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ORIGINAL: Effects of Post-Traumatic Stress Disorder on Sleep Quality in Family Members of Trauma Patients Admitted to The Intensive Care Unit

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ABSTRACT

Introduction: The hospitalization of individuals who have experienced trauma has a significant impact on their family members' lives. Consequently, the objective of this study was to examine the influence of post-traumatic stress disorder (PTSD) on the sleep quality of family members whose loved ones were hospitalized in the intensive care unit (ICU).

Material and Methods: This descriptive-analytical cross-sectional study involved 120 participants (66 males and 54 females) who were first-degree relatives of trauma patients admitted to the ICU at 5th Azar Hospital in Gorgan. Within the first 24 hours of the trauma patient's admission to the ICU, one of their first-degree relatives completed the PCL-C questionnaire for assessing PTSD symptoms. If the participant obtained a score of 45 or higher on the PCL-C questionnaire, they were then requested to complete the Pittsburgh sleep quality questionnaire. Statistical analyses were conducted using SPSS 23 software.

Results: The study found that the average score for PTSD among participants was 67.8 ± 5, indicating a high level of stress. The sleep quality score for family members of trauma patients upon hospitalization was 3.9 ± 1.8 (acceptable). However, one month later, their sleep quality significantly deteriorated to a score of 9.3 ± 2.5 (poor) ($P < 0.001$). There was no significant association found between sleep quality and PTSD ($P > 0.05$).

Conclusion: The research findings indicate that the admission of a trauma patient to the ICU has a significant negative impact on the sleep quality of their family members. Although PTSD was prevalent among these individuals, it did not directly influence sleep quality. Nevertheless, addressing psychological issues and providing adequate psychological support are crucial for improving sleep quality and managing PTSD-related problems, especially for patients with severe complications.

Introduction

Sleep is a vital process that aids in neural reconstruction and physiological maintenance in various organs of the body. For example, healthy sleep is associated with

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clearing metabolic waste from the brain and enhancing cognitive function, including improved memory (1). The need for sleep varies among individuals. Some adults only require 6 hours of sleep to feel refreshed during the day, while others need 9 hours. On the other hand, children and adolescents require more sleep compared to adults. According to the American Academy of Sleep Medicine (AASM) report, children aged 6 to 12 years need 9 to 12 hours of sleep each night, while teenagers aged 13 to 18 years need 8 to 10 hours of sleep per night (2). Sleep disorder is defined as a dissatisfaction with the quantity or quality of sleep, accompanied by one or more symptoms such as difficulty initiating sleep, difficulty maintaining sleep (characterized by frequent awakenings or difficulty returning to sleep after waking up), or early morning awakening with an inability to return to sleep. Several additional criteria exist: the sleep difficulty should persist for at least 3 months, it should cause significant distress or impairment in social, occupational, educational, academic, behavioral, or other important areas of functioning. Furthermore, the sleep difficulty should occur at least 3 nights per week, and this problem should persist despite having sufficient opportunity for sleep. It should be noted that in diagnosing insomnia or poor sleep quality, the role of mental illnesses, medication use, and other contributing factors should be considered. Additionally, attention should be given to whether the sleep difficulty is acute or chronic (3).

One of the persistent mental symptoms that individuals may experience after a traumatic event or unfortunate incident is Post-Traumatic Stress Disorder (PTSD). PTSD is a disorder that develops in some individuals who have gone through a distressing, terrifying, or dangerous event. In simpler terms, feeling fear during and after a traumatic situation is a normal response. Fear triggers rapid changes in the body to aid in defense against or avoidance of the threat. This "fight or flight" response is a natural reaction aimed at protecting oneself from harm. Almost everyone experiences a wide range of reactions after a trauma, but most individuals naturally recover from initial symptoms. However, those who continue to experience difficulties may be diagnosed with PTSD. Individuals with PTSD may feel stressed or fearful, even when they are not in immediate danger. It is important to note that not all individuals with PTSD have personally experienced a life-threatening event. Certain experiences, such as the sudden and unexpected death of a loved one, can also trigger PTSD. Symptoms typically begin within three months of the traumatic event, but in some cases, they may start years later. Symptoms must persist for more than a month and be severe enough to interfere with relationships or work in order to be considered as PTSD. The duration of the illness varies among individuals depending on factors such as the type of event, the person's personality, their access to therapy, and other factors. While some individuals may recover within six months, others may experience symptoms that last much longer (4-6).

