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Social relational quality and ethical climate as the predictors of sleep quality in employees of the operating room: a hierarchical linear regression analysis

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Abstract

Introduction Sleep quality is a crucial aspect that can affect the health, job performance, and safety outcomes of operating room employees. However, the social and work-environmental factors that predict sleep quality remain unclear. This study aimed to determine the role of social relational quality and ethical climate as the predictors of sleep quality in employees of the operating room using hierarchical linear regression analysis.

Methods This cross-sectional and multi-center study was conducted on 232 operating room employees. Data were collected using the social relational quality scale, Hospital Ethical Climate Survey, and Pittsburgh Sleep Quality Index. Pearson's correlation coefficient, ANOVA, t-test, and hierarchical multiple linear regression were used to analyze the data.

Results The mean scores of social relational quality and standardized ethical climate were 54.80(SD = 6.35) and 3.40(SD = 0.68) in the operating room employees. The mean score of sleep quality was 6.70(SD = 3.66) which was in the poor range. The last step of regression analysis showed that profession (β=-0.22, $p = .02$) and social relational quality (β=-0.20, $p = .03$) had a significant proportion of the variance of sleep quality. Based on the model, work experience, profession, social relational quality, and ethical climate accounted for 15% of the changes in sleep quality in the operating room employees.

Discussion This study indicated that more than half of the operating room employees reported poor sleep quality. Moreover, profession and social relational quality were the predictors of sleep quality. Conducting interventions to improve social relational quality might enhance the sleep quality of operating room employees.

Keywords Operating rooms, Sleep quality, Ethics, Professional, Communication

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Introduction

The operating room is a place with highly technical skills. It needs attention to patients' care and safety, surgery, and invasive procedures [1]. Professional communication plays an important role in the operating room as a complex clinical environment [2]. The operating room is one of the environments where any ineffective communication can negatively affect the quality of patient care [3]. In this setting, professional communication might abound in ethical challenges [4].

Given the intense interactions between nurses in the operating room with the patient and the surgical team, adherence to ethical principles by nurses can lead to enhanced quality of care and interaction between surgical team members [4]. A study indicated that operating room discipline and close relationships among physicians, employees, and operating room managers improved the understanding of the ethical climate in the operating room [5]. One study showed that the operating room nurses had a good understanding of their colleagues' domain of ethical climate [5].

Besides ethical climate, as a social and ethical factor, social relations may also be effective for healthcare providers such as operating room employees. Social relational quality means the quality of communication between family and friends. It consists of family intimacy, family commitment, and friendship components. Family relationships are a form of important social relationships. Family provides material, emotional, and spiritual support for their members. Family support, which plays a significant role in a person's physical and mental health [6], has also been shown to positively influence the sleep quality [7], an essential factor for maintaining overall well-being.

Researchers indicated that the prevalence of poor sleep quality was high in hospital nurses [8]. For example, a study in China on operating room employees showed that 62.3% of nurses had poor sleep quality [8]. Another study showed that approximately half of health professional employees who worked in hospitals had poor sleep quality [9]. Sleep disturbance and the resulting daytime sleepiness might lead to impairment in intraoperative skills and indirectly reduce the patients' safety [10]. Fewer hours of night sleep decreases situational awareness and decision-making during operation [11].

Regarding the concepts of this study, the following question was posed: "Is there any association between sleep and hospital ethical climate in employees of operating room?" The literature review did not exactly answer this question. A study showed that nurses' moral distress was associated with sleep quality [12]. On the other hand, a study indicated that daytime sleepiness did not affect the nurses' work quality [13]. The limitations in this field highlight the necessity of further research.

Another research question was: "Is there a correlation between sleep and social relational quality, such as family intimacy, family commitment, and friendships in employees of the operating room." One study reported that declined social relational quality was correlated with poor sleep quality [14]. Researchers believe that positive support from the closest person improves the duration, efficiency, and quality of sleep. In a study, negative support from these people increased the risk of more sleep disturbance, longer sleep latency, more daytime sleepiness, poorer sleep quality, and the need for sleep medication [14]. Also, it has been shown that family support and their relationships correlated with sleep quality [7]. Another study reported that the duration and quality of sleep of family members affected each other [15].

Theoretical frameworks

As mentioned, sleep quality plays a vital role in the intraoperative skills, patients' safety [10], and well-being and efficacy of healthcare professionals [16], particularly those working in high-pressure settings like operating rooms. The intense and demanding nature of this environment highlighted the necessity of exploring the factors influencing sleep quality, including social relational quality and ethical climate, which emerge as significant yet underexplored determinants within the workplace. This study investigated these factors through the theoretical frameworks of Social Exchange Theory and Job Demands-resources model (Fig. 1).

Social Exchange Theory emphasizes the role of reciprocity and trust in shaping workplace relationships and the broader relational climate. Supportive interpersonal dynamics, characterized by mutual respect, effective communication, and positive interactions [17], can promote the patients' safety [18], job satisfaction, decision-making, and compliance with guidelines [19]. Based on social exchange theory, workplace relationships significantly influence an individual's attitudes and behaviors in response to various job-related circumstances [20]. Having strong social relationships and receiving support from spouses, family, and friends contribute to better sleep quality [21]. On the other hand, strained workplace relationships are linked to poor sleep quality [14]. Moreover, the link between ethical climate and sleep quality based on social exchange theory could indicate that moral distress, ethical stress, and the ethical climate have a substantial impact on professionals' levels of burnout and job satisfaction [22]. Moreover, nurses' moral distress led to poor sleep quality [12].

