

Insomnia Induced by Night Shift Work is Associated with Anxiety, Depression, and Fatigue, among Critical Care Nurses

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Abstract

Objectives: The general purpose of this study was to investigate the effect of night shift work (NSW) on insomnia, anxiety, depression, and fatigue, among nurses working in critical care units. **Methodology:** Five hundred and twelve critical care nurses were recruited from the Intensive Care Units (ICU), Emergency Rooms (ER) and Operation Rooms (OR) from six major hospitals in Amman, Jordan. Participants signed an informed consent and answered, sociodemographic questionnaire, in addition to Hospital Anxiety and Depression Scale, Fatigue Severity Scale, and Insomnia Severity Index. **Results:** Critical care nurses who were working on night shift have higher levels of insomnia, depression, anxiety, and fatigue than nurses working on day shift or temporary night. Furthermore, female and ICU nurses experienced more fatigue than male nurses and nurses from OR and ER respectively. There was a dose-response relationship between the number of night that nurses work in the previous year with their (insomnia, depression, and fatigue levels) **Conclusion:** Night shift work induced insomnia for nurses working in critical care units which increased their anxiety, depression and fatigue levels. This has negative consequences in their health

and the care provided to the patients. Health care employers should use alternative methods to help nurses overcome this issue.

Keywords: Night shift work, Insomnia, Anxiety, Depression, Fatigue, Critical Care, and Nurses

Introduction

Nurse duties and responsibilities are the same among the different shift work. However, night shift does add distinctive challenges for nurses. The night shift work (NSW) disturbs the human body's circadian rhythms which help the body to renew and repair itself [1]. Shift workers go to sleep when their diurnal rhythm enhances signals of wakefulness, which could cause chronic insomnia [2]. Thus, nurses working in the night shift have been found to experience various physiological, psychological and social effects which negatively impact their professional performance and personal lives [3-4].

The majority of the previous studies have suggested a positive association among NSW and various mental disorders including: anxiety, depression, fatigue, and insomnia [2-3, 5-11]. For instance, it has been found that nurses with current or previous night shift work were associated with insomnia and chronic fatigue compared to nurses with no night work experience [2]. Moreover, the night-shift nurses were found to have higher scores of anxiety and depression than daytime nurses [12].

Working night shift was considered a risk factor for chronic and cardiovascular diseases [8, 13], gastrointestinal diseases [14-15], metabolic diseases [16], and diabetes [17]. Furthermore, there are some evidences that NSW increased the risk of ovarian [18], breast [19-20], colorectal [21], prostate [22], and endometrial cancer [23]. Night shift work was associated with poor quality of life for nurses [11, 15], missing a lot of family and social activities [11, 15].

In addition, NSW was associated with higher levels of absenteeism [15], mood disorder [24-25], loss of efficiency, decrease concentration productivity [26], and safety at work [26]. These effects will negatively influence the care given by those nurses to the patients. It has been found that mental health problems linked to the NSW were associated with higher levels of medication errors and occupational injuries or illnesses [27-28].

Understanding the impact of these factors on nurses' health and performance could help healthcare providers to set strategies that might improve the psychological status and performance of nurses. Thereby, enhancing the overall health status of nurses which could significantly contribute to keep patients' safe, improve outcomes, and better use of institutional resources; therefore the general purpose of this study was to investigate the effect of NSW on insomnia, anxiety, depression, and fatigue, among nurses working in critical care units.

Methodology

The study was designed to answer the following research questions: a) is there an association between NSW and the levels of anxiety, depression, fatigue, and insomnia? b) is there a difference in anxiety level among different night (permanent, temporary, or no) experience? c) is there a difference in depression level among different night (permanent, temporary, or no) experience? d) is there a difference in fatigue level among different night (permanent, temporary, or no) experience? e) is there a difference in insomnia level among different night (permanent, temporary, or no) experience? and f) is there a difference in anxiety/depression/ fatigue/ insomnia levels based on gender and area of practice?

