BMC Nursing

RESEARCH

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Analysis of poor work postures during morning care operations of intensive care unit nurses: a field research

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Abstract

Background Poor working postures in morning care operations contribute significantly to work-related muscle fatigue and low back pain among ICU (Intensive Care Unit, ICU) nurses. However,there are few field studies on the relationship between Poor working postures and work-related muscle fatigue, low back pain among ICU nurses.

Objective This study aims to assess the frequency and degree of posture hazards associated with poor working postures during morning care operations of ICU nurses.

Methods Two ICUs in a Grade-A tertiary hospital in Hunan Province were randomly selected for the field study in May–June 2021 research. The image data of the participating nurses' morning care work postures were collected by observation method and image recording method, and the postural hazard level was assessed by the two-person interpretation method of the work posture analysis system. The mean and standard deviation, frequency and percentage were used for the basic statistical description, and the general linear model multivariate Hotelling's T^2 test was used to calculate the Hotelling's T^2 and F statistics to explore the pattern of change in the postural hazard score curves.

Results A total of 45 nurses were observed during morning care operations, resulting in 47.8 h of video data and 34,428 effective static operation posture pictures. Among these pictures, 21,166 (61.5%) depicted poor working postures. Nurses spent up to 7 min and 30 s maintaining a challenging posture during oral care, with the highest postural hazard score (M = 2.2, SD = 0.3) observed during defecation care. Each patient requires a total of 25–30 min of oral care per day.The Hotelling's T^2 test indicated that the change curve of the postural hazard score in each step revealed the largest second-order F value, $F = 52.931$, $P < 0.001$.

Discussion ICU nurses frequently adopt poor working postures during morning care operations. Further research should focus on optimizing safe working postures to prevent or minimise detrimental occupational hazards resulting from poor working postures.Research on occupational low back pain among ICU nurses can help them work more efficiently, and thereby improving their nursing level.

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Keywords Poor working posture, ICU nurse, Morning care, Occupational health, Ovako working posture analyzing system

Introduction

Poor working posture is an important pathogenic mechanism of nurses' low back work-related muscle fatigue and occupational low back pain [1]. Studies have shown that muscle fatigue caused by daily tasks at the workplace usually has a high frequency of fatigue, short rest time, and local muscles cannot be fully rested [2]. On the one hand, it will cause nurses to have negative emotions and reduce the accuracy, efficiency, and stability of nurses' work, leading to a decline in the quality of care. These factors will threaten the lives of patients to a certain extent [3]. On the other hand, muscle damage caused by muscle fatigue will gradually accumulate and cause chronic, long-term, or even permanent damage, such as chronic non-specific low back pain [4]. Therefore, preventing or reducing the occurrence of bad working postures during the operation of ICU nurses is an important strategy to prevent ICU nurses from recurrent muscle fatigue in the lower back and prevent chronic non-specific low back pain caused by long-term repeated muscle fatigue.

Unfortunately, poor working posture frequently occurs during ICU nursing operations, such as morning nursing [5]. Morning nursing is one of the important parts of ICU nurses' daily work. Morning nursing includes multiple tasks, including bed unit preparation, cleaning, skin care, defecation assistance, turning and back percussion for auxiliary sputum expulsion, and more. Due to the critical condition of ICU patients and their heavy dependence on nursing care for daily activities, nurses often adopt poor working postures in their lower back while completing these nursing tasks [5]. Anecdotal observations conducted by our research team have confirmed the common occurrence of poor working postures such as manual lifting of patients, frequent bending, twisting, and sideways reaching in clinical settings. On average, nurses assist patients in turning over 6.9 times per shift, with 27.5% of nurses needing to assist in turning over more than 11 times per shift. Furthermore, 40% of clinical nurses manually move patients more than 5 times per shift, and over 60% of nurses frequently need to bend down or twist sideways to pick up objects while on duty [6–10]. However, existing interventions for ICU nurses' low back work-related muscle fatigue mainly focus on self-assessment questionnaires related to protective knowledge and behaviors, as well as post-event management after the onset of symptoms. There is a lack of in-depth discussions on reducing poor working postures at the source [11–16].Therefore, this study intends to conduct field observation research focusing on morning nursing during ICU daily operations. By dynamically collecting image data of ICU nurses during morning nursing operations, the study aims to evaluate and understand the frequency of poor operating postures and the degree of posture hazards during the operations. The findings may provide a basis for nursing care and offer a scientific reference for managers to develop a safer occupational working postures during morning care and a prevention system for nurses' occupational low back pain.