The Job Demands-Resources (JD-R) Model offers a robust framework for analyzing the impact of workplace conditions on employee outcomes [23] such as well-being and performance. This model differentiates between job demands, which drain energy and elevate

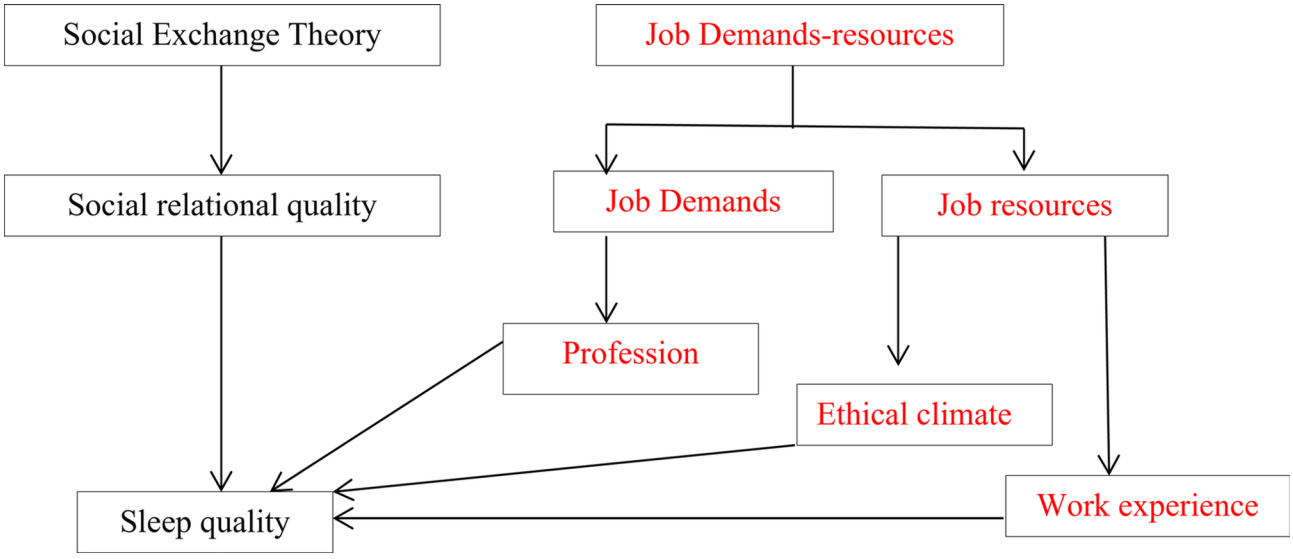

Fig. 1 Theoretical framework and hypotheses of this study

stress levels, and job resources, and helps to reduce stress and strengthen resilience [23]. The ethical climate is a crucial job resource within this context, representing the ethical standards and shared values embedded in an organizational culture. Perceived organizational support plays a crucial role in employees' well-being and health [24]. Work experience, while not a formal job resource provided by the organization, can be regarded as a personal resource within the Job Demands-Resources (JD-R) model. As employees gain experience, they often develop stronger coping strategies, better problem-solving skills, and a greater sense of self-efficacy. These qualities enhance their capacity to manage high job demands and maintain well-being. Personal resources, such as experience, contribute to motivation and act as protective factors in demanding work environments [25]. In the framework of the Job Demands-Resources (JD-R) model, the specific profession within healthcare significantly affects the job demands encountered by employees. For instance, physicians often face higher quantitative demands compared to nurses and nursing assistants, leading to increased work pressure and potential stress [26]. Moreover, sleep quality can be seen as an indicator of employee's well-being [27]. In other words, job stress and sleep quality play a crucial role in workers' well-being and contribute to enhanced productivity [28]. Furthermore, occupational stress was associated with sleep quality [29] and job stressors and social support affect the employees' sleep disturbance [30]. Job demand correlated with job and personal resources. Increase in job demand led to higher nurses' strain; on the other hand, job resources can decrease strain [31]. Moreover, a supportive ethical climate promotes fairness, shared principles, and ethical behavior; these can alleviate work-related stress and anxiety [32], contribute to reduced fatigue, and improve caring efficacy [33].

As stated above, the studies that have assessed the association between social relational quality and sleep do not focus directly on hospital and operating room employees who work in rotating shifts. Therefore, it is necessary to conduct a study on this group of people. In this study, the researchers also aimed to investigate the predictive role of social and ethical factors, such as ethical climate and social relational quality, in the work environment, family, and friends concerning the sleep quality of operating room employees. To improve the evidence-based practice, and through the theoretical frameworks of Social Exchange Theory and Job Demands-resources model, this study aimed to determine the predictor roles of social relational quality and ethical climate of sleep quality in employees of the operating room.