One of the important factors that ultimately causes a lot of stress and mental health problems for patients and their families is trauma. Trauma resulting from external causes remains a major cause of death and disability among individuals aged 5 to 29 (7). In Spain, from 2000 to 2010, there was an annual increase of 1.1% in mortality rate among men and 0.9% among women (8). In the United States, trauma-related hospitalizations accounted for 4.4% of all hospitalizations from 2000 to 2011, with a decrease observed among children and adolescents and a steady rate among older adults (9). In 2015, trauma accounted for 1.1% of the global burden of disease. Depending on the severity, trauma can have serious health consequences or even lead to death (10). In 2017, the Global Burden of Disease study estimated that non-fatal trauma resulting from falls and road accidents caused short-term and long-term disability in 2.226 million people (11). Fatal injuries accounted for 8% of global mortality, affecting 4.8 million people, which represents a 3.2%

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increase compared to 2007, with a global mortality rate of 57.9 per 100,000 populations. Additionally, in 2007, trauma accounted for 9.11% of potential years of life lost (PYLL) (12).

A significant number of trauma victims require specialized care that is essential for their survival. In the United States, in 2013, 8.33% of trauma patients were admitted to the intensive care units (ICU), with a higher incidence among individuals aged 80 and older (7.7 per 1000 people) (13). Studies on ICU admissions due to trauma are crucial for planning and organizing trauma care and developing vital prevention programs (14).

Family members of patients admitted to the ICU are often involved in the care of their loved ones and this support continues even after discharge (15, 16). During the critical illness period, they may perform various caregiving tasks, communicate with doctors, and act as decision-makers. After patients are discharged, family members provide physical and emotional support in any situation. These experiences put family members at risk for psychological symptoms, including PTSD, depression, and anxiety (17, 18). While some psychological symptoms may be expected, others may jeopardize the personal well-being of family members or impact their caregiving. To improve conditions for survivors and family members of patients, a better understanding of the psychological and financial burden and risk factors associated with psychological symptoms is crucial (19).

Some believe that families experience more suffering and hardship compared to their patients, as the patient may not be aware of their emotional situation due to their specific medical condition (20, 21). In some cases, family members may even experience more stress, particularly in stressful situations specific to ICU (22, 23). One of the changes that affects the family system is the confirmation of illness and hospitalization of an adult, which has a defined role in the family. This process can break family bonds, alter roles and structure, and create a crisis for its members (24). The intensity of this crisis increases significantly when the illness is critical and necessitates the patient's admission to ICU. This is an experience that is commonly encountered by individuals as patients, friends, or family members. These units' account for 15% of hospital beds, and it is noteworthy that 20% of deaths occur in these units. The abrupt and unexpected hospitalization without any prior preparation or knowledge puts immense pressure on both the patient and their family, leaving them with little time to adapt and cope with the situation (24-26). Consequently, the objective of this study was to examine the influence of PTSD on the sleep quality of family members whose loved ones were hospitalized in the ICU.

Methods

The study was a descriptive analytical cross-sectional study conducted on first-degree relatives of trauma patients admitted to the ICU of the 5th Azar Hospital affiliated with Golestan University of Medical Sciences in Gorgan city. Individuals who had a first-degree relative hospitalized in the ICU, were over 18 years old, had no previous personal or family history of ICU hospitalization, were not night shift workers, and provided informed consent were included in the study. The exclusion criteria included the following:

- Having a history of neurological or systemic diseases (delirium, chronic respiratory disease, heart failure, migraines) that affect sleep quality.
- Being diagnosed with psychotic disorders, self-reported by the individual.
- History of substance abuse and alcohol consumption.
- Suffering from mental retardation.
- Self-reporting of previous poor sleep quality.

Simple random sampling method was used for sample selection. One first-degree relative of a trauma patient admitted to the ICU was randomly selected, and they were asked to complete the questionnaires. Due to the lack of previous studies reporting the correlation between PTSD and sleep quality, the researcher determined the sample size

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based on the categorization of correlation values in statistical books, with a correlation value of r=0.30 at a confidence level of 95% and a power of 90%. The calculated sample size was 113. Considering a 5% attrition rate, a total of 120 participants were included in the study.

