

Original Article

Circadian dysynchrony among nurses performing shift work at a tertiary care teaching hospital: a preliminary study

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Abstract: Background: Circadian rhythm is intracellular molecular mechanisms, influenced by environmental factors such as light, noise, mealtime, and sleep pattern. Shift work affects the sleep pattern, mealtime and psychological aspects of workers. This study aims to compare the effect of shift work on circadian dysynchrony among nurses in two different groups based on the duration of shift work. Material and method: It was a cross-sectional, preliminary study done at a tertiary care teaching hospital in North India. The study enrolled 170 nurses (aged <35 years) performing shift duties for last 3 years (group-1) and 1 year (group-2) respectively in a 1:1 ratio. Tools used to collect data were case reporting form (demographic and clinical variables, anthropometric measures), Hamilton Anxiety Rating Scale, and Pittsburg Sleep Quality Index. Results: Mean age of participants was 27.39±2.89 vs. 26.14±2.45 in group 1 and 2. We found significant positive correlation of duration of shift work with diastolic blood pressure (DBP) (P=0.000), systolic blood pressure (SBP) (P=0.001), body fat % (P=0.019), weight (P=0.034), hip circumference (HC) (P=0.000) and also significant difference between means of DBP (P=0.001) and HC (P=0.003) in both groups. Whereas bad sleep quality was found in 79% and 66% of participants in group 1 and 2 respectively, the prevalence of moderate to severe anxiety in groups 1 and 2 was 60% and 37% respectively. Conclusion: Long duration of shift work increases the risk of developing cardiometabolic risk factors as a consequence of circadian dysynchrony and varies with the duration of shift work.

Keywords: Anxiety, circadian dysynchrony, cardiometabolic factors, sleep, shift work

Introduction

Circadian rhythm is intracellular molecular mechanisms constructed to prepare the cells, tissues, organs, and organisms for the stimulus before its onset [1]. Light, noise, mealtime, and sleep pattern are important factors that can influence mammalian biological clocks [2]. Lack of sleep and psychological changes due to shift work can affect circadian rhythm [3]. Along with that, the prevalence of depression and anxiety are also found to be high among shift workers in some studies [4]. Earlier studies have established body mass index, waist circumference (WC), waist to hip ratio (WHR), waist to height ratio (WHtR), and blood pressure as significant predictors for car-

diometabolic disorders [5-7]. According to the Doetinchem cohort study, the circadian disturbance is also associated with metabolic syndrome [8]. Anxiety and disturbed sleep patterns also contribute to poor quality of life among shift workers [9]. Although several studies describe circadian dysynchrony and its effect on sleep quality and psychological factors among shift workers. Sufficient literature is also available regarding the comparison in shift workers and day workers, but results are largely contradictory due to limited availability of data regarding the impact of duration of shift work. In this study, we aim to see the effect of shift work on circadian dysynchrony among nurses, to compare noninvasive markers of circadian dysynchrony and metabolic disorders in two

Circadian dysynchrony in shift work nurses

groups of nurses based on their duration of shift work.

Aim

To compare the impact of shift work on circadian dysynchrony among nurses performing shift work at tertiary care hospital.

Objectives

To compare: -

1. Noninvasive markers of circadian dysynchrony and metabolic disorders in both groups.
2. The quality of sleep among nurses performing shift work at a tertiary care hospital.
3. The anxiety status among nurses performing shift work at a tertiary care hospital.

Material and methods

- Research design: - A comparative cross-sectional design.
- Study population: - Nurses performing shift duties.
- Sampling technique: - Purposive sampling technique.
- Sample size: - 170 nurses.
- Setting: - Tertiary care teaching hospital.

Inclusion criteria

Nurses who are:

- Aged <35 years.
- Performing shift duties for more than 3 years in group-1 & for 1 year in group 2.
- Willing to give consent for the study.

Exclusion criteria

- Those who are suffering from any psychiatric illness, chronic illness, and metabolic disorders before joining of shift duties.

Method of data collection

- Ethical clearance was obtained from the Institutional Ethics Committee.

- Permission was also obtained from the hospital authority.

- Informed consent was taken from the participants.

- Tools used for data collection were case reporting form including demographic and clinical variables, anthropometric measures, Hamilton Anxiety Rating Scale (HAM-A), and Pittsburgh Sleep Quality Index (PSQI) were administered to the participants.

- After data collection, participants were thanked for participation.

