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Original Article

Investigating the prevalence of work-related musculoskeletal disorders among ICU nurses in the Sultanate of Oman

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ABSTRACT

Introduction: Intensive Care Unit (ICU) nurses are increasingly exposed to work-related Musculoskeletal Disorders (MSD), making them among the most vulnerable healthcare workers globally. This study aims to investigate the prevalence of MSD among ICU nurses in Oman. It further examines the relationship between nursing activities and the prevalence of MSD among ICU nurses.

Methods: This study deployed a cross-sectional research design and a concurrent observational ergonomic assessment. A Nordic Musculoskeletal Questionnaire was completed by a random sample of 171 nurses to assess their perception of MSD pain. Subsequently, 48 nurses were observed using the Rapid Upper Limb Assessment (RULA) tool to evaluate the impact of various nursing activities on nurses' MSD.

Results: The findings reveal a high prevalence of MSD symptoms among ICU female nurses. Significant associations were identified between adherence to safe work procedures and shoulder ($p = 0.014$), low back ($p = 0.037$), and foot/ankle pain ($p = 0.022$). Moreover, adults (heart Center) ICU were found to have the highest RULA score of about (6.6), followed by adults main, and pediatrics heart center (6.4) and (6.2) respectively.

Conclusion: This study highlights the prevalence of Musculoskeletal Disorders among ICU nurses. It underscores the need for healthcare organizations to strengthen ergonomic training, patient-handling strategies, and workplace safety measures to support nurses', safety, health, well-being and improve overall healthcare performance. The integration of occupational health and safety practices into ICU work environments enables policymakers, safety practitioners, and regulators to promote safety among ICU nurses.

Keywords: ICU, Nurses, Oman, Work-related Musculoskeletal Disorders (MSD),

Introduction

Intensive Care Unit (ICU) nurses are essential healthcare professionals who spend more time with patients than any other healthcare staff. The extensive dependence of critically ill patients on nurses for complex daily care activities increases nurses' exposure to work-related Musculoskeletal Disorders (MSD). Activities such as patient repositioning, manual handling, transferring patients, prolonged standing, repetitive movements, bending, and twisting expose ICU nurses to high ergonomic and occupational risks.[1-7] These physically and psychologically demanding working conditions make ICU nurses among the most vulnerable healthcare workers globally. [6,8–12]

Work-related MSDs among healthcare workers account for nearly 50% of occupational injuries and contribute substantially to global healthcare costs.[13–18] MSDs are highly prevalent among ICU nurses and commonly affect the lower back, neck, shoulders, wrists, legs, and feet.[19–21] Previous studies reported that ICU nurses experience higher MSD rates than many other healthcare professionals due to frequent patient-handling activities and awkward working postures. In addition to physical pain, MSD negatively affects nurses' psychological well-being, contributing to stress, anxiety, depression, absenteeism, poor job satisfaction, and reduced nurse retention.

Several ergonomic, organizational and sociodemographic factors influence the prevalence of MSD among ICU nurses. Common risk factors include age, gender, years of service, night shifts, workload, stress, and unsafe patient-handling practices.[12,22] The nature of ICU departments may also influence ergonomic exposure. For example, nurses in pediatric intensive care units frequently switch between tasks and experience high multitasking demands, increasing physical and cognitive workload.[10] These findings highlight the importance of identifying ICU-specific occupational risks to support the development of targeted ergonomic and safety interventions.

Moreover, manual patient transfers, bedside procedures, repetitive movements, and prolonged standing are common ICU activities that generate physical strain, particularly affecting the lower back and shoulders.[23–25] In addition, MSD are associated with disability, spinal disorders, osteoporosis, anxiety, depressive symptoms, and reduced well-being among nurses. [20,21,26]

Despite extensive international evidence on the burden of MSD among ICU nurses, limited research has examined nurses' perceptions of MSD risks, body pain, and safe work practices in Oman. Therefore, this study aims to investigate the prevalence of MSD among ICU nurses and the body parts most affected. In addition, this study aims to investigate the most common risk factors in the ICU work environment that influence the spread of MSD. Hence, the following research questions were developed:

1. What is the prevalence of musculoskeletal disorders (MSDs) among intensive care unit (ICU) nurses?
2. How do nursing activities affect different body regions among ICU nurses?
3. What are the risk factors that are associated with the development of MSD among ICU nurses?

Understanding the risk factors associated with the development and prevalence of MSDs enables policymakers, safety practitioners, and regulators to promote occupational health and safety among ICU nurses. The findings of this study can support the development of ergonomic interventions and safer patient-handling practices.

Methods

This study deployed a cross-sectional research design and a concurrent observational ergonomic assessment to investigate the prevalence of MSD within ICU units with particular focus on nurses at the Royal Hospital. Being one of the pioneering healthcare entities, the Royal Hospital is one of the largest tertiary healthcare institutions in the Sultanate of Oman that was established in 1987.[27]

The study integrated two methods, a questionnaire and observational ergonomic assessment methods, to provide a more comprehensive understanding of the prevalence of MSD among ICU nurses.[28] The data collection took place concurrently between 15 January and 8 February 2024 by self-administered questionnaire and direct observations of routine nursing activities. The questionnaire explored the perception of nurses of the symptoms and the risk factors of MSD, whereas the Rapid Upper Limb Assessment (RULA) tool was used to evaluate physical demands and postural risk factors.[29]

A convenience sample of (n=4) ICU was selected from a total of sixteen ICU based on accessibility, administrative approval, and willingness to participate in the study. The four departments in

this study are: adult ICU, adult heart center ICU, pediatrics ICU, and pediatrics heart center ICU. Following department selection, participant recruitment within each selected ICU was performed using random sampling to reduce selection bias and enhance representativeness. Lists of eligible nurses were obtained from each participating department, and participants were randomly selected using a simple random sampling (fishbowl) method.