The following hypotheses were posed in this study:

1) There are significant differences in sleep quality based on the socio-demographic characteristics (e.g., age, gender, marital status, hospital, working shift type, profession, work experience, etc.) of operating room employees.
2) There is a significant correlation between social relational quality, ethical climate, profession, work experience in the operating room, and sleep quality in operating room employees.
3) Using hierarchical linear regression analysis, social relational quality, ethical climate, profession, and work experience are the predictors of sleep quality in operating room employees.

We prioritized "social relational quality" over "ethical climate" in the regression based on theoretical reasoning. Social relational quality directly influences stress and well-being, which are critical for sleep quality. Ethical climate, as an organizational factor, adds its influence on sleep after personal and relational factors. This sequence aligns with the logical progression of the individual to organizational influences. Studies have shown that workplace factors, including the ethical climate of an organization, can influence employee health and behaviors; however, these effects are often more apparent once interpersonal relationships and relational dynamics are accounted for [34, 35].

Methods

Design

This is a cross-sectional study conducted on two hundred and thirty-two operating room employees.

Setting

This multi-center study was conducted in Nemazee, Shahid Faghihi, Alzahra heart, Shahid Ghamran, Shahid Rajaii, and Abu Ali Sina Hospitals affiliated to Shiraz University of Medical Sciences.

Sample

The inclusion criteria for the study included operating room employees with a profession such as nurses of the operating room, anesthesia technologists, medical residents, and specialists. The other inclusion criteria were work experience in the operating room for at least 6 months and willingness to participate in the study. Exclusion criteria included suffering from known mental illnesses confirmed by a psychiatrist and using amphetamine, midazolam, etc. However, no one was excluded from the study for these reasons.

Sampling

Stratified random sampling was used. Firstly, the hospitals with operating rooms were divided into strata. Then, people were randomly selected based on the ratio of each stratum to the total sample (232 subjects). In this way, the number of operating room employees in each hospital (stratum) was divided into the total number of staff in all hospitals. Then, this number was multiplied by the determined sample size (232). Finally, the required number of samples was randomly obtained in the operating room of each hospital.

Sample size

The required sample size was calculated using an a priori power analysis for multiple linear regression (Daniel Soper's Statistical Power Calculator: https://www.danielsoper.com/statcalc/calculator.aspx?id=1). With an anticipated effect size of f^2=0.072 (based on pilot data), desired power of 90%, $\alpha = 0.05$, and 4 predictors, the analysis indicated a minimum of 218 participants. Accounting for a 7% anticipated attrition rate (based on similar healthcare studies), we recruited 232 operating room employees to ensure adequate power.

Instruments

The data collection tools in this study included demographic characteristics, Hospital Ethical Climate Survey, social relational quality scale, and Pittsburgh Sleep Quality Index (PSQI).

Hospital Ethical Climate Survey designed by Olson [36] was used. It contains 26 items in five domains of the ethical climate of colleagues, doctors, managers, patients, and the hospital. Sample items by subscale were nurse-manager relationships (managers respect the rights of nurses), nurse-physician relationships (nurses and physicians work together to ensure patient care is ethically appropriate), nurse-colleagues relationships (nurses support each other in ethical situations), nurse-patient relationships (patients' values and beliefs are respected), and hospital practices and policies (the hospital has clear policies to address ethical issues). This questionnaire is scored using a 5-point Likert scale ("almost never true" =1 to "almost always true"=5). The total score ranges from 26 to 130. The total scores are standardized by dividing them by the number of items. The total standardized scores range from 1 to 5. The validity of this questionnaire has been confirmed by Olson using construct validity with Lisrel software. Its reliability was reported using Cronbach's alpha of 0.91 [36]. The reliability of the Hospital Ethical Climate Survey in the Persian language of surgical technologists working in operating rooms was reported as 0.91 [5]. In this study, Cronbach's alpha of Hospital Ethical Climate Survey was obtained 0.94.

Social Relational Quality Scale was designed by Kai Hou et al. in 2009. It measures the quality of communication between family and friends [37]. This scale has 17 items scored using a 4-point Likert scale ranging from strongly disagree with a score of 1 to strongly agree with a score of 4. The scores range from 17 to 68. Sample items by domain include family intimacy (I feel emotionally close to my family members), family commitment (my family members are willing to help each other with problems), and friendship quality (I have friends who listen to me when I need to talk). The reliability of this scale has been confirmed through Cronbach's alpha of 0.82. The social relational quality scale includes three subscales of family intimacy, family commitment, and friendships, the Cronbach's alpha of each one being 0.80, 0.82, and 0.75, respectively [24]. Pasyar et al. used this scale for hemodialysis patients. The face and content validity of this scale was confirmed in the Persian language, and its construct

validity was confirmed using PLS software using confirmatory factor analysis. The reliability of the scale in the Persian language was confirmed using Cronbach's alpha in PLS software 0.77 [38]. While the social relational quality scale has been utilized in various healthcare contexts, there is limited information regarding its application, especially within hospital settings or among nurses. Therefore, Cronbach's alpha of this scale was assessed in operation room employees, and it was confirmed as 0.85.

