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Latent profile analysis of factors influencing sleep quality in ICU nurses cross-sectional study

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This study aims to identify the potential classifications of sleep disturbances within the ICU nurse population, and to compare the between-group differences in demographic data and sleep characteristics. Through convenience sampling, ICU nurses from three tertiary A-level hospitals in China were selected as research subjects from March to May 2024. A survey was conducted using a demographic data questionnaire, the PSQI scale, the DASS-21 scale, and the BPS scale, and the data on the sleep quality of ICU nurses was collected via electronic questionnaires. This research also utilized latent class analysis to examine the symptomatic traits of sleep quality in ICU nurses. Additionally, it applied univariate analysis and unordered multinomial logistic regression models to determine the factors influencing the various categories of their sleep quality. A total of 545 questionnaires were distributed, of which 522 were validly returned, yielding an effective response rate of 95.7%. Four potential sleep quality profiles were identified, including "high sleep quality - no sleeping pills," "medium sleep quality - low sleeping pills," "medium sleep quality - medium sleeping pills," and "low sleep quality - high sleeping pills," with proportions of 43.7%, 40.6%, 10.5%, and 5.2%, respectively. Unordered multinomial logistic regression analysis indicated that the number of night shifts per week, marital status, BPS scores, FSS scores, and DASS-21 scores were key factors affecting the sleep quality classification of ICU nurses($P < 0.05$). The sleep quality characteristics of ICU nurses are diverse and can be divided into four different categories. Therefore, nursing managers should be aware of this heterogeneity and take corresponding intervention measures based on the classification of nurses to ensure their sleep quality and promote psychological health.

Keywords Nurse, Sleep quality, Latent profiles, ICU, Pittsburgh sleep quality index

Abbreviations

ICU	Intensive Care Unit
LCA	Latent Class Analysis
LCM	Latent Class Models
GCP	Good Clinical Practice
GICU	General ICU
MICU	Medical ICU
SICU	Surgical ICU
EICU	Emergency ICU
PSQI	Pittsburgh Sleep Quality Index
FSS	Fatigue Severity Scale
DASS-21	Depression Anxiety and Stress Scale
BPS	Bedtime Procrastination Scale
LL	likelihood
AIC	Akaike information criterion
BIC	Bayesian information criterion
aBic	adjusted Bayesian information criterion
LMR	LoMendell-Rubin adjusted likelihood ratio test
BLRT	Bootstrapped likelihood ratio test

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Sleep is an essential physiological need for nurses, their sleep quality is directly linked to the quality of nursing care and the recovery status of patients[1]. It has been documented that nurses often experience poor sleep, particularly in major hospitals. In China, a study involving approximately 27,000 nurses found that nearly 47% of nurses get less than 7 h of sleep per day, and about 28% of nurses are dissatisfied with their sleep duration[2]. Similarly, in Taiwan, 248 out of 435 nurses (57.0%) experienced poor sleep[3], and in Norway, between 32.4% and 37.6% of 1968 nurses reported symptoms of sleepiness and insomnia[4]. A meta-analysis, which integrated 53 studies on nurse sleep quality, found that the overall quality of sleep among nurses worldwide is poor, with an overall detection rate of sleep disorders at 61.0%[5].

Nurses in intensive care unit (ICU) face unique challenges, including managing the observation and rescuing of critical ill patients. They often encounter critically ill or complex cases, which can lead to fast-paced work environments and high mental stress. As a result, ICU nurses may be more prone to poor sleep compared to other groups. Multiple studies indicate that the sleep quality of ICU nurses is generally poor. For instance, research has found that compared to the general population, ICU nurses have significantly higher rates of sleep disorders, characterized by difficulties falling asleep, sleep interruptions, and poor sleep quality[6]. These issues primarily stem from the irregularity of their work schedules and high levels of stress, such as long hours of night shifts and frequent rotation shifts. Night shifts disrupt normal circadian rhythms, making it difficult for nurses to obtain adequate rest during the day or at night, thereby affecting their sleep quality and depth[7,8]. ICU nurses often face high levels of emotional and psychological stress at work, as they must deal with emergencies and sudden changes in patient conditions. These psychological pressures not only increase their workload but also directly impact their mental state and emotional health, consequently affecting their sleep quality[9,10]. Sleep disorders not only diminish the personal life quality of ICU nurses but may also significantly affect their job performance. Studies indicate that inadequate sleep and fatigue can reduce nurses' work efficiency, increase the risk of medical errors, and potentially affect patient safety and treatment outcomes[6,11].Latent Class Analysis (LCA) is a method that utilizes Latent Class Models (LCM) to explore the relationships between manifest categorical variables[12].

