The Role of Bright Light during Night Work on Stress and Health Status of Shift Work Nurses

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ABSTRACT
Research has shown that shift work, in particular night work, can have negative effects on the health, safety and well-being of workers. Our study assessed, in a hospital setting, the effects of bright light (BL) on general health and psychological problems during night shift work. In an experimental design, 15 female nurses at a general hospital that located in Tehran were exposed to moderate bright light (2000 lx) during night work. The evaluation of general health status, job stress, and burnout syndrome conditions was done as follows: The 28-item General Health Questionnaire (GHQ-28) was used as a screening tool for the detection of general health status; for assessing the level of stress, perception stress scale (PSS) was filled; and for burnout syndrome conditions, burnout self-report questionnaire (BSR) was completed. T-test and paired t-test analysis were used to assess the association between BL exposure for a total of 30 min during each night shift and changes in general health status, job stress and burnout syndrome. This study clearly shows that BL administration could not reduce anxiety symptoms, somatic symptoms, severe depression and improved social dysfunction significantly during night shift. However, BL exposure significantly decreased the perception stress ($P=0.008$) and burnout syndrome ($P=0.06$) during night permanent shift. These results suggest that BL might have provoked changes in perception stress and burnout syndrome of nurses working night permanent shift.

Keywords: Bright Light, Burnout, General health status, Perception stress, Nurses, Night shift

INTRODUCTION
Research has shown that shift work, in particular night work, can have negative effects on the health, safety and well-being of workers. Adults usually need between seven and eight and half hours sleep a night. Less than that incurs “sleep debt”. Therefore, a person who needs eight hours sleep, but only gets five, has a sleep debt of three hours. Sleep debt leads to impaired alertness, which in turn lowers reaction time, reduces concentration and perception, as well as decision-making. Together, this is usually defined as fatigue. Sleep debt is accumulative and over several nights, the effects are compounded.

Evidence from field and laboratory based work shift studies have shown that early morning eye exposure to bright light (BL) (1500-5000 lx white light) is associated with improved appetite, sleep, alertness and performance [1-5]. The effects are the result of suppression of melatonin synthesis due to BL exposure at night [6]. The suppressions of melatonin secretion can cause changes in the body such as increasing the core body temperature, mental abilities and physical capacities [7-9].

The impact of BL on psychological effects and general health status are very important in public health importance for shift work nurses. Currently, there is a scientific concern about potential shift workers health risks from working at night or graveyard shift [10-12]. Many studies have shown that shift work, particularly the involving night work, has adverse effects on the human circadian system, psychological and physical activities, and sleep patterns individual including nurses [3, 11, 14 and 15]. Night work has also been associated with emotional health, social life, and mental health disturbances [15, 16]. Exposure to long BL regards with rapidly rotating shift systems (day-night-evening) is not feasible in the health care systems.

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Prior studies had demonstrated that the duration of exposure to BL for treatment is usually about two to three hours [17]. Another study indicted that nurses obtained a short exposure (20-120 min) to BL [18, 19]. Costa et al. [18], performed an experiment, testing about the efficacy of BL at night (4× 20 min, 2320 lx) in the reducing fatigue and improved performance on a search and memory test. Iwata et al. [20], have also examined the exposure to artificial light, brighter than 3000 lx, for a short time (30-min) on the subjective mood of shift work nurses. As their study showed the BL tend to improved vigor, eagerness, appetite and reduce tension [20]. The recent studies have found that early morning exposure to BL will suppress “melatonin” [13, 21], and to improve sleep, performance, and subjective mood in shift workers [18-20].

In Iran, the rotating patterns of shift in the private hospitals are regular and specific. There are two-day shift (morning and evening) and one night shift. All of night shift staff choose voluntarily and have 15 night shifts in the month (every other night).

The main purpose of this study was to investigate the changes in general health status, stress, and burnout of night shift nurses after a short (30 min) exposure to BL (in excess of 2000 lux) and if these changes were related to exposed of BL considering physical and psychological aspects.