Methods

Study design

This study is a single-center field research utilizing a randomized design to select the research sites.

Sample and setting

This study was conducted at a tertiary comprehensive medical institution which has seven ICUs in Changsha, Hunan Province, China. These seven ICUs are Central ICU, Respiratory ICU, Thoracic Surgery ICU, Neurology ICU, Neurosurgery ICU, Cardiology ICU, and Emergency ICU. The number of nurses in these ICUs is as follows: Central ICU, 47; Respiratory ICU, 52; Thoracic Surgery ICU, 48; Neurology ICU, 52; Neurosurgery ICU, 53; Cardiology ICU, 49; and Emergency ICU, 61. Due to the high patient turnover and unpredictability in the Emergency ICU, it was excluded from the field study selection. After assessing the basic conditions of each ICU on-site and analyzing preliminary interview results, it was found that the ICUs in this institution have implemented standardized management practices. The nursing management models across ICUs are similar, with patients typically being critically ill, having multiple tubes, and requiring full assistance for daily care. Additionally, lower back pain among nurses is common across units. Therefore, after group discussion, two ICUs were randomly selected from the remaining six to be included in this phase of the field study.To ensure an unbiased selection process, a random sampling method was utilized. Each ICU was assigned a unique identifier, which was then entered into a random number generator. Two ICUs(Central ICU and Neurosurgery ICU) selected by the generator were chosen for the study, designated as Field A and Field B respectively,ensuring equal representation and accurate reflection of the hospital's ICU population.In total, there are 45 nurses in Field A and Field B combined. The researchers conducted in-depth field observations in

Field A and Field B for one month each, involving a total of 45 (22 in Field A and 23 in Field B) ICU nurses during the morning care procedures.Prior to the commencement of on-site observations, the researchers informed the participants about the research objectives, significance, observation methods, as well as the rights and obligations of the participants.

All nurses volunteered to participate and sign informed consent forms. The participating nurses were chosen as the subjects of observation, and data on their working postures during morning nursing operations were collected and recorded.

The inclusion criteria were as follows: ①ICU-employed nurses; ②voluntary participation in the study. The exclusion criteria were: ①ICU work experience less than 1 year; ② no prior experience as a participating nurse; ③nurses undergoing further education or specialized training.

Data collection methods and instruments

In November and December 2021, researchers(JW Lu; SE Yuan; Z Cheng) entered Field A and Field B as observers to conduct field observations. The observation was conducted by trained researchers (JW Lu; SE Yuan) who intermittently recorded the nurses during their morning nursing tasks in both Field A and Field B. The recording process involved capturing video footage of the nurses' postures and movements while they performed routine duties. Each nurse was observed intermittently throughout their morning nursing tasks. The exact number of observations per nurse varied depending on the specific tasks and shifts, but each nurse was observed multiple times during the study period.These recordings were then analyzed by converting the video into frames, which were assessed using the OWAS (Ovako Working Posture Analysis System) coding system.

Initially, access to these fields was facilitated by introductions from the head nurses of each department. Researchers engaged in conversations with various personnel (doctors, nurses, nursing assistants), integrated into the departmental environment, and established basic relationships. Subsequently, they conducted descriptive observations to understand the overall situation in the fields. Next, the researchers employed focused observation and video recording methods to observe and document the working postures and levels of lower back fatigue among healthcare professionals during morning nursing operations.