After the patient's admission to the ICU, and 24 hours after the hospitalization of the trauma patient in the ICU, the first-degree relatives were approached and provided with the research objectives. They were asked to complete a checklist containing their demographic information, including age, gender, marital status (single/married), education level (below diploma, diploma, above diploma), and employment status (self-employed, employee, unemployed, retired).

To measure PTSD in the participants, the PCL-C questionnaire was used. This questionnaire consists of 17 items with 5 response options and was developed by Weathers and colleagues at the National Center for PTSD in the United States, based on diagnostic and statistical criteria for mental disorders as a diagnostic tool. The questions address problems related to responding to non-war-related or normal stress events and do not specifically focus on a particular traumatic event, but rather on general events in the past (27).

The PCL-C questionnaire has scores ranging from 17 to 85, with higher scores indicating more severe PTSD symptoms. The checklist for PTSD has been standardized in Iran by Mirzaei et al. (28) and Goodarzi (29). In Goodarzi's study, the internal consistency of the questionnaire was reported as 0.93, and in Weathers' study, the coefficient of internal consistency was reported as 0.97 in a population of war veterans.

In the next stage, the participant was asked to complete the Pittsburgh Sleep Quality Index questionnaire. This questionnaire assesses the individual's perception of sleep quality over the past 4 weeks. The Pittsburgh Sleep Quality Index questionnaire consists of seven scales: 1) overall sleep quality, 2) sleep onset latency, 3) sleep duration, 4) sleep efficiency (calculated based on the ratio of sleep duration to total time spent in bed), 5) sleep disturbances (defined as nighttime awakenings), 6) use of sleep medication, and 7) daytime dysfunction (defined as problems experienced by the individual during the day as a result of poor sleep). Each scale is scored from 0 to 3, with scores of 0, 1, 2, and 3 indicating normal, mild, moderate, and severe problems, respectively. The sum of the scores on the seven scales forms the overall score, which ranges from 0 to 21 (30). A score of 1 to 5 indicates good sleep quality, while a score of 6 or higher indicates poor sleep quality. Previous studies have shown acceptable correlation between the results of this questionnaire and laboratory sleep studies using polysomnography. The Pittsburgh Sleep Quality Index questionnaire was initially designed by Buysse et al. (31) and has since been revised. In this study, the version of the questionnaire validated by Farhadi Moghaddam et al. (32) was used for the Iranian population. The questionnaire was completed in two stages (at the beginning of the study and after one month) to assess the participants' sleep status after one month from the incident.

The variables under investigation were described using descriptive statistical indices such as mean, standard deviation, frequency, and percentage, as well as graphical representations using SPSS version 23 software. The normality of the quantitative response variable was assessed using the Kolmogorov-Smirnov test. The correlation between normally distributed variables was evaluated using Pearson's correlation test, while Spearman's correlation test was used for non-normally distributed variables. Additionally, paired t-test analysis was employed to examine the differences in sleep quality scores between hospitalization and one month after. A significance level of 0.05 was considered.

Results

The basic demographic information of the 120 participants in the study is presented in ***Table 1***. Based on the obtained data, the

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mean age of patients hospitalized in the ICU was 41.1 years with a standard deviation of 19.6. The age range of the patients was between 15 and 81 years. Overall, 55% of the participants were male, and 89.2% were married. Furthermore, the majority of the patients' companions resided in urban areas (58.3%). Participants from various ethnic backgrounds, including Turkish, Sistani, Turkmen, Persian, and foreign nationals, were included in the study, with Persian ethnicity being the most prevalent. ***Figure 1*** shows the proportion of patients admitted to the ICU.