Case Reporting Form: - Demographic variables and clinical variables (anthropometric measures) were collected from the participants. In anthropometric variables, we measured body mass index, waist to hip ratio, waist circumference, hip circumference, height, weight, and body fat %.

Hamilton Anxiety Rating Scale (HAM-A): - It consists of 14 items for the measurement of anxiety, each item is scored from 0-4 (not present to severe). Total scoring range 0 to 56, <17 scores for mild severity, 18 to 24 scores for mild to moderate severity, and 25 to 30 scores moderate to severe [10].

Pittsburg Sleep Quality Index (PSQI): - This instrument is widely used to measure the sleep quality and patterns in adults under 7 domains. Scoring of the items was 0 to 3 rating scale, whereby 3 reflect the negative extreme. A score of "5" or more shows "poor" sleep [11].

Statistical analysis

The data collected from 170 participants were coded and summarized in the MS Excel data-sheet. The analysis was done based on the objectives of the study in SPSS software (version 23). Appropriate inferential analysis was applied, *p*-value considered significant as <0.05.

Results

A total of 170 subjects were included in the study having 50% age-matched participants in each group. The mean age of participants in groups 1 and 2 was 27.39±2.89 and 26.14±2.45. Hence, both groups were comparable.

Circadian dysynchrony in shift work nurses

Table 1. Demographic and clinical characteristics of participants (n=170)

S. No.	Variables	Categories	Frequency (%)	Frequency (%)
			Group-1 (performed shift work for more than 3 years)	Group-2 (performed shift work for 1 year)
1.	Age (yrs.)		Mean ± SD (27.39±2.89)	Mean ± SD (26.14±2.45)
2	Gender	Male	51 (60%)	60 (70.58%)
		Female	34 (40%)	25 (29.41%)
3	Marital status	Unmarried	36 (42.3%)	47 (55.29%)
		Married	49 (57.7%)	38 (44.70%)
4.	Education	General nursing and midwifery	41 (48.23%)	17 (20%)
		Graduation	39 (45.88%)	68 (80%)
		Post-Graduation	5 (5.88%)	0 (0%)
5	Habitat	Urban	51 (60%)	59 (69.41%)
		Rural	34 (40%)	26 (30.58%)
6	Physical activity	Sedentary	26 (30.5%)	17 (20%)
		Moderate	59 (69.41%)	68 (80%)
7	Alcohol	Non-user	77 (90.58%)	78 (91.76%)
		occasional user	8 (9.4%)	7 (8.23%)
8	Smoking	Non-user	75 (88.23%)	73 (85.88%)
		5 cigarettes per day	7 (8.23%)	7 (8.23%)
		5-10 cigarettes per day	3 (3.52%)	5 (5.88%)

Table 2. Comparison of continuous variables between both groups

Variables	Group-1 (performed shift work for more than 3 years)	Group-2 (performed shift work for 1 year)	p-Value
	n=85 Mean ± SD	n=85 Mean ± SD	
Age (yrs)	27.39±2.89	26.14±2.45	0.100
BMI (kg/m ²)	24.46±2.96	23.51±3.71	0.05
DBP (mmHg)	80.170±10.15	74.05±5.81	0.001**
SBP (mmHg)	120.21±9.92	116.26±7.99	0.06
Height (cm)	163.50±9.24	162.83±10.0	0.35
Weight (kg)	68.48±11.54	64.94±1.03	0.045*
Waist circumference (cm)	85.35±7.49	84.31±5.72	0.21
Hip circumference (cm)	92.24±8.36	88.00±5.99	0.003**
Body fat %	22.45±7.6	21.12±5.87	0.13
WHR	0.88±0.63	0.87±0.45	0.41
Duration of shift work	4.26±1.1	1.02±0.1	0.03*

Independent 't' test, P value significant as * represents <0.05, ** represents <0.01. Footnote: BMI-Body mass index, DBP-Diastolic blood pressure, SBP-Systolic blood pressure, WHR-Waist to hip ratio.

Approximately 48.23% and 20% of participants had an educational qualification of general nursing and midwifery in group 1 and group 2 respectively. 12% and 14% of participants were smokers in groups 1 and 2 whereas 10% and 8% of participants had a habit of occasional drinking in these groups (Table 1). Mean body mass index (BMI) was 24.46±2.96 kg/m²

and 23.51±3.71 kg/m² in group -1 and 2. Mean diastolic blood pressure (DBP) was 80.170±10.15 mmHg and 74.05±5.81 mmHg in study groups. Mean body fat % was 22.45±7.6% vs. 21.12±5.87% in group-1 and 2 respectively (Table 2). Duration of shift work had significant positive correlation with diastolic blood pressure (P=0.000**), systolic blood pressure

Circadian dysynchrony in shift work nurses

Table 3. Correlation coefficient of variables with the duration of shift work

Variables	Correlation coefficient (R-value)	Duration of shift work (P Value)
Diastolic blood pressure	.786	0.000**
Systolic blood pressure	.669	0.001**
Body fat %	.591	0.019*
Weight	.473	0.034*
Hip circumference	.797	0.000**

P value significant as * represents <0.05, ** represents <0.01.