This approach sets up internal latent class variables to reveal the connections between manifest variables while ensuring the conditional independence among these variables, facilitating statistical analysis of these variables. Its statistical foundation lies in multivariate probability analysis. This research evaluates the sleep quality of ICU nurses by utilizing the LCA method to pinpoint factors that affect their sleep, with the goal of aiding hospital management and health policymakers in creating strategies to improve nurses' work efficiency, quality of life, and the overall quality of nursing care.

Methods

Participants

The study has been approved by the hospital ethics committee, with the ethics approval number KY2024130. Also has been registered in the China Medical Research Registration Information System, with the filing numberMR-33-24-035208. All methods of this study were conducted in accordance with the guidelines and regulations of the Good Clinical Practice (G**CP)** Committee of our institution. A survey was conducted among in-service clinical nurses from three Grade A tertiary comprehensive hospitals in China from March to May 2024. Participants in the survey were required to meet the following criteria: ① In-service nurses in the ICU; ② Participants volunteered to take part in the study. Exclusion criteria were: ① Nurses who were not working in the hospital due to illness, maternity leave, or training outside the hospital during the survey period; ② Nurses undergoing training in other hospitals; ③ Nurses who were pregnant or lactating; ④Nursess who have been using sleep aids long-term.

This study employed the formula for calculating the overall rate $n = \frac{Z^2 \cdot P \cdot (1-P)}{d^2}$, with the Z-value corresponding to the confidence level set at 1.96 (95% confidence interval). The expected prevalence rate (p) was 60%[6], the allowable margin of error (d) was 0.05, and aapproximately 20% of the samples may be lost. The calculated sample size was 422 cases.

Research tools

General information questionnaire

This questionnaire includes gender, age, educational level, marital status, professional title, department of General ICU(GICU), Medical ICU(MICU), Surgical ICU(SICU) and Emergency ICU(EICU), years of work experience, years of ICU work experience, number of night shifts per week, etc.

Pittsburgh sleep quality index (PSQI)

The PSQI was an assessment tool developed by Buysse[13] in the Department of Psychiatry at the University of Pittsburgh in 1989. It is widely used to evaluate the sleep status of patients with sleep disorders, mental health issues, and the general population. The PSQI consists of 9 items, with the first 4 being open-ended questions and the remaining 5 being multiple-choice questions, including 10 sub-questions for the 5th item. The scale comprises 7 dimensions: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Scores for each dimension range from 0 to 3, with higher scores indicating poorer sleep quality. Zheng et al.[14] reported that the Cronbach's alpha coefficient of the PSQI questionnaire was 0.734.

Fatigue severity scale (FSS)

The FSS was an internationally recognized scale for measuring fatigue severity. Developed by Krupp[15] and colleagues in the United States in 1989, it consists of 9 items rated on a scale from 1 to 7, representing responses from strongly disagree to strongly agree. Initially designed to assess fatigue in patients with conditions such as

systemic lupus erythematosus and multiple sclerosis, the FSS has demonstrated high internal consistency and sensitivity. The Chinese version of the FSS demonstrates strong internal consistency, with a Cronbach's alpha coefficient of 0.934, as reported by Wu et al.[16].

Depression anxiety and stress scale (DASS-21)

DASS-21 is a self-report questionnaire originally developed by Lovibond[17] et al. in 1995. The scale comprises 21 items across three dimensions: depression, anxiety, and stress, with 7 items for each dimension. Responses are scored on a 4-point scale from "0" (did not apply to me at all) to "3" (applied to me very much, or most of the time). Scores for each dimension are multiplied by 2, with higher scores indicating higher levels of the corresponding emotional state.The psychometric study of the DASS-21 in Chinese college students demonstrated that the scale validated by Wang et al.[18]exhibits satisfactory reliability. The internal consistency coefficients (Cronbach's α) were 0.83 for the Depression subscale, 0.80 for the Anxiety subscale, 0.82 for the Stress subscale, with the total scale achieving a Cronbach's α of 0.92.