Objective measurement of working postures

Smartphone cameras were used to record video data of the subjects performing morning nursing tasks. To facilitate data analysis, we (JW Lu; SE Yuan)organized the morning nursing process according to the specific steps outlined in the "Fundamentals of Nursing" (6th edition) textbook [17]. The descriptions of each step are as follows:

① Check: means checking patient information; ② Assess: includes greeting, assessing patient's condition, and explaining the purpose of nursing operation; ③ Oral care; ④ Facial care; ⑤ Bowel care; ⑥ Replace drainage bags; ⑦ Placement: and patient communication, understanding the patient's comfort, asking about the patient's needs, and organizing the bed unit.

Video data processing

The Swift Video Converter Windows software, developed by Shanghai Hudun Technology Co., Ltd., was used for video processing. The Windows version of the Swift Video Converter was employed to extract static posture data by frame capturing. The "Add File—Image Capture" function was selected to save screenshots of the same subject performing the same step in a single folder. These screenshots were stored on the lead researcher's (SE Yuan)password-protected computer.

Static image analysis of working posture

The Ovako Working Posture Analyzing System (OWAS) was used in this study to objectively assess working postures [18]. This tool was developed by a Finnish scholar in 1977 to evaluate workloads during the maintenance of smelting furnaces. Its intra-group test–retest reliability ranged from 0.655 to 0.962, inter-rater reliability ranged from 0.655 to 0.934, Cronbach's α coefficient was 0.87, and split-half reliability coefficient was 0.89, indicating good reliability and validity [19, 20]. OWAS categorizes action categories (AC) into four levels: AC1, AC2, AC3, and AC4. The classification criteria for each level are as follows: AC1 = normal posture, no action needed; AC2 = slight posture hazard, improvement measures needed in the near future; AC3 = significant posture hazard, improvement measures needed promptly; AC4 = severe posture hazard, immediate improvement measures needed [21]. Since research on nursing-related muscular fatigue in the waist and back is still in its early stages in China, there are currently no standardized safe work regulations. Therefore, in this study, the OWAS analysis system concept was adopted, with AC1 classified as a normal posture and AC2 and above as hazardous postures, i.e., poor working postures.In both Field A and Field B, using smartphones with the participants' consent, intermittent recordings were randomly made of 45 observed individuals performing morning nursing tasks. After converting the videos into frames, a total of 34,428 valid static posture images were obtained. The OWAS

Table 1 General Information of the 45 Study Participants

Instrument	Field A				Field B				Total			
	n	%	M	SD	n	%	M	SD	n	%	M	SD
Age, years			34	4.0			32	3.7			33	3.9
Length of ICU service,years			12	4.9			10	3.4			11	4.3
Professional Title												
Nurse	0	0.0			1	4.3			1	2.2		
Senior Nurse	7	31.8			8	34.8			15	33.3		
Supervisor Nurse	15	68.2			14	60.9			29	64.4		
Education Level												
College degree	0	0.0			1	4.3			1	2.2		
Bachelor's degree	21	95.5			18	78.3			39	86.7		
Graduate degree	1	4.5			4	17.4			5	11.1		
BMI												
< 18.5	4	18.2			1	4.3			5	11.1		
18.5 ~ 23.9	14	18.2			21	91.3			35	77.8		
24 ~ 27.9	2	9.1			0	0.0			2	4.4		
≥ 28	2	9.1			1	4.3			3	6.7		

SD Standard deviation, *BMI* Body Mass Index, *M* Average of data

coding system was used for manual interpretation and double-checked by two individuals(JW Lu;HH Wang).