Research Design, Sample, and Setting

For this study, a non-experimental, descriptive cross-sectional correlational design was used. The study was conducted at six major hospitals in Amman, Jordan. These hospitals included three private, one teaching, one governmental, and one Royal Medical Service. Nurses were recruited using a convenience sampling method from the following units: a) Intensive Care Unit (ICU), b) Emergency Room (ER), and c) Operation Room (OR). To participate in the study, the participants met the following inclusion criteria: a) signed an informed consent, b) registered nurse with more than 3 months experiences, and c) hold a Jordanian nationality. A sample size calculation revealed that 224 participants were enough to achieve 80% power with an alpha of 0.05, and a medium effect size of 0.3. This number was obtained based on Cohen power tables with the following statistical tests to answer research questions [29]. A correlation coefficient for question number one. Analysis of variance (ANOVA) with post hoc test for questions two through five. Independent sample t-test, or ANOVA with post hoc for question number six. Based on that, the number of participants needed to answer question number one was 85 participants and for questions two through five was 224 participants. Regarding question six, 64 participants were sufficient. Therefore, 512 participants were deemed sufficient to get statistical significant.

Ethical consideration

The study was approved by the research and ethical committee at the Applied Science Private University, Amman, Jordan (Faculty 010). Institutional Review Board (IRB) approval was also obtained before data collection from all sites. Participation in the study was voluntary and anonymous. All participants signed an informed consent after a detailed explanation of the study by the research assistants. All collected data were coded and entered to a password protected computer with an access only to the principle investigator and the co-authors. Only aggregate data were used for publication purposes.

Procedure

The principle investigator explained the purpose of the study to the head nurses and informed them that research assistants will start data collection. The research assistants explained the study to the participants and informed them that the participation is voluntary and they can withdraw at any time. If the participants agreed to participate, they were asked to sign an informed consent. During the interview, the participants answered the sociodemographic questionnaire, Hospital Anxiety and Depression scale, Fatigue Severity Scale, and Insomnia Severity Index.

Measurement of variables

Sociodemographics

The following socio-demographics were collected; age, gender, educational level, years of experience, area of practice, how many nights worked in the last year, and if the nurse is currently or previously working on night duty.

Anxiety and Depression

Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS). This instrument has been used in previous research studies [30-33]. This scale consists of two sub-scales; one for anxiety and one for depression. Each subscale consists of seven items scored on a zero to three Likert scale type. The scores for each sub-scale range from 0-21. Higher scores indicate higher levels of anxiety and depressive symptoms. Scores were categorized as follow: (0-7) normal, (8-10) mild, (11-14) moderate, and (15-21) severe [34-35].

Hospital anxiety and depression scale has shown very good psychometric proprieties. The internal consistency was found to be 0.80 for the anxiety subscale and 0.81 for the depression subscale during the initial testing [35]. Whelan-Goodinson et al [36] found good internal consistency with Cronbach's alpha scores of 0.94 on the total scale score, 0.88 on the depression subscale and 0.92 on the anxiety subscale.

Moreover, the instrument has shown a good convergent validity; the correlation between the depression subscale and the Beck Depression Inventory Primary Care has been found to be .62, $p < 0.001$ [37]. Regarding discriminate validity; Lewis & Wessely [38] found that the correlation between the HADS total score and the General Health Questionnaire-28 was .75.

Fatigue

Fatigue was measured by Fatigue Severity Scale. This scale consists of 9 items Likert scale assessing the severity of fatigue symptoms. The participants rated their condition by agreement or disagreement about the items on a seven point scale. One indicates "strongly disagree" and seven indicates "strongly agree". Scores can range from 9-63, with higher scores indicating higher severity of fatigue symptoms. Scores were classified as following: < 36 , no fatigue, ≥ 36 ,

indicating that the participant is suffering from fatigue symptoms and further evaluation by a physician is recommended [39].