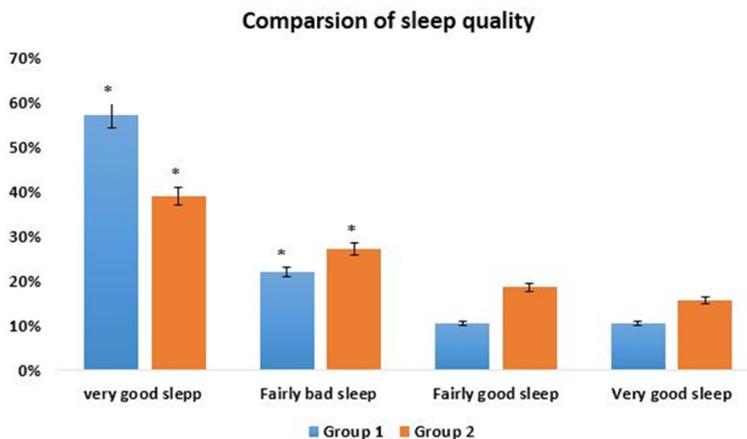


Figure 1. Comparison of Sleep quality between group 1 and group 2, bars represents frequency % with standard error and p value. P value significant as * represents <0.05, ** represents <0.01.

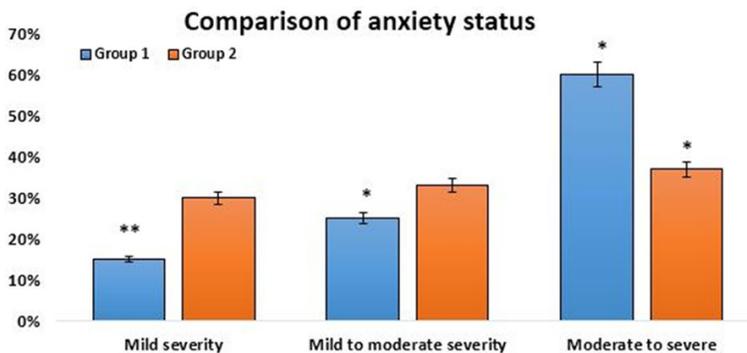


Figure 2. Comparison of anxiety status between both groups using the Hamilton Anxiety Rating Scale, bars represents frequency % with standard error and p value. P value significant as * represents <0.05, ** represents <0.01.

($P=0.001^{**}$), body fat % ($P=0.019^*$), weight ($P=0.034^*$), hip circumference ($P=0.000^{**}$) (Table 3). We also found a significant difference between means of clinical variables such as DBP ($P=0.001^{**}$) and hip circumference (HC) ($P=0.003^{**}$) between the two groups (Table 3). We found that 48 (57%) of nurses in group 1

had very bad sleep quality and 17 (22%) had fairly bad sleep quality in comparison to group 2 wherein 33 (39%) had the very bad quality of sleep and 23 (27%) had the fairly bad quality of sleep. Only 9 (10.50%) in Group 1 and 13 (15.50%) in group 2 had very good sleep quality (Figure 1). It is also evident that 51 (60%) nurses in group 1 and 31 (37%) in group 2 had moderate to severe anxiety. It was also found that mild to moderate anxiety was higher in group-2 than group 1 (Figure 2).

Discussion

Noninvasive markers of circadian dysynchrony

In the present study, we measured the impact of duration of shift work on noninvasive markers of cardiometabolic disorders. We compared the impact of duration of shift work among nurses performing shift work at a tertiary care hospital between two groups. We found a significant positive correlation of duration of shift work with Diastolic blood pressure (DBP), Systolic blood pressure (SBP), Body fat %, Weight, and Hip circumference (HC). We also found significant difference in DBP and HC as noninvasive markers of circadian dysynchrony and metabolic disorders amongst these groups. Earlier studies have already established, body mass index (BMI), waist circumference (WC), waist to hip ratio (WHR) and waist to height ratio (WHtR) and blood pressure (BP) as important determinants of cardiometabolic disorders [5-7]. In concurrence to the present study, Korea National Health and Nutrition Examination Survey for the year 2008-2011 and a retrospective longitudinal study also found that shift