PSQI, which has nine questions, is used to assess sleep quality in operating room employees. This index has seven components including subjective sleep quality, sleep latency, sleep duration, sleep efficacy, sleep disturbance, use of sleep medication, and daytime dysfunction. Sample items by component include subjective sleep quality (during the past month, how would you rate your sleep quality overall?), sleep latency (during the past month, how long (in minutes) has it usually taken you to fall asleep at night?), and sleep duration (during the past month, how many hours of actual sleep did you get at night?). Sample items for the other subscale include sleep efficiency (during the past month, how many hours did you usually spend in bed each night?) and sleep disturbances (during the past month, how often did you wake up in the middle of the night or early morning?). Use of sleep medication (during the past month, how often have you taken medicine to help you sleep?), and daytime dysfunction (during the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?) were the other sample items. In each component, the individual's score was between zero and three. The total score was obtained from the sum of the scores of seven components, which ranged from zero to 21. A score of less than 5 and more than that indicates good and poor sleep quality, respectively. The reliability of the Persian version of PSQI was 0.83 and 0.85 [39].

Data collection methods

To collect the data, the research assistant attended the operating rooms of each hospital. After permission was obtained, samples were selected based on stratified random sampling. The questionnaires were given to the employees' operating room, and they were asked to complete them. The research assistant was present with the participants to help them answer the questions. After the data was collected, it was entered into SPSS software.

Data analysis

Data analysis was done in SPSS software, using descriptive data such as mean, standard deviation, frequency, and percentage. Pearson's correlation coefficient was used to assess the correlation between the two variables. The r values of Pearson correlation coefficients were 0, 0.1 to 0.3, 0.4 to 0.6, 0.7 to 0.9, and 1, indicating no, weak, moderate, and strong and perfect linear correlation, respectively [40]. Then, hierarchical multiple linear regression was used to investigate the predictive role of variables. In this way, each variable was entered into the regression model and the effect of each was checked with the presence of the next variable. The analyses assumed normally distributed variables, confirmed through Kolmogorov-Smirnov test (all $p > .05$) and examination of skewness statistics (all values between − 1.96 and + 1.96). Linear relationships between predictors and outcomes were verified through residual plot inspection and correlation analysis prior to model fitting.

Ethical considerations

This study was approved by Research Ethics Committees of the Schools of Nursing and Midwifery, Management and Medical Information Science affiliated to Shiraz University of Medical Sciences. (IR.SUMS.NUMIMG.REC.1402.130, date 2024-01-06). Permission was obtained from hospital managers and operating room officials. The written informed consent form was signed by the operating room employees. All methods were conducted following relevant guidelines and regulations. The anonymity and confidentiality of the employees of the operating room information were considered in all stages of the research. The operating room employees were ensured that they could withdraw from the study at any time and quit cooperating and completing the questionnaires. All the processes of this study were based on the principles mentioned in the Declaration of Helsinki.

Results

A total of 232 operating room employees participated in this study; their demographic characteristics are presented in Table 1. The sample consisted predominantly of female (59.9%) and married (59.3%) operating room employees. The mean age of the participants was 33.59 years ($SD = 8.67$). Most participants (77%) worked in rotating shifts, averaging 49.02 weekly hours ($SD = 21.64$) in the operating room. The operating room nurses compromised the largest professional group (54.5%). The mean work experience of the participants was 10.97 years ($SD = 8.45$), and the average duration of presence per surgery was 3.77 h ($SD = 2.51$).

The mean scores of social relational quality, ethical climate, and sleep quality in operating room employees

As shown in Table 2, the mean score for social relational quality among operating room employees was 54.80 ($SD = 6.35$), with scores ranging from 36 to 68. The mean scores for each subscale of social relational quality are also presented in Table 2.

Table 1 The socio-demographic characteristics of operating room employees in this study

Variables	n (%)	Sleep quality Mean (SD)	Test, *p*-value, CI 0.95%
Gender			
Female	91 (40.1)	7.56 (3.72)	t = 4.79, *p*<.001, CI: 1.33 to 3.18
Male	136 (59.9)	5.30 (3.06)	
Marital status			
Single	92 (40.7)	6.90 (3.77)	t = 1.03, *p* = .30, CI: -.46 to 1.48
Got married	134 (59.3)	6.39 (3.53)	
Hospital			
A	82 (36.0)	7.00 (3.47)	F =.45, *p*=.80, CI: 6.16 to 7.12
B	23 (10.1)	6.21 (3.21)	
C	27 (11.8)	6.40 (3.64)	
D	48 (20.7)	6.17 (3.37)	
E	27 (11.6)	6.66 (4.83)	
G	21 (9.2)	7.09 (3.75)	
Profession			
Nurses operating room	119 (54.5)	7.17 (3.72)	F = 3.21, *p*= .04, CI: 6.15 to 7.12
Anesthesia technologist	69 (31.7)	6.17 (3.32)	
Medical specialties	30 (13.8)	5.60 (3.42)	
The number of patients who are present at the bedside for surgery[†]			
1-4	92 (48.4)	6.33 (3.41)	F = 1.49, *p*=.22, CI for mean: 5.86 to 6.89
5-9	78 (41.1)	6.73 (3.73)	
≥10	20 (10.5)	5.37 (3.44)	
Working shift type			
Fixed morning	11 (5.0)	6.27 (3.95)	F =.41, *p*= .74, CI for mean: 6.12 to 7.08
Fixed evening	1 (.5)	4.00	
Fixed morning or evening	39 (17.6)	7.05 (3.34)	
Rotating	171 (77.0)	6.53 (3.69)	

[†] In each shift

The mean standardized score for ethical climate was 3.40 (*SD* = 0.68), with a range of 1.69 to 4.77. Among the ethical climate subscales, the highest mean score was related to employees' perceptions of their managers, while the lowest mean score was associated with their views regarding the managers and hospital environment (Table 2).

