

## RESEARCH ARTICLE

### Night shift working and its impact on sleep quality, calorie intake, and serum thyroid stimulating hormone level among health-care workers in a tertiary hospital, Bengaluru

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Received: May 21, 2018; Accepted: June 10, 2018

#### ABSTRACT

**Background:** There are several health and social problems which are associated with shift work. This is mainly due to negative working environment and impairment of biological rhythms during the shift work. **Aims and Objectives:** The present study was designed to study the impact of night shift working on sleep quality, calorie intake, and serum thyroid stimulating hormone (TSH) level among health-care workers. **Materials and Methods:** Sleep quality, calorie intake, and serum TSH level were assessed by the Pittsburgh sleep quality index (PSQI), 24-h dietary recall, and chemiluminescence immunoassay, respectively, among night shift and day shift workers. **Results:** The PSQI scores ( $P = 0.026$ ) and serum TSH level ( $P = 0.023$ ) showed statistically significant difference among day shift and night shift workers. There was no statistically significant difference in calorie intake among the day shift and night shift workers. **Conclusion:** Shift working has a negative impact on sleep quality and serum TSH level with increased risk of subclinical hypothyroidism.

**KEY WORDS:** Shift Work; Pittsburgh Sleep Quality Index; Thyroid Stimulating Hormone

#### INTRODUCTION


Shift work is prevalent globally and, especially in the hospital environment, night shift is very much needed to ensure the continuity of care.<sup>[1]</sup> As per the Labor Standards Act, the night shift work is defined as the work that is performed between 10 PM and 6 PM the next day.<sup>[2]</sup>

There are several health, security, and social problems which are associated with shift work. These problems could be due to an impairment of biological rhythms because of negative

working environment associated with shift work. Several studies also revealed that shift work lead to health problems such as cardiovascular diseases, gastrointestinal diseases, excessive caffeine consumption, smoking, and body weight changes due to lack of exercise. These problems may be due to disruption to psychological, physiological, and social circadian rhythms due to shift work.<sup>[3]</sup>

Disturbed sleep is one of the major problems among shift workers. This is independent of smoking, drinking habits, and levels of physical activity.<sup>[4,5]</sup> The common sleep problems associated with night shift workers are sleep latency, i.e., difficulty getting to sleep, insufficient sleep duration, and the feeling of not being refreshed even after a good sleep.<sup>[5,6]</sup>

The eating behavior among night shift workers could be altered due to diverse range of biological, cultural, and social factors.<sup>[7-9]</sup> This can be explained as, that the night shift work causes a conflict between socially determined meal schedules

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DOI: 10.5455/njppp.2018.8.0619510062018	

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and the circadian biological rhythms in hunger, satiety, and metabolism.<sup>[10,11]</sup>

A study by Moon and Lee revealed that night shift workers had 1.399-fold higher risk of subclinical hypothyroidism when compared to day shift workers. There were also disturbed levels of cortisol, prolactin, and growth hormone among night shift workers. The thyroid stimulating hormone (TSH) levels also change in accordance with sleep patterns and circadian rhythms.<sup>[2]</sup> Another study by Varli and Bilici reported that the mean sleep duration of the day shift workers was significantly higher than that of night shift workers. The total number of main meals consumed per day was also significantly higher for day workers compared to shift workers.<sup>[3]</sup>

Therefore, this study was designed to study and to compare the impact of night shift working on sleep quality, calorie intake, and serum TSH level among health-care workers, i.e. day shift and night shift workers in a tertiary hospital.

## MATERIALS AND METHODS

The present cross-sectional study was done at Sathagiri Institute of Medical Sciences and Research Centre, Bangalore, between July 2017 and August 2017, i.e., for 2 months. The study participants comprised doctor's, nurse's, technician's, and support staff's ( $n = 40$ ).

Ethical clearance for the study protocol was obtained from the Institutional Ethical Committee (IEC NO: SIMS&RC/IECC/06/2012). Through purposive sampling, all shift workers (regular, i.e., only day shift and rotational shift, i.e., both day and night shift) of age ranged between 25 and 50-year-old and those who are willing to participate in the study were recruited. The study participants had minimum 1 year of working experience based on their working status in 2016.

