of confounding factors, and the type of sampling (census). Evaluation of the types of confounding factors affecting the normal process of sleep can be a better way to conclude and control the conditions of the study. One of the limitations of the present study was the study design (cross-sectional) with a probability of bias because of poor response by participants. Furthermore, assessment of a female population reduces its generalizability. In addition, there was no possibility of finding a causal relationship between shift work and sleep disorders. Objective measures [biochemical and neurochemical dynamics, sleep log, polysomnography (PSG), and actigraphy] were not investigated in this study.

## Conclusion

In the present study, although there was no association between circadian type and sleep disorders including insomnia and daytime sleepiness in shift work nurses, we observed the capability of coping with working in the rotating shifts among nurses with flexible circadian rhythms. Our results showed no relationship between the type of circadian rhythm and shift work sleep disorder, including insomnia and daytime sleepiness, but we noticed a further tendency of flexible people to work in the rotating shifts.

## Conflict of Interests

Authors have no conflict of interests.

## Acknowledgments

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