Table 1. Arrhythmias prevalence after acute myocardial infarction

Variable		N (%)
Age (years)	<20	28 (23.3)
	21-40	33 (27.5)
	41-60	38 (31.7)
	60<	21 (17.5)
Gender	Male	66 (55)
	Female	54 (45)
Marital status	Single	13 (10.8)
	Married	107 (89.2)
Residence status	Urban	70 (58.3)
	Rural	50 (41.7)
Ethnicity	Turkish	4 (3.3)
	Turkmen	33 (27.5)
	Fars	57 (47.5)
	Sistani	22 (18.3)
	Foreign nationals	4 (3.3)



Figure 1. The ratio of patients with the person admitted to the ICU

Another variable that was investigated was the reason for hospitalization of the patients. Among hospitalized patients, according to the obtained results, the most common cause of hospitalization in ICU was trauma with 92 cases (76.7%). After trauma, craniotomy, cerebral hemorrhage, and subdural hematoma (SDH) were the causes of hospitalization in 12, 6, and 6 patients, respectively. Other factors included epidural hemorrhage and rupture of the spleen (***Table 2***).

Table 2. Causes of admission of patients in ICU

Causes of admission	N (%)
Trauma	92 (76.7)
Craniotomy	6 (5)
Epidural hemorrhage	2 (1.7)
Cerebral hemorrhage	12 (10)
Rupture of the spleen	2 (1.7)
Subdural hematoma	6 (5)

Before examining the quality of sleep in the companions of patients hospitalized in the ICU, the status of PTSD in these people was examined. Based on the data analysis, the average score of the PCL questionnaire was 67.8 with a standard deviation of 5.2. The range of scores varied from 52 to 81. These results show that, on average, the participants in the study were seriously injured after the accident that led to their patient being admitted to the ICU (a score above 45 indicates that the person has PTSD). And some people have very high levels of PTSD.

The information obtained from the patient's companion regarding the quality of sleep in the 1 month before their patient's hospitalization in the special treatment department showed that the overall average score of the Pittsburgh questionnaire was 3.9 with a standard deviation of 1.8. The score range was from 1 to 15. According to the classification of sleep quality, 86.6% of the companions had good sleep quality 4 weeks before admission to ICU.

Based on the results of examining the sleep quality of the patients after one month of hospitalization in the ICU, it showed that the sleep quality of these people has decreased significantly. The average score of the questionnaire in 4 weeks after hospitalization was 9.3 with a standard deviation of 2.5. The score range was from 5 to 16. Based

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on the classification of sleep quality, 80.1% of the companions did not have good sleep quality.

Based on the information obtained from paired t-analysis, the quality of sleep of companions 4 weeks after hospitalization in ICU was significantly lower compared to 4 weeks before hospitalization (P<0.001). The information related to the comparison of the components of the Pittsburgh Questionnaire two times before and after hospitalization in ICU is shown in ***Table 3***. In addition to the overall score of sleep quality, the domains of sleep quality include the subjective quality of sleep (P<0.001), sleep duration (P<0.001), delay in falling asleep (P<0.001), sleep quality (P=0.004), sleep disorders (P=0.001) as well as daytime dysfunction (P<0.001) caused by sleep related problems, all significantly after one month of patient hospitalization had decreased. However, the score related to the use of sleeping pills had not changed and a small percentage of people were using these drugs at the time of the accident and one month later.

Table 3. The results related to the comparison of the components of the Pittsburgh questionnaire before and after hospitalization in the ICU

Variable	Four weeks before hospitalization		Four weeks after hospitalization		Mean difference	Paired t-test score	P-value
	Mean	SD	Mean	SD			
Subjective quality of sleep	0.28	0.49	1.5	0.53	-1.2	-20.5	<0.001
Delay in falling asleep	2.4	1.1	4.3	1.1	-1.8	-16	<0.001
Sleep duration	0.18	0.46	0.83	0.89	-0.65	-7.7	<0.001
Sleep quality	0.10	0.38	0.24	0.50	-0.13	-2.9	0.004
Sleep disorders	0.95	0.24	1.1	0.26	-0.11	-3.5	0.001
Sleeping pills	0.08	0.27	0.08	0.30	0	0	0.999
Daily dysfunction	0.11	0.41	0.52	1.3	-1.18	-22.2	<0.001
PSQI total score	3.7	1.7	9.5	2.6	-5.7	-18.7	<0.001

The results of univariate linear regression analysis showed that the older the patient's age, the sleep quality score will be significantly lower (P=0.005). According to the results, if the patient's gender is female, the sleep quality score shows a significantly higher number (P>0.001). The obtained results showed that there is no significant relationship between PCL score and sleep quality (P=0.649, ***Table 4***). The results of the multivariate linear regression analysis showed that after adjusting for other factors, the age of the hospitalized patient and the gender of the patient's companion will be considered as two influencing factors on the overall score of sleep quality (P<0.05, ***Table 5***). Based on the results of the Pearson correlation coefficient test, a weak and direct relationship between the state of stress and sleep quality was observed, which was not statistically significant (P=0.649, r=0.044). The distribution chart related to the relationship between stress and sleep quality is shown in ***Figure 2***.