Bedtime procrastination scale (BPS)

The BPS developed by Kroese[19] et al., consists of 9 items rated on a 5-point Likert scale, ranging from "almost never" to "almost always." Items 2, 3, 7, and 9 are reverse-scored. The scale's total score is calculated as the average score, ranging from 1 to 5, with higher scores indicating more severe bedtime procrastination behavior[20]. The Chinese version of the FSS exhibits excellent internal consistency with a Cronbach's alpha coefficient of 0.91[20].

Data collection

After obtaining informed consent from the participating hospitals, the research team conducted the survey following the procedure outlined below: ①the research leaders at each participating hospital disseminated the survey link to members of the nursing management hierarchy via WeChat groups. Before participating in the survey, ICU nursing staff were provided with clear explanations of the research objectives, participation requirements, and their rights, and their informed consent was obtained; ② To ensure the accuracy of the survey questionnaire, standardized guidance language was used during the survey. This helped in minimizing misinterpretations and ensuring consistency in responses; ③Electronic Questionnaire System: To prevent missing answers or duplicate responses, an electronic questionnaire system was utilized. This system included features such as mandatory questions, prompts, and limitations on the number of responses; ④The questionnaire is distributed daily from 14:00 to 15:00. It takes approximately 10 min to complete and does not interfere with nurses' sleep schedules. Additionally, the system automatically excluded invalid questionnaires that did not meet the inclusion criteria, had excessively short response times, or exhibited patterns of regular responses. Also, the system included a basic information screening. Nurses who have been using sleep aids for an extended period prior to their work are excluded from the sleep disorder survey To improve nurses' participation, the study provided a 24-hour psychological counseling hotline and issued continuing education credits. These methods were implemented to enhance the quality and reliability of the data collected during the survey process.

Statistical methods

Latent Class Analysis (LCA) using Mplus Software[21] the LCA model was constructed using Mplus software. Model fit was evaluated using the following indicators: log likelihood (LL), Akaike information criterion (AIC[22]), Bayesian information criterion (BIC[23]), and adjusted Bayesian information criterion (aBIC)[23]. Lower values of these indicators indicate better model fit. LoMendell-Rubin adjusted likelihood ratio test (LMR) and Bootstrapped likelihood ratio test (BLRT) were utilized to assess differences in model fit between different models. A p-value less than 0.05 suggests that a k-class model has a better fit than a k-1 class model. An entropy value greater than or equal to 0.8 suggests high classification accuracy.

Statistical Analysis using SPSS 27.0 Software. For continuous variables following a normal distribution, t-tests were conducted using mean and standard deviation, and for categorical variables, frequency and percentage were used for representation, and chi-square tests were performed. Multivariable logistic regression analysis was conducted using significant variables identified in the univariate analysis as independent and covariate variables, with the results of latent class analysis as the dependent variable. This analysis explored the associations between different latent classes and significant variables. Emphasis was placed on statistically significant indicators to identify factors influencing the latent classes of sleep dysfunction among ICU nurses. $P<0.05$ was considered statistically significant.

Results

A total of 545 questionnaires were distributed in this study, with 522 valid responses, yielding a 95.7% response rate. The results indicate that the average PSQI score among ICU nurses was (7.94 ± 3.06), with 66.09% of nurses having a PSQI total score ≥ 7. The mean age of the 522 participating nurses was (29.87 ± 4.85) years. Further general information is provided in Table 1.

In exploring sleep dysfunction among ICU nurses through latent profile analysis, the study utilized the seven dimensions of PSQI as indicators, examining 1 to 5 different latent profile models (refer to Table 2). Across models 1 to 5, as the number of profiles increased, AIC, BIC, and aBIC values showed a decreasing trend, with entropy values exceeding 0.900. When selecting the fourth latent profile, entropy was closest to 1 (0.998), and the decreasing trends of AIC, BIC, and aBIC slowed down. Both LMRT and BLRT showed significant p-values, indicating that the model with four-profile better reflected classification information with higher reliability than other models. Considering the above, the four-profile model was chosen.

The distribution of latent profiles is shown in Fig. 1. According to the results, the sleep quality decreases sequentially in the C1-C4 models, and the use of sleep medications decreases in the order C1, C3, C2, and C4.