Based on the OWAS assessment results, four observational indicators were calculated: the rate of poor posture, the rate of AC3 posture, the rate of AC4 posture, and the posture hazard score. The rate of poor posture refers to the ratio of the number of static posture images rated as AC2 or higher by OWAS to the total number of images during the observation period. The rate of AC3 posture refers to the ratio of the number of AC3 posture images to the total number of images during the observation period. The rate of AC4 posture refers to the ratio of the number of AC4 posture images to the total number of images during the observation period. The posture hazard score refers to the mean of the sum of OWAS scores for all working posture images divided by the total number of images during the observation period. Previous studies have demonstrated that for the reliability of OWAS analysis results to reach 95%, at least 100 action images need to be observed [22, 23]. Therefore, in this study, image data were extracted by frame capturing at a rate of 1 image per 5 s during video analysis. Manual judgment of the posture hazard level was conducted, and the accuracy of image interpretation was verified by two reviewers(JW Lu; JL Li). In case of any disputes, a third party, namely the research team leader(SE Yuan), was consulted for evaluation. In morning care operations, smartphone cameras were used to record video data of the subjects performing morning nursing tasks for 60 min.

Data analyses

For continuous data, statistical analysis was performed using SPSS version 26.0 on historical data. The Shapiro–Wilk test was used to analyze whether the data followed a normal distribution. For normally distributed data, descriptive statistics such as mean and standard deviation were used. For non-normally distributed data, median and interquartile range were used for description. Categorical data were described using frequencies and percentages. The general linear model with multivariate Hotelling's T^2 test was used to examine whether the posture hazard scores changed with the duration of work time. Hotelling's T^2 and F statistics were calculated, and the patterns of curve changes were investigated.

Results

These observations resulted in approximately 10,000 words of field notes, and a total of 47.8 h of video data were obtained.

Basic information of the study participants

A total of 45 participating nurses were observed in the two fields. The comparison of age, Length of ICU service, professional title, education level, and Body Mass Index (BMI) values among the groups showed *P*-values greater than 0.05, indicating no statistically significant differences between the groups. Detailed information can be found in Table 1.

Table 2 Results of postural interpretation of morning care operations

Operation name	Operation steps	OWAS Interpretation Results(n, %)							
		AC1		AC2		AC3		AC4	
		n	%	n	%	n	%	n	%
morning care	Check	498	72.4	98	14.2	6	0.9	86	12.5
	Assess	860	43.0	632	31.6	74	3.7	434	21.7
	Oral Care	4386	39.0	3590	31.9	908	8.1	2356	21.0
	Facial care	1516	37.2	1432	35.1	418	10.3	708	17.4
	Fecal care	1834	32.9	1826	32.8	1004	18	906	16.3
	Replace drainage bags	2222	31.2	3408	47.9	680	9.6	808	11.4
	Placement	1946	52.1	1032	27.6	234	6.3	526	14.1
	Subtotal	13,262	38.5	12,018	34.9	3324	9.7	5824	16.9