Table 4. The results of univariate linear regression analysis

Variable	β	SE	P-value
Age of patients	-0.035	0.012	0.005
Gender of patient companions	1.70	0.463	<0.001
Total score of PCL	0.021	0.046	0.649

Table 5. The results of multivariate linear regression analysis

Variable	β	SE	P-value
Age of patients	-0.037	0.011	0.001
Gender of patient companions	1.76	0.446	<0.001
Total score of PCL	0.022	0.046	0.579

Discussion

Research conducted over the years has consistently demonstrated that chronic emotional distress is a common occurrence among patients and their families following an injury that necessitates admission to the ICU. Although not all patients and caregivers

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experience chronic emotional distress, such as PTSD, many caregivers are at a heightened risk of developing illnesses and experiencing physical and psychological harm (33). Similarly, the current study revealed that the companions of patients suffered from significant PTSD as a result of being exposed to the unfamiliar circumstances surrounding their family member's illness. Limited research has been conducted on the psychological stress experienced by caregivers. Previous findings from the Canadian RECOVER cohort indicated that nearly two-thirds of caregivers reported depressive symptoms upon discharge, with 43% still experiencing these symptoms one-year post-discharge. Additionally, this group of caregivers exhibited a decline in psychological well-being and overall mental health over time, despite their physical health symptoms remaining relatively stable (34).