The participants were categorized into day shift workers with work schedule timings between 8.00 and 17.00 ( $n = 20$ ), and night shift workers with work schedule timings between 20.00 and 8.00 ( $n = 20$ ). The night shift workers had  $\geq 3$  night shifts per week and monthly night shift working hours of 60–90 h. Participants who are smokers and alcoholics, diagnosed thyroid diseases (abnormal TSH and T4 levels), personal or family history of sleep disorders, pregnant, and breast-feeding women were excluded from the study.

The written informed consent was obtained from all the participants after explaining the procedure and the need for the study. The following details were collected through an interview:

### Demographic Details

Age, gender, type of occupation, and duration of work.

### Shift Schedule Details

Current shift, shift timings, no of shifts per week, and no of working hours per month.

### Pittsburgh Sleep Quality Index (PSQI)

This is a self-report questionnaire which was developed by researchers in the University of Pittsburgh. This questionnaire is designed to assess the sleep quality over 1-month time interval.<sup>[12]</sup> It is not only used to measure the patterns of sleep and sleep quality but also in the diagnosis of sleep disorders in adults. It has got seven components which measures and differentiates “poor” from “good” sleep quality and these are as follows: subjective sleep quality, sleep latency, habitual sleep efficiency, sleep duration, sleep disturbances, use of sleeping medications, and day time dysfunction over the last month.<sup>[13]</sup> This self-report questionnaire which takes 5–10 minutes to complete is intended to be a standardized sleep questionnaire for clinicians and researchers and can be used for multiple populations.<sup>[14,15]</sup>

### Calorie Intake

This was calculated by using 24-h dietary recall of the quantitative assessment of their dietary intake. The 24-h dietary recall is an open-ended survey and requires 20–30 min to complete a single-day recall. This survey is conducted in an in-depth interview manner and is used to collect a detailed information about food consumed over a specific period. The eating occasions using 24-h dietary recall were described using participant definitions, for example, breakfast, lunch, dinner, and snacks including beverages. The amount of food consumed was estimated with reference to a common size container such as bowls, cups, and glasses or standard measuring cups and spoons or three-dimensional food model or photographs. The limitations of this 24-h dietary recall survey is that, all information depends on the participants memory and the interviewer skills.<sup>[16,17]</sup>

### Serum TSH

The determination of serum TSH is used for assessing thyroid function. This is a specific and sensitive parameter and is particularly suitable for early detection of disorders in the central regulating circuit between the hypothalamus, pituitary, and thyroid.

The serum TSH assay in the present study was done through chemiluminescence immunoassay (CLIA). It is a sensitive and also economical alternative to conventional colorimetric methodologies, such as Enzyme-Linked Immunosorbent Assays.<sup>[18]</sup>

In the present study, the blood sample to determine the serum TSH was collected after 10–12 h of fasting between 7.30 and 8.30 am. The normal range for TSH using CLIA method is 0.2–6.4  $\mu\text{IU/ml}$ .

Descriptive and inferential statistical analyses have been carried out in the present study. Independent *t*-test was used to analyze and compare the means. Significance is assessed at 5% level of significance. Data were analyzed using SPSS version (version-18.0) software.

**RESULTS**

**Demographic Characteristics**

In the present study, there was no statistically significant difference in gender distribution among participants of the two groups. However, as shown in Table 1, the mean age among night shift workers was  $27.50 \pm 5.14$  and in day shift workers was  $34.25 \pm 8.16$  which was statistically significant ( $P < 0.05$ ). The mean body mass index (kg/m<sup>2</sup>) among night shift workers was  $20.40 \pm 1.01$  and among day shift workers was  $21.93 \pm 2.79$  which was statistically significant ( $P < 0.05$ ).

**Sleep Quality**

As shown in Figure 1 – The PSQI scores were  $4.25 \pm 2.38$  in night shift workers and  $2.90 \pm 1.07$  in day shift workers, which was statistically significant ( $P < 0.05$ ).

**Calorie Intake**

As shown in Figure 2 – The calorie intake in night shift workers was  $1590.20 \pm 309.79$  kcal/day and in day shift workers was  $1576.80 \pm 199.64$  kcal/day, which was statistically not significant ( $P > 0.05$ ).