AC Action categories

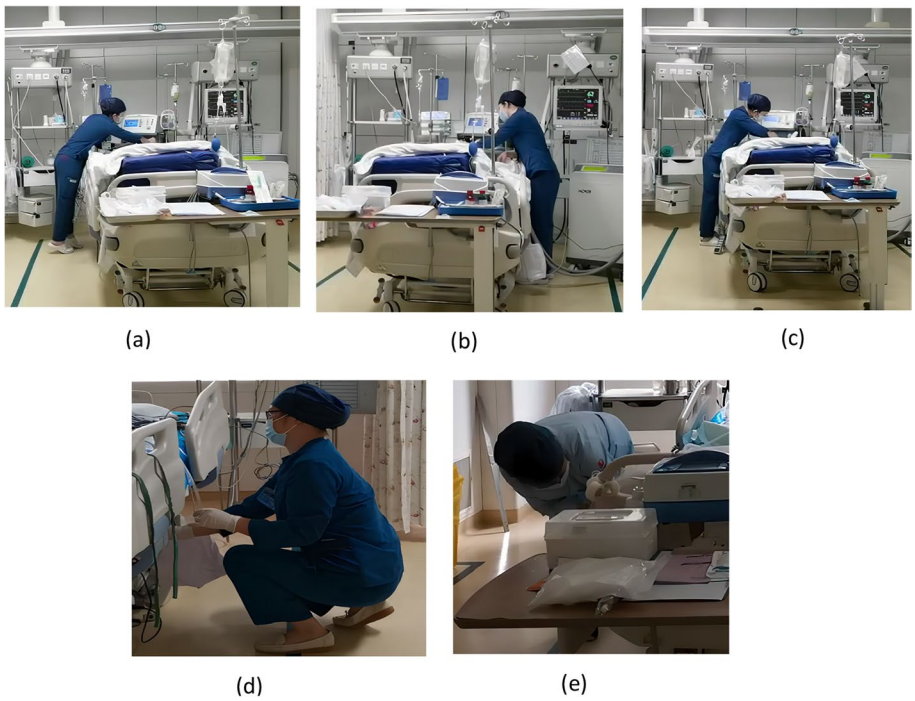

Fig. 1 On-site observations of the working postures of the participating nurses

Adverse posture operation rate

The results revealed that out of the total images, 21,166 (61.5%) were classified as adverse posture images. Notably, the AC4 level images accounted for a significant proportion of 16.9% (5,824 images) (Table 2).

During on-site observations, it was found that when nurses operated the bedside ventilator screen, they adopted a posture with one foot bearing weight, leaning forward 45°, and twisting to the left (Fig. 1a). When communicating with patients, nurses needed to shift their center of gravity to the right, twist their body 15° to the right, and lean forward 25° (Fig. 1b). This posture was repeated more than 20 times during a 4-hour shift, with varying durations, with the longest duration being 2 minutes and 45 seconds. During oral care procedures, nurses needed to lean their upper body forward 40°, and the procedure took 7 minutes and 30 seconds to complete (Fig. 1c). When organizing items such as drainage bags, restraints, and wires under the bed, nurse 1 assumed a squatting position (Fig. 1d), while nurse 2 bent over at a 90° angle (Fig. 1e).

Table 3 Operating posture hazards score

Operation steps	morning care	
	Mean	SD
Check	1.5	0.5
Assess	2.0	0.7
Oral Care	2.0	0.5
Facial care	2.0	0.5
Fecal care	2.2	0.3
Replace drainage bags	2.0	0.2
Placement	1.8	0.3

SD Standard deviation

Working posture hazard scores

The results of the working posture hazard scores for the 45 nurses indicated that Step 5, fecal management, had the highest score, followed by Step 2, oral care. There were significant differences in the posture hazard scores among different steps ($P<0.001$) (Table 3).

Comparison of working posture hazard scores at different time points

To further analyze the dynamic changes in working posture hazard scores at different time points, a multivariate Hotelling's T2 test using a general linear model was conducted in this study. Hotelling's T2 and F statistics were calculated. The results showed that the difference is statistically significant ($P<0.05$). Therefore, it can be concluded that there are differences in posture hazard scores at different time points during the morning care activities. Univariate tests of within-subject effects (Greenhouse–Geisser) also revealed a significance level of $P<0.001$, consistent with the multivariate results. Further investigation of the patterns of change in posture hazard scores for each step revealed that the second-order F value was the highest, with $F=52.931$ and $P<0.001$. Thus, it can be inferred that a linear relationship better fits the pattern of posture hazard score changes, and there were no significant differences between groups ($F=1.636$, $P=0.208$). The profile plot indicated that the peak point was observed during Step 5 (fecal management) (Fig. 2).

Independent samples t-test was conducted to compare the working posture hazard scores between the two field sites. The results showed no significant difference between the groups (M = 2.0, SD = 0.6 vs M = 1.9, SD = 0.5, $t=1.213$, $P=0.226$) (Table 4).