The validity and reliability of this instrument was evaluated by Valko et al [40]. The questionnaire was administered to 454 healthy subjects. Item analysis showed an excellent internal consistency and reliability; Cronbach's alpha was 0.93. Test-retest variability showed that the values were stable over time. Regarding validity, five experts in neuroscience with at least two years of experience examined the severity of fatigue among 104 healthy individuals. Then, the results were compared with the results obtained from the instrument. The comparison demonstrates that the Fatigue Severity Scale is a simple and valid instrument to measure fatigue for clinical and research purposes [40].

Insomnia

Insomnia was measured by Insomnia Severity Index (ISI); a widely used self-report measure of insomnia symptoms. This Index includes seven Likert scale questions about insomnia symptoms. Participants rated each question from zero to four. Higher scores indicated more insomnia symptoms. Interpretation of Insomnia Severity Index scores was performed according to a commonly used guideline, which classifies scores of 0-7 as no clinically significant insomnia, 8-14 as sub-threshold insomnia, 15-21 as clinical insomnia of moderate severity, 21-28 as severe clinical insomnia [41].

Previous studies demonstrated that ISI is valid and reliable with a strong to excellent convergent and divergent validity [42]. A principal component analysis indicated a single construct with excellent internal consistency (Cronbach's alpha = 0.92) [42]. In a sample of 410 patients from six hospitals, ISI showed a high reliability Cronbach's alpha of 0.92. Moreover, the ISI has 82.4% sensitivity, 82.1% specificity, for detecting clinical insomnia [43]. In a study to detect insomnia cases and evaluate treatment response, ISI showed excellent internal consistency for both cases and controls (Cronbach alpha of 0.90 and 0.91) respectively [43]. Convergent validity was supported by significant correlations between total ISI score and measures of fatigue, quality of life, anxiety, and depression. In addition, the ISI had 86.1% sensitivity and 87.7% specificity for detecting insomnia cases [43].

Night shift

Regarding night shift, participants were asked three questions; the first one was about how many night shifts did the nurse work in the last year. The second one; if the nurse is currently on night shift (yes/no), and the third question; if the nurse was on night shift (yes, no). Based on questions number two and three, the participants were categorized into three groups: permanent night experience (if the two answers are yes), no night experience (if the two answers are no), temporary night experience (if one answer is yes and the other is no). This method was used by others to classify nurses according to their night experience [2].

Data analysis

SPSS software version 21.0 was used to analyze the data (SPSS Inc, Chicago, Illinois). A P value of less than .05 was considered significant. Descriptive statistics with numbers and frequencies or mean \pm standard deviation were used to describe the sociodemographic characteristics of the sample. To test research questions number one, a correlation coefficient between the numbers of night/c shift with the total scores of (anxiety, depression, fatigue, and insomnia) was done. To test questions from two to five, ANOVA with post hoc was used. To test research question number six, independent sample t-test was used for two group variables and ANOVA with post hoc for three or more variables.

Results

Descriptive statistics

The study was conducted in the ICU, ER and OR, of six major hospitals in Amman, Jordan covering the four health sectors (private, teaching, governmental, and Royal Medical Services). Six hundred and thirty questionnaires were distributed and 512 were completed and returned back ending with a response rate of 81.3%.

The mean age of the participants was 28.4 ± 4.9 years and the mean number of years of experience was 6.0 ± 4.7 years. Approximelty, the same numbers of males and females were included. The largest percentage of the sample was from the ICU (40.6%). Slightly more than half of the sample had permanent night experience (51.4%) and the majority (91.8%) hold BSc. Sociodemographics are presented in Table 1.