**Serum TSH Level**

As shown in Figure 3 – The serum TSH level in night shift workers was  $3.11 \pm 1.81$   $\mu$ IU/ml and in day shift workers was  $2.04 \pm 0.8$   $\mu$ IU/ml, which was statistically significant ( $P < 0.05$ ).

**DISCUSSION**

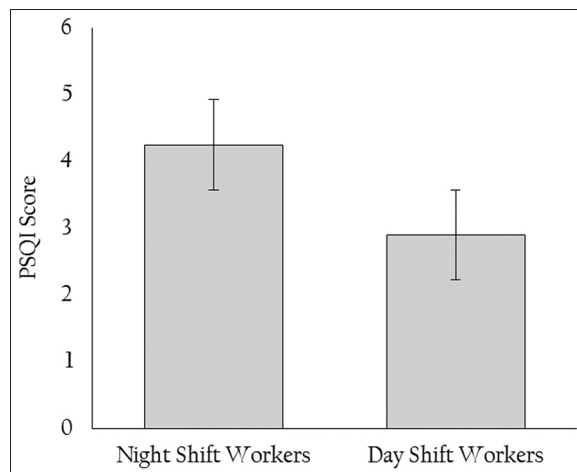
Shift working has its roots in the history of human life, and therefore, is an old social phenomenon.<sup>[19]</sup> The circadian rhythms are interactive and thus require a high degree of phase relationship to produce subjective feelings of

**Table 1:** Comparison of age and BMI variables in two groups of participants

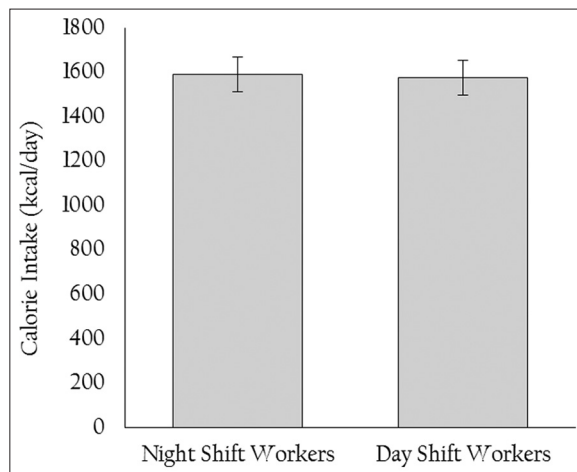
Variables	Night shift workers	Day shift workers	Total	P value
Age in years	27.50±5.14	34.25±8.16	30.88±7.55	0.003**
BMI (kg/m <sup>2</sup> )	20.40±1.01	21.93±2.79	21.17±1.90	0.027

Significant student *t*-test ( $P < 0.05$ ). BMI: Body mass index

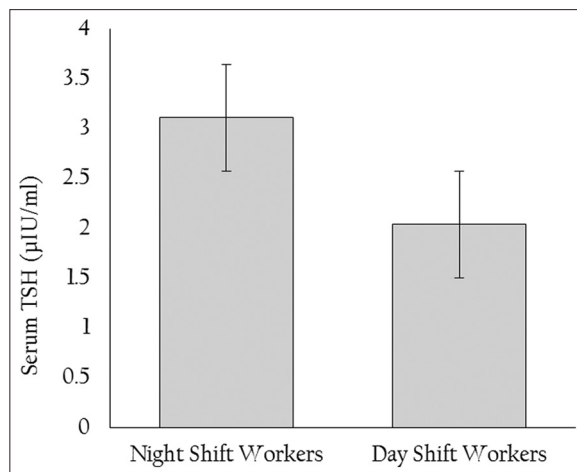
well-being. The health problems such as disturbance in the quality and quantity of sleep, gastrointestinal disturbances, and other organ system activities is mainly due to circadian desynchronization because of shift rotation.<sup>[20]</sup>



**Figure 1:** Comparison of pittsburgh sleep quality index score in two groups of participants ( $P = 0.026$ : Significant difference)



**Figure 2:** Comparison of calorie intake (kcal/day) in two groups of participants ( $P = 0.872$ : no significant difference)