**Materials and Methods**

**Subjects**

Twenty night female nurses from Asia Hospital in Tehran Province, Iran, participated in this study. All subjects were carefully screened to ensure were healthy, and five nurses were excluded from the study because of sickness during the study. Their mean age was 37 years (range: 27-52), and they had been working at the hospital as a nurse on night shift. The subjects worked in permanent shift system including only night shifts. But the hospital rotating pattern of shifts was regular (every other night), and day shift nurses worked two shift system (morning and evening). Each week consist of five consecutive work shifts of the same type (day (D) shift: 07:00–14:00, evening (E) shift: 14:00–21:00, and night (N) shift: 21:00–07:00. The night shifts had a length of 10 hours and the nurses will divided it between them. First group of the subjects work until 03:00 am and the second group work from 07:00 am. The Ethical Committee of Tehran University of Medical Sciences approved the study.

**Protocol**

We investigated two series of one permanent night shift (N) with the typical pattern described above. During the first series the subjects were not to BL and the illumination in the nurse unit room was approximately 150 lux horizontally at eye level. During the second series, the subjects were exposed to BL for the 15 days. The mean interval between the last night shift of before intervention (without BL exposure) and the first night of second series was 15 days. The health status, stress and burnout were measured using three self-administered questionnaires twice (before and after intervention).

**Light exposure**

The nurse unit room was used for exposure to BL. Three compact fluorescent luminaries (day light lotus lamp) with color temperatures of 6400 Kelvin, and initial lamp lumen of 6500 lumens, were installed in the ceiling of the nurse unit room that gave an indirect white light in excess of 2000 lx at eye level. The dim lighting (normal light) in the nurse unit room was approximately 150 lux horizontally at eyes level. Subjects were explicitly instructed to sat in the lighted unit room with exposure to BL for total 30 min. Subjects were exposed to BL exactly around 02:00-03:00 during the night shift within a period of 15 days (every other night). During the before intervention (15 days) the subjects were not exposed to BL and the dim lighting in the nurse unit were 150 lx.

**Measurement**

The evaluation of general health status, job stress, and burnout syndrome conditions was done. For measuring general health status, the 28-item general health questionnaire (GHQ-28) was used as a screening tool for the detection of general health status. This questioner was developed by Goldberg & Hillier (1979) for screening for somatic symptoms, anxiety symptoms, social dysfunction and severs depression [22]. This questionnaire was translated into Persian, which was comprehensible to almost every Iranian, and its validity and reliability (The reliability of the questionnaire indicated a high internal consistency with chronbach α coefficient 0.85) were approved in an independent study [22].

For assessing the level of stress, perception stress scale (PSS) was filled five-point scale ranging. The scale’s chronbach α coefficient (0.21) of the questionnaire for an Iranian population has been reported by [15].

For burnout syndrome conditions, the Iranian version of the burnout self-report questionnaire (BSR) was completed [23]. The 20 items of the self-report questionnaire were scored on a 3-point scale (0= disagree, 1= do not know, 3= agree). The internal consistency and reliability of the question items of the questionnaire with regard to the scale’s chronbach α coefficient (0.26) was sufficiently high.

**Statistical analysis**

Statistical analysis was carried out using SPSS for windows version 11.5. The data obtained during night work were coded, and computer assisted analysis were performed. Significance of the differences between the night work nurses before exposure to BL was tested with t-test, and fisher. The associations between general health status, stress, and burnout problems before and after exposure to BL in the past 1-month were examined with paired student’s t-test.
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**RESULTS**

**Characteristics of the samples**

Table (1) summarizes the main characteristics of the participants. The study group consisted of 15 female night shift nurses with a mean (±SD) age of 38.53±6.98 years (range, 27-52 years). With regard to marital status, 46.67 % were married. Of the total subjects none smoked or drunk alcohol. They all were night shift nurses in the hospital.

Table (2) indicates the mean scores change of the four subgroups of general health status for before intervention during the night shift. As we can see from the table, the percentage of those who scored 7-21 (with general health problems) was 40%, and the remaining 60 percent scored 0-6 considered general health in good status. For general health status, paired student t-test yielded a statistically insignificant main effect of BL for the somatic symptoms, anxiety symptoms, social dysfunction and severe depression (P=0.15) (Table 3). Thus, there was no statistically significant interaction between BL and general health status on the score changes found in this study.