Variable	C1($n=228$)	C2($n=212$)	C3($n=55$)	C4($n=27$)	Estimates	p
Gender						
Male	32(14.04%)	21(9.91%)	5(9.10%)	3(11.11%)	2.381[a]	0.497
Female	196(85.96%)	191(90.09%)	50(90.90%)	24(88.89%)		
Night shifts per week						
0	11(4.82%)	11(5.19%)	6(10.91%)	1(3.70%)	40.569[b]	< 0.001
≤ 2	195(85.53%)	158(74.53%)	42(76.36%)	25(92.60%)		
≥ 3	22(9.65%)	43(20.28%)	7(12.73%)	1(3.70%)		
Educational Background						
Associate's Degree	35(15.35%)	38(17.92%)	8(14.55%)	3(11.11%)	10.502[b]	0.083
Undergraduate	190(83.33%)	173(81.61%)	45(81.82%)	24(88.89%)		
Master's Degree	3(1.32%)	1(0.47%)	2(3.63%)	0(0%)		
Professional Title						
Junior Nurse	51(22.37%)	33(15.57%)	6(10.91%)	2(7.41%)	15.318[b]	0.016
Senior Nurse	95(41.67%)	108(50.94%)	23(41.82%)	24(88.89%)		
Supervisor Nurse	79(34.65%)	68(32.08%)	24(43.63%)	1(3.70%)		
Associate Senior Nurse and above	3(1.31%)	3(1.41%)	2(3.64%)	0(0%)		
Department					38.816[b]	< 0.001
MICU	35(15.35%)	34(16.04%)	11(20.0%)	4(14.82%)		
SICU	15(6.58%)	2(0.94%)	2(3.64%)	0(0%)		
GICU	129(56.58%)	138(65.10%)	29(52.73%)	15(55.56%)		
EICU	49(21.49%)	38(17.92%)	12(21.82%)	8(29.63%)		
Marriage						
Married	117(51.32%)	147(69.34%)	40(72.73%)	20(74.07%)	29.144[a]	< 0.001
Unmarried	111(48.68%)	65(30.66%)	15(27.27%)	7(25.93%)		
Age	29.61 ± 4.94	29.91 ± 4.72	31.13 ± 5.11	31.89 ± 4.87	2.868[c]	0.036
work experience	7.50 ± 5.41	7.63 ± 4.49	9.06 ± 4.91	9.19 ± 5.41	2.208[c]	0.086
work experience of ICU	6.57 ± 2.87	5.68 ± 3.97	4.43 ± 3.07	5.81 ± 4.15	0.947[c]	0.418

Table 1. Demographic information of survey subjects and univariate analysis of potential profiles of sleep quality. a: χ^2; b: Fisher; c: F.

Model	AIC	BIC	ABIC	Entropy	LMR	BLRT	Percentage (%)
1	8519.99	8579.598	8535.159	—	—	—	100
2	7376.911	7470.58	7400.747	0.967	0.4316	< 0.0001	54.2/45.8
3	7131.323	7259.053	7163.826	0.994	0.0004	< 0.0001	54.2/40.5/5.3
4	6883.556	7045.348	6924.727	0.998	0.0035	< 0.0001	43.7/ 40.6/10.5/5.2
5	6551.751	6747.603	6601.589	0.997	0.1543	< 0.0001	10.5/43.7/36.0/4.6/5.2

Table 2. Model fit information for potential profiles of nurse sleep quality model.

Therefore, they are named accordingly.: "High Sleep Quality - No Sedatives," "Moderate Sleep Quality - Low Sedatives," "Moderate Sleep Quality - Moderate Sedatives," and "Low Sleep Quality - High Sedatives," comprising 228, 212, 55, and 27 nurses, respectively, with proportions of 43.7%, 40.6%, 10.5%, and 5.2%.

In the univariate analysis, differences among nurses in different categories were statistically significant ($P < 0.05$) for age, number of night shifts per week, professional title, department, marital status, BPS, FSS, and DASS-21 scores. The C4 group exhibited the highest proportion of nurses experiencing sleep disorders among married individuals, those working in comprehensive ICUs, nurses with professional titles, and those working ≤ 2 night shifts per week, with corresponding rates of 74.07%, 55.56%, 88.89%, and 92.60% respectively. Additionally, this group demonstrated a higher average age (31.89 ± 4.87 years) compared to the other three groups.For detailed information, refer to Tables 1 and 3.