Discussion

Our study involved on-site observations of ICU nursing practices in two field sites, aiming to understand the working posture characteristics of ICU nurses during morning care. We found that adverse working postures were frequent during ICU nurses' morning care tasks, which is similar to the findings by Çınar-Medeni Ö et al. [24].They often had to maintain difficult positions for extended periods of time, especially during oral care procedures. Overall, the hazard scores for working postures were relatively high during morning care tasks, and there were differences in the hazard scores at different time points, showing a gradual upward trend. The highest score was observed during assisting patients with defecation, reaching its peak. This finding is consistent with the

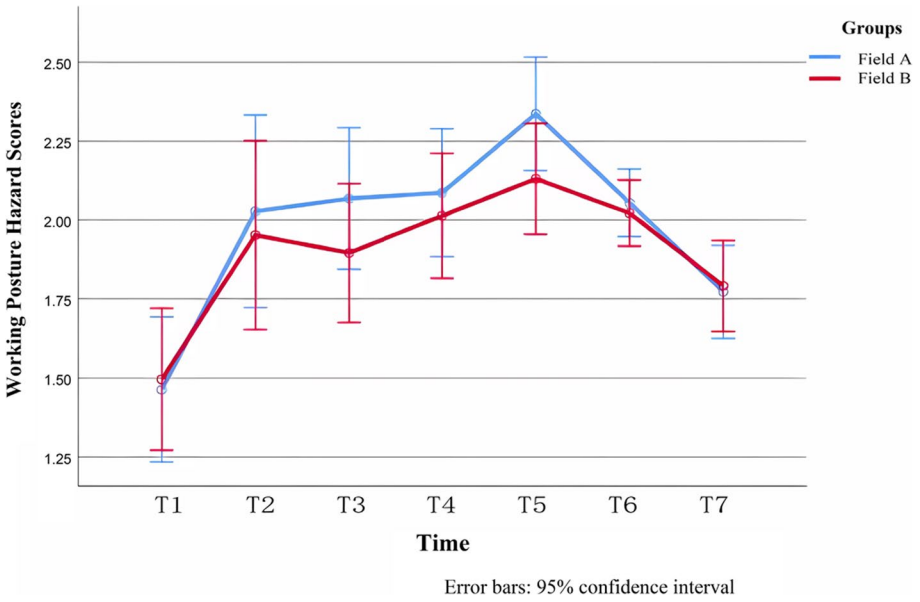

Fig. 2 Profile Plot of Working Posture Hazard Scores during Morning Care Activities

Table 4 Comparison of field A and B posture hazard scores

Operation steps	Field A		Field B		*t*	*P*
	Mean	SD	Mean	SD		
Check	1.5	0.6	1.5	0.5	-0.200	0.842
Assess	2.0	0.8	2.0	0.6	0.353	0.726
Oral Care	2.1	0.6	1.9	0.5	1.105	0.276
Facial care	2.0	0.3	2.0	0.3	0.516	0.610
Fecal care	2.3	0.6	2.1	0.2	1.624	0.116
Replace drainage bags	2.1	0.3	2.0	0.2	0.440	0.662
Placement	1.8	0.4	1.8	0.3	-0.181	0.858

SD Standard deviation

results of a study by Cargnin et al. [25] In our study, there was no significant difference in the occurrence of adverse working postures during morning care tasks between the two ICU settings, which could be partly attributed to a small sample sizes in either groups and standardized management practices in ICUs.

During oral care procedures, ICU nurses had to maintain challenging positions for a relatively long time. It was observed that due to the absence of family members, nurses needed to communicate and establish cooperation with patients before performing the procedure. During communication, nurses adopted positions that involved shifting their body weight to the left or right, rotating their upper body and limbs, and leaning forward. Subsequently, during oral care procedures, some patients had orally inserted endotracheal tubes, while others had severe oral infections with blood clots, scabs, sputum, or purulent secretions that needed to be removed. Nurses had to pay close attention to the effectiveness of cleaning, while also preventing the risk of aspiration or choking caused by mouthwash solution entering the airway. They also needed to prevent oral mucosal injuries resulting from the procedure. As a result, nurses were highly focused and completely unaware that they had been in a static forward-bent hazardous posture for an extended period of time, neglecting their own well-being. Nurses frequently bent their upper bodies forward at angles ranging from 25° to 90°. This was particularly evident during procedures such as oral care and when organizing items under the bed. Significant twisting of the body was observed when nurses interacted with patients or operated bedside equipment. For instance, nurses often twisted their bodies 15° to the right while communicating with patients and 45° to the left when handling the ventilator screen.Nurses had to reach out frequently, which combined with bending and twisting, exacerbated their poor posture. This was notable during tasks that required accessing equipment or supplies located at different heights and positions around the patient bed. Nurses often have to sustain poor working postures for extended periods.A study about operating room nurses of five major hospitals located in Istanbul,Turkey,showed that majority of the participants had occupational low back pain and it was associated with coercive movements during surgery [26].