Table 1: Sociodemographic charstaristics of the sample (N=512)

Charstaristics	M \pm SD or n (%)
Age	28.4 \pm 4.9
Gender	
Male	254 (49.6)
Female	258 (50.4)
Hospital type	
Private	185 (36.1)
RMS	159 (31.1)
Governmental	88 (17.2)
Teaching	80 (15.6)
Area of practice	
ICU	208 (40.6)
ER	178 (34.8)
OR	126 (24.6)

Table 1: (Continued): Sociodemographic characteristics of the sample (N=512)

Night experience	
Permanent experience	236 (51.4)
Temporary experience	69 (13.5)
No Experience	180 (35.2)
Educational level	
BSc	470 (91.8)
Master	42 (8.2)
Years of experience	6.0±4.7
Approximately how many night/c shift duties you did in the last	68.1±65.8
Total anxiety score	11.0±3.3
Total depression score	9.7±3.7
Total insomnia score	12.7±6.3
Total Fatigue score	36.9±11.7

RMS: Royal Medical Services, ICU: Intensive Care Unit, ER: Emergency Room, OR, Operation Room, BSc: Bachelorate of Science

Research question number one: is there an association between night shift work and the levels of anxiety, depression, fatigue, and insomnia. A series of bivariate correlations were done among these variables, table 2.

Research question number two: is there a difference in anxiety level among different night (permanent, temporary, or no) experience? ANOVA with post hoc test was performed to answer this question. There was a significant difference in total anxiety scores ($F_{(2,509)}=5.83, p<0.01$). Post hoc analyses showed that nurses who have permanent night experience were responsible for the significant main effect. They have higher levels of anxiety (11.5 ± 3.3) than nurses with temporary night experience (10.5 ± 3.1) or no night experience (10.4 ± 3.5) table 3.

Research question number three: is there a difference in depression level among different night (permanent, temporary, or no) experience? ANOVA with post hoc test was performed to answer this question. There was a significant difference in total depression scores ($F_{(2,509)}=3.65, p<0.05$). Post hoc analyses showed that nurses who have permanent night experience were responsible for the significant main effect. They have higher levels of depression (10.1 ± 3.9) than nurses no night experience (8.8 ± 3.0) table 3.

Research question number four: is there a difference in fatigue level among different night (permanent, temporary, or no) experience? ANOVA with post hoc test was performed to answer this question. There was a significant difference in total fatigue scores ($F_{(2,509)}=9.32, p<0.001$). Post hoc analyses showed that nurses who have no night experience were responsible for the significant main effect.

They have lower levels of fatigue (34.20 ± 10.4) than nurses with temporary night experience (39.71 ± 12.8), and lower than nurses with permanent night experience (39.74 ± 12.0), table 3.

Research question number five: is there a difference in insomnia level among different night (permanent, temporary, or no) experience? ANOVA with post hoc test was performed to answer this question. There was a significant difference in total insomnia scores ($F(2,509)=6.93$, $p<0.005$). Post hoc analyses showed that nurses who have no night experience were responsible for the significant main effect. They have lower levels of insomnia (10.2 ± 6.4) than nurses with temporary night experience (12.6 ± 6.0), and lower than nurses with permanent night experience (13.3 ± 6.3), table 3.

Research question number six: is there a difference in anxiety/depression/fatigue/ insomnia levels based on gender and area of practice? To test this question, independent t test was done for gender and ANOVA with post hoc was done for the area of practice. The only difference based on gender was that female nurses have more fatigue scores than male nurses (38.0 ± 11.3 vs. 35.9 ± 12.0 , <0.05).

Regarding area of practice, there was no significant main effect in regard to anxiety and depression. However, there was a significant difference in the total fatigue scores ($F(2,509)=9.93$, $p<0.001$). Post hoc analyses showed that nurses who were working in ICU were responsible for the significant main effect. They have higher levels of fatigue (41.2 ± 11.8) than nurses working in ER (34.6 ± 10.9), and nurses working in OR (34.3 ± 10.3), table 4. Moreover, there was a significant difference in the total insomnia scores ($F(2,509)=5.23$, $p<0.01$). Post hoc analyses showed that nurses who were working in ICU were responsible for the significant main effect. They have higher levels of insomnia (13.7 ± 6.4) than nurses working in ER (11.8 ± 6.2), and nurses working in OR (12.2 ± 6.0), table 4.

Discussion:

Working in rotating shifts is inevitable in certain professions due to the nature of the profession. In nursing; patients' care should be continuous 24 hours a day, seven days a week, and 365 days a year; making working at night shift is a must. Many of the previous studies showed that working at night shift was associated with negative consequences on nurses and patients.