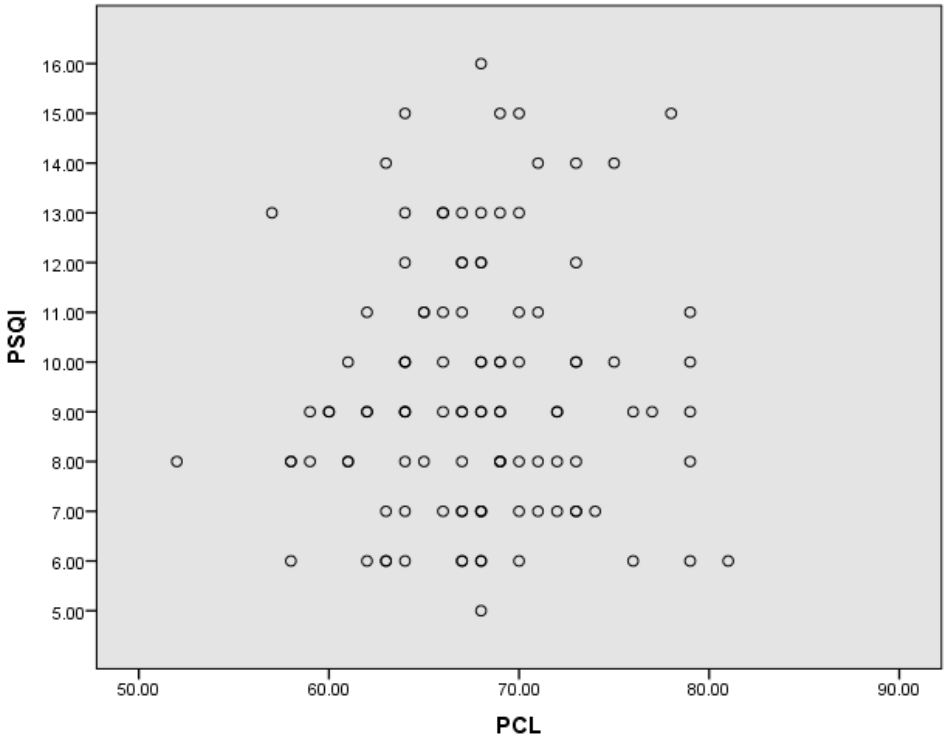

Figure 2. Scatter diagram of the relationship between stress and sleep quality

Furthermore, a study conducted on a population-based group of spouses of critically ill patients with sepsis and septic shock revealed that the incidence of new mental illness was 23.5%, which was higher than the general population during the same period (35). Additionally, recent prospective data from France indicated that caregivers of patients with acute respiratory distress syndrome (ARDS) resulting from COVID-19 had a higher prevalence of PTSD symptoms compared to both the general population and caregivers of patients with ARDS caused by other diseases (36). In a systematic review study examining the prevalence of depression, anxiety, and PTSD in family members of patients hospitalized in ICUs, the prevalence of these psychological outcomes in caregivers ranged from 4% to 94% for depression, 2% to 80% for anxiety, and 3% to 62% for PTSD. Most studies assessing longitudinal outcomes reported a decrease in caregivers' depression, anxiety, and PTSD over time. Several common risk factors associated with adverse psychological outcomes were identified, including younger caregiver age, caregiver-patient relationship, lower socioeconomic status, and female gender (37). These findings have raised significant concerns regarding the potential for mental health complications among both patients and their caregivers after ICU

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discharge (38).

In the present study, it was observed that the quality of sleep for most caregivers was reasonably good before the accident and the patient's admission to the ICU. However, after one month of the accident and the patient's hospitalization in the ICU, the sleep quality significantly deteriorated, with a high percentage of individuals reporting poor sleep quality. This decline was evident not only in the overall sleep quality score but also in most domains related to sleep quality. Similar findings regarding the worsening trend of sleep quality following an accident leading to a family member's ICU hospitalization were also observed in the study conducted by Choi et al. In their study, caregivers, especially those who were employed, exhibited a worsened trend in sleep quality and objective sleep/wake patterns. Furthermore, caregivers of patients who were unable to return home within two months after ICU discharge experienced a higher trend of worsening sleep quality compared to caregivers of patients who were able to return home (39). Similarly, in the study by Day et al., family members of patients who spent one or two nights in the hospital had significantly higher sleep disorder scores. Anxiety, tension, and fear were reported as common reasons for poor sleep among family members in this survey. Emotional stimuli, such as anxiety, fear, and tension, have a negative impact on a person's ability to fall asleep (40). Factors such as literacy, financial status, and self-management skills can play a role in managing sleep problems among caregivers who are family members of the patient. However, the role of self-control skills is particularly important, and it is recommended that nurses provide training to patients' companions to prepare them for post-discharge conditions and enable them to better maintain their own health and that of their patients. Additionally, reducing stress and anxiety is crucial for better management, as individuals with better stress control are more resourceful and can better adapt to new situations (41).

In this study, no significant relationship was found between sleep quality scores and PTSD scores. This finding contradicts the results reported by Krakow et al., who found a significant association between PTSD and sleep quality. Krakow et al. also identified a relationship between PTSD and different domains of sleep quality (42). One possible reason for the discrepancy between the present study and previous research could be the use of different questionnaires. Additionally, the authors did not come across any studies that specifically examined the relationship between PTSD and sleep quality in patients' companions, suggesting that future studies could focus on this aspect.

One limitation of this study was the lack of assessment of PTSD in patients after one month. Due to the relatively large sample size, it was not feasible to re-evaluate both questionnaires, and fewer participants were willing to complete both questionnaires.

Conclusion

The present study demonstrates that PTSD following an accident is prevalent among many caregivers of patients hospitalized in the ICU, posing a significant problem for these individuals. Additionally, most participants in the study had acceptable sleep quality before their loved one's ICU admission, but after one month of hospitalization, their sleep quality significantly declined. It appears that these individuals are in great need of psychological support following the trauma to be able to maintain their own health and provide sufficient care for their patients. Moreover, this study did not find a significant association between PTSD and sleep quality, contradicting some previous research findings. However, future studies can update the questionnaires to assess PTSD and sleep quality and include other variables such as self-management strategies and stress control courses to enhance the existing knowledge in this area.

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Ethical standards statement

This study has been reviewed and approved by the Research Ethics Committee of Mazandaran University of Medical Sciences (approval code: IR.MAZUMS.REC.1402. 037).

Conflicts of interest

The authors declare no conflict of interest.

Authors' contributions

All authors contributed equally to preparing this article.

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