Some scholars have used the Opensim platform to build multi-rigid-body musculoskeletal models and simulate the muscle force distribution of the lumbar muscle group under different static postures and motion conditions [27–29]. The study found that in a static forward-bent posture, when the forward bending angle exceeded 40°, the erector spinae muscles played a major role, and at the maximum forward bending angle (70°), the force provided by the erector spinae muscles exceeded 1200N. As the axial rotation of the torso increased from 0° to 45°, the force provided by each muscle group also increased. Some scholars found that when the rotation angle reached 45°, the force provided by the external oblique muscles was 330N, and the erector spinae muscles approached 250N [27–29]. It can be seen that ICU nurses need to exert a significant amount of force from their erector spinae muscles to maintain balance when maintaining a static forward-bent posture during oral care procedures for an extended period of time. However, the current basic nursing procedures in China do not mention how to reduce the force exerted on the lumbar back muscles by the operators, and effective measures to protect the lumbar back muscles are not implemented in clinical practice [17]. Chinese guidelines strongly recommend evaluating the relevant regulations on safe patient handling in hospitals and departments, conducting regular training on the principles of ergonomics, and evaluating the effectiveness of the training to enhance nurses' awareness and ability to protect against low back pain [17]. Therefore, it is recommended to further explore the lumbar muscle loading and interventions during oral care

procedures of ICU nurses in future research, develop healthy workflow processes, and strengthen nurses' knowledge training on preventing adverse working postures. If it is necessary to maintain a challenging posture for a long time without affecting patient care and treatment, appropriate changes in body position and posture should be made to alleviate fatigue in the lumbar back muscles.

This study found that the highest hazard score for working postures was observed when ICU nurses assisted patients with defecation. Currently, when performing defecation care for bedridden patients in clinical practice, it is common to assist the patient by placing a bedpan under their buttocks. During this procedure, two nurses stand on either side of the bed and use arm strength in a forward-bent posture of 90° to lift the patient's buttocks while quickly placing the bedpan underneath. After defecation, the nurses need to lift the buttocks again to remove the bedpan and assist with cleaning the buttocks. If the bedpan or patient's clothing is soiled, they also need to assist with changing the bedding. Therefore, our research found that ICU nurses have a high hazard score for adverse working postures when performing defecation care. In fact, during this procedure, nurses not only adopt adverse working postures but also need to exert force to lift the patient's buttocks. The "Guidelines for the Prevention of Work-related Low Back Pain" in the Netherlands explicitly states that lifting devices should be used as the first choice when the load exceeds 25 kg [30]. In 2003, the UK Health and Safety Executive Guidelines recommended the use of mechanical aids by healthcare personnel when moving patients [28]. However, lifting devices have not been widely implemented in hospitals. Therefore, future research should focus on optimizing healthy workflow processes, and hospital administrators should help alleviate the load on ICU nurses during their work processes by improving the available equipment.

In addition, exploring the potential impact of factors such as nurses' experience, workload, and equipment availability on the adoption of poor postures is of crucial importance for comprehensively solving this problem [26]. More experienced nurses may be able to adopt correct postures more effectively due to improved skills and familiarity with operational procedures. Less experienced nurses may be more prone to poor postures because they may not have fully mastered the correct techniques. High workloads may force nurses to adopt poor postures under time pressure to increase efficiency. In such cases, reducing the workload or improving task distribution can help reduce the occurrence of adverse postures. Insufficient or poorly designed equipment may lead to poor postures as nurses are forced to adopt uncomfortable positions to perform their tasks. Improving the availability and design of ergonomic equipment is essential [31, 32].