**Perception stress and burnout syndrome**

The second field experiment focused on the evaluation of exposure to BL on the changes in perception stress and burnout syndrome among the night shift nurses (Table 3). For each of the two variables, we conducted a separate paired t-test and co-variance analysis. For both perception stress and burnout syndrome we found statistically significant main effect for exposure to BL (P=0.008 and P=0.06), respectively. As can be seen from the table, perception stress and burnout syndrome were decreased more with BL during the 15 night shift (every other night) compared with those during the before intervention (15 night shift without exposure to BL).

The results gained from evaluation of the nurses health status, stress and burnout scores, are shown in Fig. 1. In these cases, statistical analysis showed that perception stress and burnout syndrome were affected significantly and positively by the BL, and no effects on a general health status were observed.

**DISCUSSION**

Few field and laboratory based studies have been conducted examining relationships between exposure to BL and improved mental abilities, physical capacity and general health status, among night work nurses in a developing country. So far, there has been no study in this regard in Iran. We studied whether the BL might improve the general health status and reduce perception stress and burnout syndrome in night shift nurses.

The results of the field study in the experimental conditions, showed that exposure to BL could not reduce anxiety symptoms, somatic symptoms, severe depression and improved social dysfunction significantly during night shift. The results also indicated that BL exposure significantly decreased the

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**Table 1.** Characteristics of the subjects

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean ± SD or total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38.53 ± 6.98</td>
</tr>
<tr>
<td>Working as a nurse (years)</td>
<td>13.5 ± 6.10</td>
</tr>
<tr>
<td>Time in the night shift (years)</td>
<td>9.6 ± 6.05</td>
</tr>
<tr>
<td>Time in the total shift work (years)</td>
<td>11.7 ± 5.46</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Married (%)</td>
<td>7 (46.67)</td>
</tr>
<tr>
<td>Net married (%)</td>
<td>8 (53.33)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Nursing college graduate (%)</td>
<td>10(66.67)</td>
</tr>
<tr>
<td>Nursing university graduate (%)</td>
<td>5(33.33)</td>
</tr>
</tbody>
</table>

**Table 2.** Mean scores of general health status (GHQ-28), before intervention

<table>
<thead>
<tr>
<th>Score</th>
<th>General health</th>
<th>Somatic symptoms</th>
<th>Anxiety symptoms</th>
<th>Social dysfunction</th>
<th>Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
</tr>
<tr>
<td>0-6</td>
<td>9</td>
<td>60</td>
<td>9</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>7-21</td>
<td>6</td>
<td>40</td>
<td>6</td>
<td>40</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>100</td>
<td>15</td>
<td>100</td>
<td>15</td>
</tr>
</tbody>
</table>

F = Freq. (No. of nurses)

**Table 3.** Score changes of GHQ-28, perception stress (PSS) and burnout syndrome (BSR) before and after intervention for 15 night shift nurses

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal Light (Before)</th>
<th>Bright Light (After)</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>GHQ-28</td>
<td>15</td>
<td>22.1</td>
<td>11.9</td>
</tr>
<tr>
<td>PSS</td>
<td>15</td>
<td>26.9</td>
<td>8.2</td>
</tr>
<tr>
<td>BSR</td>
<td>15</td>
<td>23.4</td>
<td>7.4</td>
</tr>
</tbody>
</table>

N = No. of Nurses; SD = Standard Deviation; * Paired t-test & Co-variance
perception stress ($P=0.008$) and burnout syndrome ($P=0.06$) during night permanent shift. These results suggest that BL might have provoked changes in perception stress and burnout syndrome of nurses working night permanent shift.