**Figure 3:** Comparison of serum thyroid stimulating hormone in two groups of participants ( $P = 0.023$ : Significant difference)

## Sleep Quality

One of the important functions which is disturbed during night shift is sleep.<sup>[21]</sup> The sleep duration among the night shift workers is reduced and this is mainly due to obligation to sleep during the morning hours. The surrounding conditions for sleep in these morning hours are unfavorable due to light, temperature, and noise.<sup>[6]</sup>

In the present study, the PSQI scores were used to evaluate the sleep quality and were significantly affected among night shift workers compared to day shift workers. The PSQI was used to evaluate the sleep quality during the month preceding the study and is widely used in other surveys too.<sup>[22,23]</sup> Our results were consistent with Rutenfranz *et al.*,<sup>[24]</sup> who reported that, almost 70% of night shift workers complained of sleep disorders, assessing their sleep as unsatisfactory, insufficient, and little restorative.

## Calorie Intake

The daily routine is interrupted among shift workers as they work in irregular hours. One of the most common interruptions among night shift workers is their eating habits. Although the quantity, quality, and frequency of food eaten by shift workers differ, the calorie intake remains substantially unaltered. These workers on their night shift usually have quick meals consisting of fast food. They also have more consumption of caffeinated drinks, such as tea and coffee.<sup>[3]</sup>

In the present study, there was no statistically significant difference in the overall calorie intake (kcal/day) among the day shift and night shift workers, although the meal consumed among day shift workers differed from the meal consumed among night shift workers. Our results were consistent with Debry *et al.*,<sup>[25]</sup> who was one of the first to demonstrate that the total energy intake for workers on alternating shifts is similar to that of day workers. However, our results were not consistent with Cervinka *et al.*,<sup>[26]</sup> who reported that compared to controls there was higher energy intake among night workers.

## Serum TSH

The TSH is released from the thyrotrophic cells of the anterior pituitary gland. This is a glycoprotein hormone and is responsible for the regulation of body metabolism by regulating thyroid hormone release.<sup>[27]</sup> The determination of serum TSH is one of the most sensitive methods in identifying the thyroid dysfunction.<sup>[28]</sup> TSH levels exhibit a normal circadian rhythm, with study-specific peaks at approximately 2–4 AM and troughs at approximately 4–8 PM.<sup>[29]</sup> The night shift work-related changes in sleep schedule, timing, and quality may alter the body's normal circadian rhythm and lead to an abnormal TSH circadian rhythm.<sup>[30]</sup>

In the present study, there was rise in TSH levels among night shift workers compared to day shift workers. Our results were consistent with Parker *et al.*,<sup>[30]</sup> who reported that sleep deprivation promotes oscillations in the TSH circadian rhythm. This increases the likelihood of TSH levels to rise among night shift workers. Our results were also consistent with Holmbäck *et al.*,<sup>[31]</sup> who reported that nocturnal eating may affect hormone levels such as TSH, insulin, and glucagon. As the night shift work is associated with irregular eating habits and thus nocturnal eating might lead to increase in TSH levels.

The present study was done in tertiary hospital with less sample size and only with serum TSH assay. Hence, further studies are needed with more sample size and other hormonal assay. Further studies are also required to correlate the duration of night shift working and its impact on health.

## CONCLUSION

Our preliminary findings showed that, shift working has a negative impact on sleep quality and serum TSH level. Night shift workers have increased the risk of sleep disorders and also increased the risk of subclinical hypothyroidism compared to day shift workers. This study suggests that there should be a periodic examination of health-care workers who are working on shift basis and also undertake certain preventive measures against these health hazards.

## Acknowledgment

Our sincere acknowledgments to ICMR STS project for funding, Participants, Dean of Saphthagiri Institute of Medical Sciences and Research Centre, and Statistician for their support.

## Funding

This study was funded by ICMR STS Project.

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**How to cite this article:** Sathyanarayana SM, Gangadharaiah S. Night shift working and its impact on sleep quality, calorie intake, and serum thyroid stimulating hormone level among health-care workers in a tertiary hospital, Bengaluru. *Natl J Physiol Pharm Pharmacol* 2018;8(9):1330-1334.

**Source of Support:** Nil, **Conflict of Interest:** None declared.