By considering these factors, more comprehensive support can be provided to nurses, thereby achieving more effective intervention measures and ultimately improving working conditions and the quality of patient care.

Strengths and limitations of the study

Strengths: 1. We observed the nursing operation processes of 45 nurses on a large scale and in all aspects, collected a large amount of photo and video evidence, and studied the hazards of poor postures during nurses' care operations through the analysis system. 2.The complete parts of the filming were selected for the result analysis instead of the videos of all operations of morning care during the entire shift to ensure that the nursing operation process of each observed subject was reasonably evaluated.

Limitations: 1. Single-center study: The research was conducted in only two ICUs of a single hospital, which may limit the generalizability of the findings. 2.Lack of longitudinal data: The study was cross-sectional, capturing the nurses' postures at a single point in time. Longitudinal data could provide insights into the patterns and progression of poor postures over time. 3.Absence of outcome measures: The study did not assess the direct impact of the observed poor postures on the nurses' physical health, such as the prevalence of musculoskeletal disorders or work-related injuries. 4.Potential observer bias: The presence of researchers observing the nurses' work may have influenced their natural postures and behaviors to some extent. 5.Future research could employ qualitative designs to hear the voices of ICU nurses and get deeper insights into their occupational experiences including working postures and the impact of these on their health.

Conclusion

1. The study highlights the high prevalence of poor working postures among ICU nurses during morning care operations, which puts them at significant risk of work-related musculoskeletal disorders.ICU nurses spend most of their time in poor working posture during morning nursing operations. When performing oral care, nurses needed to maintain difficult posture for a longer period of time. The highest postural hazard score was observed when performing fecal care. It is recommended that the next step is to conduct a study on optimizing the health workflow of morning care around reducing the occurrence of poor working posture.

2. The findings can inform the development of ergonomic interventions and the optimization of nursing workflows to reduce the physical demands and posture-related hazards faced by ICU nurses.Implementing ergonomic improvements in the ICU setting faces several challenges. Financial constraints can hinder the upgrading of equipment and comprehensive training due to substantial costs. Seeking external funding through grants or partnerships and demonstrating long-term cost savings from reduced injury rates can justify initial investments. Resistance to change among healthcare staff accustomed to existing methods can be mitigated by involving nurses in decision-making and providing clear communication and hands-on training. Logistical issues, such as significant changes to the ICU layout, can be addressed by planning phased implementations and consulting ergonomic experts for seamless workflow integration.
3. Future research should consider a multi-center, longitudinal design to better understand the broader trends and consequences of poor working postures in this population.
4. Interventions should also focus on promoting awareness, training, and the implementation of ergonomic principles to empower nurses to adopt safer work practices.Lack of awareness about the importance of ergonomics can be tackled through awareness campaigns and educational sessions, highlighting its impact on nurse health and patient care. Addressing these barriers with targeted strategies can create a safer, more efficient working environment for ICU nurses, leading to improved patient care outcomes.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12912-024-02417-7.

Supplementary Material 1.

Authors' contributions

Junwei Lu and Su'e Yuan: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data. Wrote the paper. Jieli Li and Zhi Cheng: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data. Honghong Wang: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Funding

This study was supported by the Foundation of Science,Technology, and Health Combination Project of Science ane Technology of Hunan Province (grant no. 2022JJ70166).

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The Medical Research Ethics Committee of Xiangya Hospital of Central South University approved the study pro tocol (no. 202109003). Confirm that all methods are executed according to relevant guidelines. Informed consent was obtained from all subjects and/or their legal guardian(s).

Consent for publication

This study confirms that informed consent has been obtained from all subjects and/or their legal guardians for the publication of identification information/images in online open access publications.

Competing interests

The authors declare no competing interests.

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Received: 15 September 2023 Accepted: 8 October 2024
Published online: 14 October 2024

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