Table 2: Correlations between night shift work and the levels of anxiety, depression, fatigue, and insomnia (N=512).

Variables	Total anxiety scores	Total depression scores	Total fatigue scores	Total insomnia scores	Age	Years of experience
Number of night shifts in last	NS	0.11*	0.26**	0.13**	- 0.24**	- 0.34**
Total anxiety scores	1	0.41**	0.33**	0.34**	NS	NS
Total depression scores		1	0.25**	0.32**	NS	NS
Total fatigue scores			1	0.44**	- 0.22**	- 0.21**
Total insomnia scores				1	- 0.19**	- 0.23**
Age					1	0.84**
Years of experience						1

NS: Not significant, ** significant, P < .001, * significant at P < .05.

Table 3: Post hoc LSD test for differences of total anxiety, depression, fatigue and insomnia scores among different types of night experience.

Dependent variable	Night experience	Compared with	Mean difference	Significance
Anxiety	Permanent	No night experience	1.04	<0.05
		Temporary night experience	0.98	<0.01
Depression	Permanent	No night experience	1.24	<0.05
Fatigue	No	Permanent night experience	-5.55	<0.001
		Temporary night experience	-5.52	<0.001
Insomnia	No	Permanent night experience	-3.11	<0.001
		Temporary night experience	-2.45	<0.005

Table 4: Post hoc LSD test for differences of total fatigue and insomnia scores among different areas of practice

Dependent variable	Area of practice	Compared with	Mean difference	Significance
Fatigue	ICU	ER	6.6	<0.001
		OR	6.9	<0.001
Insomnia	ICU	ER	1.95	<0.01
		OR	1.56	<0.05

ICU: Intensive care unit; ER: Emergency room; OR: Operation room.

Night shift work was associated with insomnia [8, 15, 44-45], fatigue [44], higher levels of absenteeism [15], mood disorder [24-25], loss of efficiency, decrease concentration productivity [26], and safety at work [26]. Moreover, working night shift was considered a risk factor for chronic and cardiovascular diseases [8, 13], gastrointestinal diseases [14-15], metabolic diseases [16], and diabetes [17]. Furthermore, there are some evidences that night work increased the risk of ovarian [18], breast [19-20], colorectal [21], prostate [22], and endometrial cancer [23]. Night shift work was associated with poor quality of life for nurses [11, 15], missing a lot of family and social activities [11, 15].

The results of this study showed that critical care nurses who were working on night shift have higher levels of insomnia, depression, anxiety, and fatigue than nurses working on day shift or temporary night. Furthermore, female and ICU nurses experienced more fatigue than male nurses and nurses from OR and ER respectively. ICU nurses suffered from insomnia more than ER and OR nurses. There was a dose-response relationship between the number of night that nurses work in the previous year with their (insomnia, depression, and fatigue levels). Age and years of experience were negatively correlated with the number of night shift worked in the last year. These results are in line with previous studies which showed that night shift was associated with insomnia [8, 15, 44-45], depression [5, 7, 44, 46-47], and fatigue [9, 44, 48].

The results of this study showed that female nurses complained from fatigue more than male nurses. Different changes occurred in this century regarding the role of the females in the community. However, the role of home responsibility is still on the females shoulder. This role includes but not limited to the house work, birth, care of children and spousal roles [49-51]. Nursing profession is made up mostly of females [52] and they usually have more responsibilities when they are working compared to male nurses. This might explain why female nurses in this study have more fatigue compared to male nurses [2, 11].

Another interesting finding in this study is the negative relationship between the (age, years of experience) and number of night worked in the last year. This result is in line with previous studies [15, 49] which showed that night worker were younger than day worker and have shorter years of experience. A possible explanation for this association is that nurses with longer years of experience will shift to the administrative role. Being in an administrative position will decrease the number of night shift work if not preventing it at all.