The mean global sleep quality score was 6.70 (*SD* = 3.66), falling within the poor range. Global scores ranged from 0 to 20. Table 2 provides the mean scores for the components of sleep quality, with the best and worst scores corresponding to sleep efficiency and sleep latency, respectively.

Additionally, 59.1% of the participants reported poor global sleep quality. Approximately half of the operating room employees rated their subjective sleep quality as "fairly good", while one-third reported "fairly bad" or "very bad" subjective sleep quality. One-third of the employees reported sleeping less than six hours per night, and two-thirds indicated they fell asleep in less than 30 min each night (Table 2).

Impact of socio-demographic characteristics on sleep quality among the operating room employees

As shown in Table 1, no significant difference was observed between sleep quality and most socio-demographic characteristics of operating room employees, except for work experience in the operating room (r = -.16, p = .04). This finding indicates that employees with more work experience tend to have better sleep quality.

The results of the ANOVA test revealed a significant difference in global sleep quality across professional roles (F (2, 232) = 3.21, p = .04), with operating room nurses reporting the poorest sleep quality compared to other professional groups. No significant correlations were found between sleep quality and age (r = -.13, p = .07) or the duration of presence during each surgery (r = -.02, p = .71).

The correlation between sleep quality and work experience, profession, social relational quality, and ethical climate in the operating room employees

As Table 3 and the Pearson correlation coefficient showed, there was a significant, negative, but weak correlation between employees' sleep quality and their work experience in the operating room, profession, social

Table 2 The mean scores of social relational quality, ethical climate, and sleep quality in operating room employees

Variables	Mean (SD) or n (%)
Social relational quality, Mean (SD)	54.80 (6.35)
Subscales	
Family intimacy	22.33 (3.25)
Family commitment	17.50 (2.34)
Friendship	14.92 (2.66)
Standardized ethical climate, Mean (SD)	3.40 (0.68)
Subscales	
Colleagues	3.75 (0.75)
Doctors	3.06 (0.87)
Hospital	2.95 (0.86)
Patients	3.55 (0.79)
Managers	3.88 (0.88)
Sleep quality, Mean (SD)	6.70 (3.66)
Components	
Subjective sleep quality	1.17 (0.74)
Sleep latency	1.30 (0.92)
Sleep duration	1.04 (0.95)
Sleep efficacy	0.40 (0.76)
Sleep disturbance	1.23 (0.63)
Use of sleep medication	0.40 (0.76)
Daytime dysfunction	1.17 (0.96)
Sleep quality, n (%)	
Good	94 (40.9)
Poor	136 (59.1)
Subjective sleep quality, n (%)	
Very good	38 (16.8)
Fairly good	120 (53.1)
Fairly bad	58 (25.7)
Very bad	10 (4.4)
Sleep duration, n (%)	
>7 hours	72 (34.3)
6-7 hours	79 (37.6)
5-6 hours	39 (18.6)
<5 hours	20 (9.5)
Hours being in bed, n (%)	
>7 hours	87 (41.6)
6-7 hours	60 (28.7)
5-6 hours	38 (18.2)
<5 hours	24 (11.5)
Time usually take to fall asleep each night, n (%)	
< 15 minutes	74 (35.4)
16-30 minutes	87 (41.6)
31-60 minutes	40 (19.1)
> 60 minutes	8 (3.8)

relational quality, and ethical climate ($p < .05$). These results suggest that as work experience, social relational quality, and ethical climate improved, employees' sleep quality also tended to improve.

The results of this study indicated a significant relationship between global sleep quality and the subscales of social relational quality, including family intimacy and family commitment ($p < .05$). However, no significant correlation was found between global sleep quality and the friendship subscale ($p > .05$). Additionally, global sleep quality was significantly correlated with all subscales of ethical climate, including colleagues, doctors, hospital, and patients ($p < .05$). However, the association with the managers subscale was not significant ($p = .05$).

Predictors of sleep quality in employees of the operating room: A hierarchical linear regression analysis

As shown in Table 4, a hierarchical linear regression analysis was conducted to evaluate the predictors of global sleep quality among operating room employees. Based on Table 5, as sleep quality, social relational quality, and ethical climate Skewness and Kurtosis z-scores were between – 1.96 and 1.96, all variables had a normal distribution. Moreover, Kolmogorov-Smirnov tests confirmed normality for all variables ($p > .05$) and regression residuals ($p = .14$), satisfying parametric assumptions. The Durbin-Watson statistic was 1.86, indicating no autocorrelation in the residuals, as it falls within the acceptable range of 1.5–2.5. Additionally, collinearity diagnostics indicated no multicollinearity among independent variables, as the Variance Inflation Factor (VIF) for all variables was below 10 (Table 4). As shown in Table 4, step 1 containing work experience and professional role ($R^2 = 0.09$, $p < .001$). Both work experience in the operating room ($\beta = -0.22$, $p = .02$) and profession ($\beta = -0.24$, $p = .01$) were associated with global sleep quality.