In this study we found that BL from three day light compact fluorescent had a considerable effect on reduce perception stress and burnout. However, an association between exposure to BL and the general health status (somatic symptoms, anxiety sleep disorder, social dysfunction and severe depression) was not found. The present quasi experiment study, based on 15 female nurse night shift, represents the specific condition such study conducted to date, notably to difference of shift pattern (permanent night shift) and the timing of the night steep (have a regular time of sleep) than the previous studies of Iwata et al.[20], and Costa et al.[18], which involved 45-min rest period during the four shift (N-N-E-E) and two-shift system (morning, evening or night shift) with $20.9 \pm 0.78$ min night break, respectively. Iwata and others founded that mental state only eagerness and tension was improved by exposure to BL in the early morning (around 03:00), whereas at evening (around 20:00-21:00), BL exposure appeared ineffective [20]. Costa et al. [18], also have found that a rapidly rotating shift system containing two consecutive night shifts in the 14 hospitals and with a short exposure to bright light at night ($4 \times \text{min}, 2350 \text{ lux}$), reduce the job fatigue and improved psychophysical conditions and performance efficiency. Whereas, in the present study, subjects had been working in the discontinuous shift work (permanent night shift) and exposed to BL, in excess of 2000 lx, at around 02:00-03:00 during the night shift, and therefore, our results seem to nearly agree with their finding. Our finding is substantiated by two previous field studies [24, 17]. They demonstrated that an intervention combining moderate exposure to BL ($\sim 2000$ lux), shielding from morning BL, and a stable diurnal sleep, darkness schedule could promote circadian adaptation in nurses working permanent night shift. These finding differ from those reported by other researchers who have studied the effects of BL on shift workers. For example, exposure to BL in the morning (around 03:00), has been shown that the circadian sleep rhythm was phase-advance [25]. Not at all field studies support the use of BL for shift workers. In some studies, associations have been found between exposure to BL (moderate exposure) and nightshift alertness, sleep, subjective mood and physical ability [17, 18, 20], but in others, no such associations were found [26, 27]. Under this field study condition (4D shift, 4Doff, 4 night shift, 4D off and expose to BL at least 50 percent of their work time for 3 months), the diurnal rhythm of alertness remained unchanged. This discrepancy may be attributable to difference in the dose light (i.e., duration and number of days), the rotating pattern of shifts, rest period and situation of shift worker sleep in during the day. Previous studies also reported that the shielding from morning sunlight, by wearing sleep mask, could also elicit adaptive phase delays independently of BL exposure at night [14, 21], and can significantly improve daytime sleep quality [28]. The segregation results in this study are adverse with those of two previous studies that examined the relationship between the effect of BL on subjective mood, fatigue and performance of shift work nurses [20, 24]. The present study after used a indirect light point source (compact fluorescent) in excess of 2000 lux, showed that decreased perception stress and burnout syndrome of night shift nurses were associated with exposure to BL. In contrary with previous studies[17, 20], we used a different methodological approach in our study in terms three self-administered questionnaires, the moderate BL, compact fluorescent and the subjects with permanent night shift. A notable finding is that nurses with permanent night shift schedules did not have a developed general health status. This might be due to BL that did not necessarily have positive effects on all the typical problems associated with working the night shift. It is important to note that nurses work night shift on permanent basis and we could not set an exact time schedule for light exposure because they have an informal rest and sleep time.

Since the results of study on associations between exposure to BL and general health status are equivocal, further investigation with emphasize on the circadian rhythm of Melatonin synthesis in the Iranian shift workers are necessary.

There were some limitations to this study such as self-administered questionnaire which there may be a reporting bias, the study sample was small, this experimental study focuses the exposure to more moderate BL (2000 lux) on permanent night shift nurses, and does not account for other exposure such as very bright light (in excess of 5000 lux).

**CONCLUSION**

In conclusion, the results of present study highlights that general health status of hospital night shift nurses was poor, as shown by the mean GHG-28 score (25-6) and that general health are a variables that do not improved with the exposure to moderate BL. However, the association between the exposure to BL and...
decreased of burnout (chronic fatigue syndrome) and stress, in the present analysis could be adequately estimated using the liner model. In addition, these results confirm those previously reported from Japan, and Europe.

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REFERENCES