The study also showed that there is a dose-response relationship between the number of night shift worked in the last year and the severity of depression, fatigue and insomnia. These results are consistent with previous studies [2, 5, 51, 53]. This result is very important for nurses who are working in night duty. There should be an upper limit for the nights worked per year. For instance, a nurse who worked 50 night shifts had 50% greater probability to develop these symptoms than a nurse with zero night shifts during the last year [53].

In this study, ICU nurses had higher levels of fatigue than OR and ER nurses. It has been shown in previous studies that work load is a contributing factor to increase emotional stress and a trigger for different illness including fatigue [52, 54]. The nature of the ICU work is different from those in ER and OR. Patients in the ICUs are in need for continuous and hourly monitoring. In OR, the situation is different, since if there are no urgent operations, nurses can have a rest or a nap. The situation is approximately the same in the ER. Another explanation for this result is the higher levels of insomnia that ICU nurses have compared to OR and ER nurses. Insomnia has a strong relationship with fatigue [49].

Different explanations were presented in the literature about the nature of the relationship between night shift work and the negative consequences. The most common and remarkable theory is the alteration or misalignment of the circadian rhythm [46, 51]. Circadian rhythm is controlled by a nucleus in the hypothalamus which regulates the physiologic and psychological functions of the human [11]. The basic principle for this rhythm is to make the body ready to work during day and rest during night[11].

Circadian rhythm timing system is firmly entrained by internal body clocks and exposure to environmental light [55-56]. Late evening light will impede rhythms, while morning light will advance them; ending with the optimum mental performance between 2-4pm, and lowest between 3:30-5:30am [11, 57] Based on this theory, nurses working at night shift will go to bed when they are supposed to work and vice versa. The end results for this situation is development of insomnia.

Different studies showed that insomnia is correlated with anxiety [58], depression [2, 58], fatigue [2, 49, 51, 58] and number of errors committed by nurses [11]. Therefore, appropriate treatment of insomnia will result in better outcomes. The results of this study gave further support to this theory since there was a significant positive correlation between the number of night shifts and insomnia. In addition, there was a significant positive correlation between insomnia and (anxiety, depression, and fatigue).

Employers should do every effort decreasing risk factors negatively affect their employees and support protective measures which maintain their health [51]. This is crucial for nursing profession for the reason that the outcomes will not affect the nurses only, but also the patients. Diverse strategies have been proposed for this purpose, mainly focusing on the treatment of insomnia since it is the major character of the shift work disorder. In a recent study done by Kallestad et al. [58], treatment of insomnia significantly reduce fatigue, depression and anxiety. These results were significant even with moderate change in insomnia.

Short naps during night work have been shown to improve outcomes for employees [59-60], and were recommended by researchers [59, 61]. The efficacy of napping depends on the timing, duration and the circadian phase [58]. Napping for 20 minutes between 1 am and 3am was used in a cross over design by Purnell and colleagues [62] over two weeks. During the week when the employees have their naps, they were more alert at work place and could sleep well at home.

Circadian misalignment occurs with night shift workers because they work when they are supposed to sleep and sleep when they are supposed to work. Accordingly, those workers will have lower levels of Melatonin due to suppression by indoor light [63]. Though, the exposure to artificial light has been shown to neutralize this response and leads to adaptation to NSW [64-66]. Therefore, The American Academy for Sleep Medicine guidelines recommended designed light exposure in the work environment and light constraint in the morning [61].

Nutrition is another factor that plays a vital role for night shift workers to overcome the problem of insomnia. Researchers [67-68] explored the beneficiary outcome of certain meal use on the performance of shift workers. The recommendations of these studies were the ratio of proteins to carbohydrates should be 1:3. This ratio improved psychometric performance and alertness of nurses [67-68].

Conclusion

Night shift work alters the circadian rhythm and induced insomnia for nurses working in critical care units which increased their anxiety, depression and fatigue levels. This has negative consequences in their health and the care provided to the patients. Health care employers should use alternative methods to help nurses overcome this issue. This might include but not limited to napping, light exposure, and diet therapy.

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