In step 2, after incorporating social relational quality, the model explained an additional 5% of variance ($\Delta R^2 = 0.05$, $p < .001$). The results indicated that profession ($\beta = -0.40$, $p = .01$) and social relational quality ($\beta = -0.23$, $p = .01$) remained significant predictors of global sleep quality, while work experience was attenuated to marginal significant ($\beta = -0.17$, $p = .06$). Employees with better social relational quality and those in the physician profession reported better sleep quality.

In step 3, ethical climate was added to the model. The findings showed that profession ($\beta = -0.22$, $p = .02$) and social relational quality ($\beta = -0.20$, $p = .03$) continued to significantly predict global sleep quality. However, neither work experience ($\beta = -0.17$, $p = .07$) nor ethical climate ($\beta = -0.09$, $p = .30$) was a significant predictor in this step. The full model explained 15% of the variance in global sleep quality ($R^2 = 0.15$), with no significant improvement in variance explained from step 2 ($\Delta R^2 = 0.009$) (Table 4).

Discussion

Our findings showed that 59.1% of the participants reported poor sleep quality. Furthermore, this aligns with the findings from Ethiopia [41], suggesting that poor sleep quality is a widespread issue among healthcare workers.

Table 3 The correlation between sleep quality, work experience, profession, social relational quality, and ethical climate in the operating room employees

	Sleep quality	Work experience	Profession	Social relational quality	Ethical climate
Sleep quality	1				
Work experience †	- 0.16*	1			
Profession	−0.16*	−0.200*	1		
Social relational quality	−0.19**	0.12	0.08	1	
Ethical climate	−0.21**	0.07	0.21**	0.34**	1

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

† in the operating room

Table 4 Hierarchical linear regression analysis used to determine the predictor of sleep quality in operating room employees

Model[a]		Standardized Coefficients	*p*-value	95.0% CI[b] for B	R	R^2	ΔR2	F-change, *p*-value	Collinearity Statistics
		Beta							VIF
1	(Constant)		< 0.001	7.31 to 11.28	0.30	0.09			
	Work experience [c]	−0.22	0.02	−0.18 to −0.01					1.02
	Profession	−0.24	0.01	-2.16 to −0.30					1.02
2	(Constant)		< 0.001	10.46 to 22.94	0.38	0.14	0.05	6.13, 0.01	
	Work experience [c]	−0.17	0.06	−0.16 to 0.004					1.06
	Profession	−0.24	0.01	-2.11 to −0.29					1.02
	Social relational quality	−0.23	0.01	-0.24 to −0.02					1.03
3	(Constant)		< 0.001	11.11 to 24.03	0.39	0.15	0.009	1.05, 0.30	
	Work experience [c]	−0.17	0.07	−0.16 to 0.007					1.06
	Profession	−0.22	0.02	-2.03 to −0.17					1.06
	Social relational quality	−0.20	0.03	-0.23 to −0.007					1.12
	Ethical climate	−0.09	0.30	-1.64 to 0.52					1.13

[a] Dependent Variable: Sleep quality

[b] Confidence Interval

[c] in the operating room

Table 5 Normality testing for sleep quality, social relational quality, and ethical climate

Variables	Skewness	Std. error	Skewness z-scores	Kurtosis	Std. error	Kurtosis z-scores
Sleep quality	0.62	0.36	1.69	0.34	0.32	1.06
Social relational quality	−0.14	0.16	−0.87	−0.26	0.32	−0.81
Ethical climate	−0.48	0.28	−1.66	−0.45	0.36	- 1.25

Consistent with global trends, our study identified poor sleep quality among healthcare workers such as operating room employees, with a mean score of 6.70. However, disparities exist across parts of Iran; for instance, operating room employees in Hamedan, Iran, reported a worse sleep (mean score of 8.6) [42]. These variations suggest those institutional policies and regional and environmental factors may affect the sleep outcome, indicating the need for context-specific interventions.

Beyond overall sleep quality, our study examined subjective sleep quality. More than half of the operating room employees rated their sleep as "fairly good", while 16.8% stated very good sleep- a trend consistent with prior studies [8, 43]. In a study, it was stated that 30.9% of the health workers working in the hospital had "fairly good" subjective sleep quality and 37.8% had very good sleep [41]. The observed that sleep patterns likely result from distinct surgical workplace stressors, including (1) circadian rhythm disruption from artificial operating room lighting that suppresses melatonin production [44]; (2) elevated cortisol levels from procedural demands that impair deep sleep [45]; and (3) workplace cultures normalizing fatigue among surgical staff [46]. These factors contribute to the staff's acceptance of suboptimal sleep quality.