Variables identified as statistically significant in the univariate analysis were defined as independent variables in the multivariate analysis. The latent profile of sleep quality was treated as the dependent variable, and unordered multi-category logistic regression analysis was performed. The dependent variable was assigned values as follows: "High Sleep Quality - No Sedatives," "Moderate Sleep Quality - Low Sedatives," "Moderate Sleep Quality - Moderate Sedatives," and "Low Sleep Quality - High Sedatives," designated as 1, 2, 3, and 4, respectively. Independent variable assignments are provided in Table 4. Age, BPS score, FSS score, and DASS-21 score were included in their original values. The results of the logistic regression analysis indicate that compared to C1, nurses in C3, C2, and C4 with lower DASS-21 scores are more likely to be categorized as "High Sleep

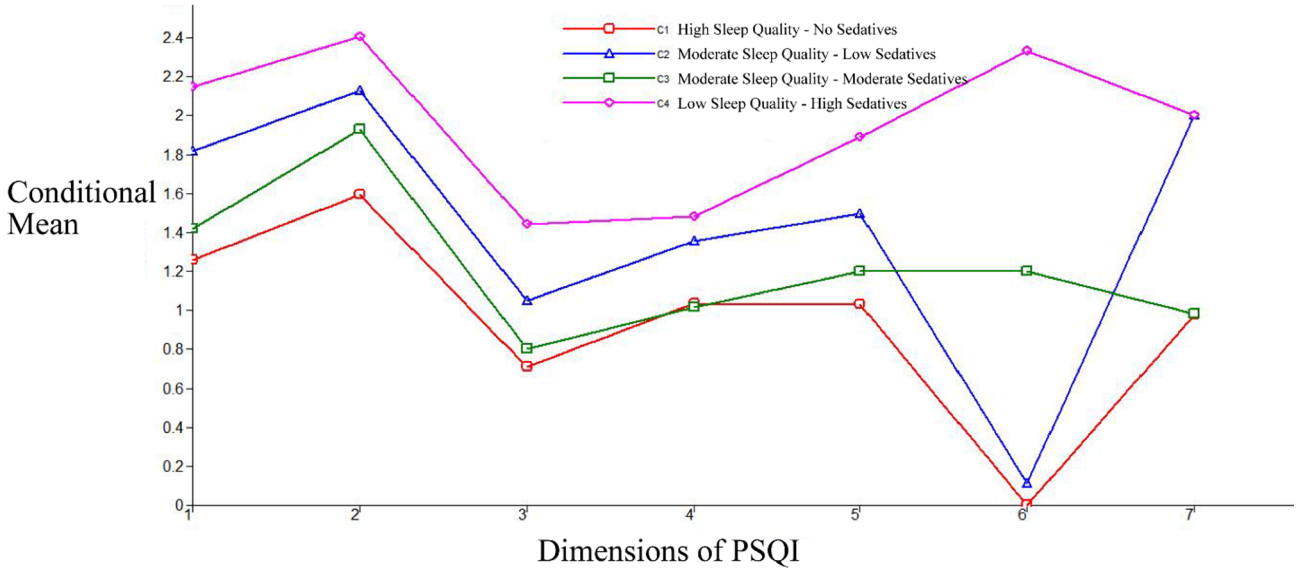

Fig. 1. Distribution of characteristics of 4 potential profiles of ICU nurse sleep quality.

Variable	C1 ($n=228$)	C2 ($n=228$)	C3 ($n=55$)	C4 ($n=27$)	F	*P*
BPS	24.55 ± 6.34	28.82 ± 6.47	25.19 ± 7.29	30.0 ± 7.71	10.075	< 0.001
FSS	39.88 ± 11.39	49.89 ± 11.75	41.70 ± 14.11	55.06 ± 12.76	19.056	< 0.001
DASS-21	20.61 ± 20.15	47.85 ± 30.77	32.80 ± 28.52	59.56 ± 39.86	45.234	< 0.001

Table 3. Comparison of FSS, DASS-21, and BPS scale scores across different potential profiles.