Circadian dysynchrony in shift work nurses

workers have a higher risk of weight gain and abdominal obesity in Korea [12, 13]. However, in a cohort study done in China, a significant association was found among shift work duration, high blood pressure, and WC [14]. Furthermore, significant associations of the duration of shift work with WC along with BMI, HC, and WHR were also observed in the cross-sectional study in Poland [15]. A study from Lebanon not only strengthened these findings but also found that not only WC but BMI also got significantly increased with the number of years of work [16]. Van Amelsvoort LG and co-workers also had similar observations between duration of shift work, BMI, and WHR [17]. In contrast to these studies, our findings are unique and supplementing to existing knowledge base, these include a significant correlation between duration of shift work and DBP, SBP, BF%, and HC.

Sleep quality with the duration of shift work

We also assessed and compared the sleep quality of nurses in two groups and found that 57% of nurses in group 1 had very bad sleep quality and 22% had fairly bad sleep quality in comparison to group 2 where 39% had very bad sleep quality vis-à-vis 27% having a fairly bad sleep quality. Only 10.50% in Group 1 and 15.50% in group 2 had a very good quality of sleep. A cross-sectional study from Iran found that 59.4% had a problem in sleep maintenance and 91.3% of the participants were not satisfied with their sleep [18]. In a cross-sectional study done on 60 nurses, reported bad sleep quality in 68.3% of these shift work nurses [19]. In our study, 89.50% of nurses were not satisfied with their sleep. Although the prevalence of poor sleep quality among shift work nurses was recorded as high as 78% in a cross-sectional study [20]. Insomnia was reported only in 10.5% shift workers from Nigerian hospital [21].

Anxiety status with the duration of shift work

It was also found that poor sleep quality was associated with the reduction in cognitive skills of workers [22]. In the present study, we also evaluated and compared anxiety status of shift workers and found that 37% of nurses had moderate to severe anxiety in group 2 and 60% of nurses had moderate to severe anxiety in group 1 which is nearly double in comparison to group 2. In a case-control study conducted on

59 participants found that rotating night shifts too frequently may cause anxiety among workers [23]. Another study observed that shift work in nurses increases insomnia and anxiety compared to those performing day shift work [24, 25]. However, another comparative cross-sectional study from Australia suggested that shift work is not related to worse psychological functioning in nurses and no significant differences were observed between the groups of shift workers and non-shift workers [26]. In a cross-sectional study from India, concluded that shift work disorder was quite prevalent (43.07%) and anxiety symptoms was found in as many as 17.6% nurses [27]. In another study from Ethiopia shift work sleep disorder was found as 25.6% in shift work nurses [28]. Prolonged poor sleep, high blood pressure, and overweight is a risk factor for the development of the cardiometabolic syndrome and in the long term may lead to premature death [29].

Present study is different from previous studies in few more contexts, as this study included only young participants aged <35 years and compared the noninvasive markers of cardiometabolic risk factors as a consequence of circadian dysynchrony, their temporal association with circadian dysynchrony, it also delineates the relationship of a disturbed circadian rhythm with sleep quality and anxiety status among nurses in two studies. There is convincing evidence arising out of this study that Circadian dysynchrony has not only a bearing on shift workers' physiological processes but also affects health status adversely, leading to emergence of cardiometabolic risk factors in a time-dependent fashion.

Clinical Implications

It is required to plan periodic health assessment of shift workers for noninvasive biomarkers of circadian dysynchrony to identify cardiometabolic disorders followed by lab investigations of those, found at risk. There should be provision for change of shift work to day duties after such periodic noninvasive and invasive health assessment, to reverse circadian dysynchrony.

Limitations

It was a cross-sectional study with small sample size and invasive markers of cardiometabolic risk factors are not investigated.

Conclusion

Shift work affects the sleep pattern and increases the risk for developing cardiometabolic risk factors due to circadian dysynchrony and varies with the duration of shift work, even in the young group (<35 yrs). Applicable intervention strategies are required for the prevention of cardiometabolic disorders amongst shift work nurses. There is an urgent need for large and detailed research with invasive biomarkers to establish the mechanisms that underlie the interactions between duration of shift work, sleep displacement, circadian dysynchrony, behavioral and societal factors.

Disclosure of conflict of interest

None.

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Circadian dysynchrony in shift work nurses

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