While 71.9% of the operating room employees slept more than 6 h a day, only 34.3% met the National Sleep Foundation (NSF)-recommended time, which is more than 7 h. This deficit contrasts with Chinese operating room workers, of whom only 19.1% slept more than 7 h at night [8]. In addition, a study in Ethiopia showed that 70.3% of operating room and ICU employees were in bed for more than 6 h a day. The guidelines of the (NSF) recommend that adults aged 18 to 64 should sleep 7 to

9 h at night and sleeping for less than 6 h can negatively affect their health and well-being [47]. While our results showed better sleep duration than some Asian reports [8], 28.1% of the operating room staff sleep < 6 h, and it remains a concern given NSF guidelines [47], which requires further attention. These findings highlight the need for workplace interventions like optimized shift scheduling and controlled light exposure in surgical environments.

A majority of operating room employees (77%) took less than 30 min to fall asleep, mirroring findings from Ethiopia (68%) [43]. While the percentage of operating room employees who took more than 30 min to fall asleep in our study is comparable to the Ethiopian study, notable differences were observed. These discrepancies could be attributed to various factors, including cultural, environmental, and occupational differences between the two settings. This highlights the importance of considering contextual influences when examining sleep patterns in healthcare workers, suggesting that cultural and workplace factors may play a significant role in shaping sleep behaviors. Moreover, differences in shift policies, work culture, sleep hygiene education, or regulatory frameworks might affect sleep patterns. By addressing these factors, our study contributes to a deeper understanding of the diverse influences on sleep quality among healthcare professionals, filling a gap in existing literature.

The standardized ethical climate score (3.40) indicated that the operating room employees perceived stronger ethical climate provided by managers than from the hospital- a trend also observed in Shiraz, Iran. In that study, the researchers showed that the best score of the dimensions was related to colleagues and the lowest score belonged to the hospital [5]. Interestingly, while ethical climate did not significantly predict sleep quality in our model, prior research links moral distress to sleep disturbance [12], suggesting that its influence may be indirect.

Our study revealed that the mean score for social relational quality among operating room employees was 54.80, which indicates a favorable level of interpersonal relationships within the work environment. This finding is consistent with previous research that highlights high levels of professional communication among operating room nurses [2]. However, to the best of our knowledge, no studies have specifically examined social relational quality among operating room employees. This gap in the literature suggests that our study contributes new insights into the importance of social relations in this critical healthcare setting. The favorable social relational quality observed in our study can be indicative of positive workplace and family dynamics, which could potentially influence other aspects of employees' well-being, including sleep quality. Further research is needed to explore these relationships more thoroughly.

Operating room employees with greater work experience reported better sleep. Additionally, medical specialties had superior sleep quality compared to nurses and technicians. Similarly, prior research which has utilized multiple regression analysis identified years of work experience as a significant predictor of insomnia among nurses [48]. Another study found that older participants with greater work experience reported improved working conditions and stronger management support [49]. Furthermore, research indicated that nurses working in operating rooms and ICUs with extended work hours experienced poorer sleep quality [43]. Conversely, a study conducted in Ethiopia on operating room staff revealed no significant association between job roles within the operating room and sleep quality, suggesting that the specific professional roles in this setting did not influence sleep outcomes [41]. The findings offered new insights into the relationship between work experience and sleep quality, highlighting that greater experience could predict sleep in some contexts, such as operating room. These findings contribute to a nuanced understanding of how occupational and environmental factors interact to affect one of the dimensions of the operating room well-being named sleep quality.

While work experience was linked to better sleep, another critical factor was the social relational quality, operating room employees with greater social relational quality reported better sleep quality. Furthermore, social relational quality was a predictor of sleep quality. In the second step of hierarchical linear regression analysis, social relational quality had a significant proportion of the variance of sleep quality (5%). In addition, operating room employees with higher family intimacy and commitment reported better sleep quality, aligning with previous research that showed that family relationships influence sleep quality [50]. Negative family dynamics were correlated to poor sleep quality [51], while family support was identified as a predictor of insomnia. The nurses perceiving greater family support experienced less insomnia [48, 52]. The number of supportive ties was associated with better sleep quality, whereas a higher number of bad ties were associated with poorer sleep quality [53]. Sleep problems are exacerbated when family relationships are extremely strained and provide insufficient emotional support. Family strain is also more harmful to sleep among those in frequent contact with family members [54]. Family functions such as communication, problem-solving ability, conflict management, and emotional attachment [6] may significantly affect sleep outcomes. Besides family relations, friends who could be coworkers might affect the sleep quality. Researchers highlighted the positive impact of supportive managers, effective nurse-physician relationships [55], and strong

colleagues and manager relationships on improving sleep quality [56].

In the present study, operating room employees who perceived a better ethical climate reported improved sleep quality. The participants with strong ethical relationships with their colleagues, patients, hospitals, and physicians also experienced better sleep outcomes. Moreover, 1% of the change in sleep quality was related to the ethical climate. These findings align with previous research that identified a link between nurses' moral distress and components of sleep quality such as sleep disturbance and daytime dysfunction [12]. Additionally, broader research across 25 counties indicated that negative emotions related to ethical and environmental challenges, such as climate change, were associated with insomnia and mental health issues [57]. Trust in colleagues has also been shown to correlate with perceptions of ethical climate [58], underscoring the importance of workplace ethical relationships in influencing sleep quality.