Variable	Assignment
Night shifts per week	0 = 1, ≤ 2 = 2, ≥ 3 = 3
Professional Title	Junior Nurse = 1, Senior Nurse = 2, Supervisor Nurse = = 3, Associate Senior Nurse and above = 4
Department	MICU = 1.SICU = 2, GICU = 3, EICU = 4
Marriage	Married = 1, Unmarried = 2

Table 4. Assignment of independent variables.

Quality - No Sedatives" (OR = 1.722, 2.581, 5.078). Similarly, nurses in C2 and C4 with lower FSS scores are also more likely to fall into the "High Sleep Quality - No Sedatives" category (OR = 1.043, 1.070). Furthermore, compared to C1, nurses in C2 with lower BPS scores are more likely to be classified as "High Sleep Quality - No Sedatives" (OR = 1.057). Nurses in C4, C2, and C3 who work fewer than two night shifts per week are also more likely to belong to the "High Sleep Quality - No Sedatives" group compared to those in C1 (OR = 0.163, 0.170, 0.269). Finally, unmarried nurses in C2 and C3 are more likely to be classified as "High Sleep Quality - No Sedatives" compared to those in C1 (OR = 1.993, 2.532), as shown in Table 5.

Discussion

This study found that ICU nurses experienced poor sleep quality, with a significant proportion of them having PSQI scores indicating disturbed sleep. When compared with similar research[24], it was evident that ICU nurses' sleep quality was a common concern across different regions and hospital types. Despite variations in specific scores, both studies highlight the widespread issue of sleep quality among nurses, emphasizing the need for interventions to improve their overall well-being and quality of life.

We discovered that nurses with lower DASS-21 scores were more readily categorized as having "High Sleep Quality - No Sedatives". A lower total DASS score is associated with better emotional and work life, leading to better sleep quality[25]. However, higher stress levels among nurses were associated with poorer sleep quality[26]. Depression, anxiety, and stress are usually interrelated mental health issues. ICU nurses face highly stressful work environments and need to deal with rapidly changing patient conditions. The results of this study also confirmed that patients with higher DASS scores have poorer sleep quality, showing a negative correlation between the two. This work pressure and patient care burden may lead to higher levels of anxiety and stress among nurses, indirectly affecting their sleep quality through physiological mechanisms such as the neuroendocrine and

Variable	C2($n=212$)			C3($n=55$)			C4($n=27$))		
	OR值	95%CI	P值	OR值	95%CI	P值	OR值	95%CI	P值
BPS	1.057	1.035 ~ 1.08	< 0.001	0.976	0.947 ~ 1.005	0.107	0.996	0.955 ~ 1.039	0.847
FSS	1.043	1.03 ~ 1.056	< 0.001	0.993	0.977 ~ 1.008	0.361	1.07	1.036 ~ 1.106	< 0.001
DASS-21	2.581	2.089 ~ 3.189	< 0.001	1.722	1.267 ~ 2.342	0.001	5.078	3.45 ~ 7.475	< 0.001
Night shifts per week									
01)	0.844	0.302 ~ 2.421	0.769	0.131	0.032 ~ 0.544	0.005	0.138	0.433 ~ 2.050	0.882
≤ 22)	0.170	0.109 ~ 0.265	< 0.001	0.269	0.137 ~ 0.527	< 0.001	0.163	0.74 ~ 0.359	< 0.001
Married	2.532	1.814 ~ 3.533	< 0.001	1.993	1.214 ~ 3.272	0.006	1.049	0.526 ~ 2.095	0.892
Department									
MICU3)	1.295	0.71 ~ 2.361	0.399	0.94	0.433 ~ 2.04	0.876	0.596	0.183 ~ 1.939	0.390
SICU4)	0.194	0.057 ~ 0.654	0.008	0.875	0.332 ~ 2.305	0.787	1.11	0.908 ~ 1.349	0.319
GICU5)	1.277	0.964 ~ 1.693	0.089	0.866	0.577 ~ 1.3	0.488	0.561	0.329 ~ 0.956	0.033

Table 5. Multifactor analysis of the four potential profiles of ICU nurse sleep quality. C2, C3, and C4 all use C1 as the reference group.1)Compared to having more than 3 night shifts per week, having 0 night shifts is used as the reference group; 2) Compared to having more than 3 night shifts per week, having ≤ 2 night shifts is used as the reference group; 3) Compared to the emergency ICU, the MICU is used as the reference group; 4) Compared to the EICU, the SICU is used as the reference group; 5) Compared with the EICU, the GICU served as the reference group.

immune systems, thus affecting sleep quality[27]. Managers should focus on identifying signs of suboptimal health among nurses, provide stress management programs to help them cope with work-related stress and improve sleep quality. Additionally, enhancing psychological health education can raise ICU nurses' awareness of fatigue management and sleep hygiene, while encouraging them to adopt healthier lifestyles.

Categorization of nurses with lower BPS scores as having "high sleep quality - without hypnotic drugs" was more prevalent. This aligns with Zhou et al.[1] et al.'s findings that ICU nurses had an average bedtime procrastination score. Dutch scholars, led by Kroese et al. in 2014[19], conducted the inaugural study on bedtime procrastination. This term describes the common inability to go to bed and fall asleep at a planned time without external disturbances. Excessive use of phones at night can postpone the release of melatonin, reducing its levels in the body. This can lead to difficulties in falling asleep, vivid dreams, poorer sleep quality, and even sleep disorders[28].To address this issue, healthcare institutions can support ICU nurses in managing their sleep more effectively by offering sleep health education, which can help reduce sleep procrastination behavior.

The greater the number of night shifts one works, the lower the quality of sleep tends to be. The research[11] conducted a survey of 746 nurses and found that the symptoms of shift work sleep disorder were directly related to the number of past night shifts, which is consistent with the findings of this study. In addition to interfering with the biological clock, night shift work may also increase psychological and emotional stress for nurses[1], leading to sleep problems[29]. Research indicates that the use of sleeping pills is a risk factor for sleep disorders, though the exact mechanism is currently unclear[25]. It may be because sleeping pills are primarily used for the specific treatment of sleep disorders, but they can interfere with sleep quality to a certain extent, causing sleep cycle disruptions.

This study's results indicate that compared to C1, the higher proportion of unmarried nurses in C2 and C3, the greater the probability of being categorized as "high sleep quality - no sleeping pills". The research indicates that unmarried nurses generally have better sleep quality[20], which is consistent with the findings of this study. Previous studies[30,31] have often focused on self-care aspects, which to some extent support the argument of this study. The analysis suggests that unmarried nurses tend to focus more on their career development and personal achievements, generally exhibiting higher levels of job satisfaction, which contributes to improving sleep quality[32,33]. To address this issue, nursing managers should not only focus on nursing quality and work attitude but also promptly identify nurses' family situations and provide assistance to those in need.

Building on the findings of this study, several recommendations are made to optimize nurses' sleep quality: implement a "sleep-friendly scheduling system," limiting night shifts to no more than two per week, with at least a 48-hour gap between shifts; introduce a team rotation system to ensure nurses have adequate rest after night shifts; equip nurses' rest areas with smart light-blocking systems and develop a sleep monitoring app specifically for nurses, incorporating the results into the scheduling process; provide training and resources on sleep hygiene and strategies for managing circadian rhythm disruptions, enabling nurses to adopt effective practices for improving their sleep.These measures aim to reduce the occurrence of sleep disorders and enhance overall sleep quality for nurses.

Conclusion

This study tracked and analyzed the sleep quality of ICU nurses, categorizing them into four potential groups: high sleep quality - no sleeping pills, moderate sleep quality - low sleeping pills, moderate sleep quality - moderate sleeping pills, and low sleep quality - high sleeping pills. This finding reveals the existence of varying sleep qualities among ICU nurses. Specifically, compared to those with high sleep quality - no sleeping pills, nurses with low sleep quality - high sleeping pills are more likely to experience persistent fatigue.

Limitation

Although this study is a cross-sectional survey, it has limitations in revealing causal relationships between variables. First, the cross-sectional design restricts our ability to establish causal relationships between the variables. The study sample was limited to nurses from a single region, all of whom worked an 8-hour rotating shift system, which restricted the analysis of how different shift lengths, particularly night shifts, might affect sleep quality. Additionally, the use of self-report questionnaires introduces the potential for recall bias. Furthermore, the study focused exclusively on ICU nurses, excluding those from other departments, such as emergency, general, and outpatient services. These factors may limit the generalization of the findings and their applicability to nurses in other wards or geographical regions.Future research should consider conducting longitudinal cohort studies or intervention studies to create better sleep environments for clinical nursing staff.

Data availability

Data is provided within the supplementary information files.

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Author contributions

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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