Although we hypothesized that ethical climate was a significant predictor of sleep quality, it did not enhance the predictive model in Step 3 of our analysis. One possible explanation is that the impact of ethical climate on sleep quality may be indirect, with other factors—such as workplace stress or individual coping strategies—acting as mediators, thereby reducing its direct effect in our model. Furthermore, the tools used to assess ethical climate in this study may not have fully captured its subtle influences on sleep quality. Future investigations should consider using different methods to measure ethical climate and examine additional variables that could clarify its potential impact on sleep outcomes.

Clinical and practical implications and future studies

Our model explained 15% of sleep quality variance, suggesting that unmeasured factors (e.g. psychological or organizational factors, and methodological limitations such as sample size or measurement tools) play a role. Future research should address these gaps by including additional variables, refining measurements, and using larger, more diverse samples to enhance the robustness and explanatory strength of the model.

With one-third of employees sleeping less than 6 h and 59% reporting poor sleep quality, hospitals must prioritize structural changes to shift scheduling. Given that rotating shifts can negatively affect the employees' quality of sleep, operating room managers or supervisors need to perform interventions to improve these hospital employees' quality of sleep. Regular sleep assessments and tailored support can help address sleep disturbances and enhance both employee well-being and ethical climate.

Operating room managers or supervisors should recognize that poor sleep quality was a significant issue among these employees. The study highlighted that poor sleep was influenced by such factors as limited rest hours and strained social relational quality. To address this, operating room management teams should implement policies promoting work-life balance, such as flexible schedules and reduced overtime, while fostering a supportive work culture that strengthens interpersonal relationships. Providing education on sleep hygiene, with regular monitoring for sleep-related issues, can further support the staff. Since family relationships also emerged as protective, employee wellness programs should expand to include family sleep education sessions and couples counseling referrals. Additionally, investing in research to develop evidence-based interventions ensures sustainable improvements in operating room employees and their workplace outcomes such as the ethical climate. Furthermore, these results highlight critical gaps in understanding operating room professionals' sleep patterns. Subsequent investigations should adopt integrated approaches assessing biological, mental health, and workplace factors through extended observation periods. A priority research area involves examining the combined effects of institutional ethics policies and shift rotation systems on staff rest patterns - an interaction our current design could not adequately assess. Bridging these knowledge gaps will enable creation of precise strategies that enhance both employee rest and clinical outcomes.

Limitations

The cross-sectional nature of the study is one of its limitations. Evaluating the sleep quality of the operating room employees and the factors affecting it in the long term provides more information. Because the study investigated the relationship between the variables, the cause-and-effect relationship cannot be considered between the profession, ethical climate, and social relation quality with the quality of sleep in the operating room employees. In addition, 85% of the factors associated with sleep quality are unknown and should be identified in other studies. The study limitations also include the reliance on self-reported data, which may introduce social desirability bias and affect the accuracy of the findings. Additionally, the results may have limited generalizability to other settings or populations, emphasizing the need for caution when applying these findings more broadly. Another limitation was a relatively small sample size ($n = 232$), which limited generalizability and reduced statistical power. It increased the risk of Type Π errors (i.e. failing to find true relationships between variables). As a result, some potential effects may not have been observed, particularly in more complex models where smaller effect sizes may require larger samples to achieve adequate power. Furthermore, samples may not fully represent the broader

population, limiting the extent to which these findings can be applied to deferent organizational and demographic contexts. Therefore, the study should acknowledge its limitation and recommend future research with a larger and more diverse sample to strengthen the reliability and generalizability of the results.

Conclusion

In summary, poor sleep quality among operating room employees was influenced by work experience, profession, social relational quality, and ethical climate. Addressing these factors through targeted interventions could improve overall well-being. Furthermore, given that poor sleep quality affects a majority of operating room employees; interventions must address key predictors like social relational quality and profession-specific stressors. Therefore, improving family intimacy, family commitment, and friendships may be effective in improving the quality of sleep. Healthcare institutions should consider implementing strategies that improve the employees' social relational quality and sleep quality. Strengthening workplace relationships, fostering a supportive environment by friends and family, and promoting work-life balance may help reduce sleep disturbances. Further studies should explore how organizational policies, work culture, and ethical climate influence the employees' sleep patterns. Longitudinal research can help determine whether changes in workplace dynamics lead to long-term improvements in sleep quality.

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Authors' contributions
MR, NP, AA, MS participated in conceptualization of this study. AA participated in management of the data collection. MR, AA and MS conducted the management of the data analysis. All authors participated in writing and approving the original draft of the manuscript.

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Data availability
The data of this study will be available by email to Masoume Rambod.

Declarations

Ethics approval and consent to participate
Research Ethics Committees of Schools of Nursing and Midwifery, Management and Medical Information Science-Shiraz University of Medical Sciences (IR.SUMS.NUMIMG.REC.1402.130, approval date: 2024-01-06) approved this study. The study was conducted based on the Declaration of Helsinki. The questionnaires were completed anonymously by the operating room employees. The written consent form to participate in this study was obtained from the operating room employees. All of them signed the consent form. It was approved that this consent was informed.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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