The sample questionnaire size was determined in two stages. First, the required sample size for an infinite population was calculated and then adjusted based on the number of eligible nurses in each ICU. The lists of eligible nurses were obtained from the ICU head nurses. Eligibility criteria included full-time ICU nurses with at least two years of work experience and who are directly involved with patients' care. Nurses on leave or those in administrative roles were excluded from study. The final adjusted sample size was proportionally allocated across the four ICU departments. Details of the eligible population, adjusted sample size, completed responses, and response rates are presented in Table 1. The questionnaire was shared with 171 individuals, and 107 responses were returned, yielding a response rate of about 63%.

Table 1: Eligible population, sample size, responses, and response rates

ICU departments	Eligible population (N)	Adjusted sample size Sample	Completed responses (n)	Response rate (n/ adjusted sample size%)
Heart center (Adults)	58	36	29	80.5
Heart center (Pediatric)	63	38	10	26.3
Pediatric (main building)	98	49	37	75.5
Adult (main building)	96	48	31	64.58
Overall Total	***315***	***171***	***107***	***62.6***

For the RULA, a purposive sample technique was used to select observees from the list of nurses based on availability, meeting the study eligibility criteria, and agreeing to be observed. The sample included individuals with different demographic and work characteristics, including age, gender, service years, marital status, and shift work patterns, to ensure variability in observed nursing activities. The observations of a variety of activities, based on availability, were conducted in the three shifts. Observations were concluded after assessing 48 nurses, as data saturation was achieved and all major nursing activities had been recorded. Each session was task-based and lasted for the duration of the activity being performed. The scores were reported according to their corresponding action levels to ensure consistent interpretation of ergonomic risk severity. All observation sessions were photographed and later reviewed using a standardized RULA scoring procedure to enhance scoring consistency.

The questionnaire comprised two sections: participants' demographics and the prevalence of work-related MSD using the Musculoskeletal Disorders Nordic Musculoskeletal Questionnaire (NMQ-E). This study adapted the NMQ-E to assess nurses' perceptions of musculoskeletal pain or discomfort across nine body regions, including the neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs, knees, and ankles/feet.[18,30] To evaluate the questionnaire clarity, readability, and suitability for this study, it was pilot tested on a small group of ICU nurses, and no issues were raised.

The RULA instrument is an observational ergonomic assessment method used to evaluate postures and ergonomics in nurses' routine activities, such as patient repositioning, patient transfers, bedside care and equipment handling. Each nurse was observed during a certain activity, and the postures associated with the highest ergonomic load were scored. Prior to the

observation sessions, the researchers received training with the RULA to ensure consistency in posture evaluation and scoring. To minimize disruption to workflow, the study objectives and RULA procedure were explained individually to participants before observations. Participants provided informed consent for observation and video recording using a phone camera to support accurate posture assessment and scoring.

The data from the questionnaire and RULA were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26 and Microsoft Excel. Descriptive statistics were used as graphical displays and numerical summaries of quantitative data, such as means, percentages, and frequencies, to present data categories, and standard deviations were used to present continuous data.

To identify factors associated with MSD, Chi-square tests were conducted using IBM SPSS Statistics to examine the relationships between demographic and MSD symptoms across the nine body parts. The assumptions of the Chi-square test were assessed prior to analysis. Fisher's Exact Test was applied when expected cell counts were low or zero-frequency cells were identified.

The reported RULA mean scores indicate the level of ergonomic risk and priority for intervention. For example, a score of 7 or higher indicates that an immediate ergonomic intervention is required; scores of 5-6 suggest implementing intervention as soon as possible; and scores of 3-4 indicate the need for further investigation. Following similar studies,[31,32] the results from both methods were integrated during the results discussion and interpretation to provide insight into the prevalence of MSD risks among ICU nurses.

At the beginning of the questionnaire, researchers clearly indicated that participation in this study was voluntary and that participants could withdraw without consequences. At the beginning of each observation session, researchers thoroughly explained the study to participants and obtained their consent to take and use their photos, in accordance with research ethical guidance, without compromising participants' confidentiality. Ethical approval for this study was obtained from the Center of Studies and Research, Ministry of Health, Sultanate of Oman (MoH/CSR/23/27637).

Results

The sociodemographic characteristics of ICU nurses, including gender, age, service years, marital status, and rotations shifts, are summarized in Table 2. Most participants were female nurses across all ICU departments, ranging from 90% to 100%. The participants are mostly between 30-49 years, with service years ranging between 5-16+ years. While 80% of the participants were married, around 38.6% work night shift.

Table 2: Sociodemographic characteristics of ICU nurses

		Department			
		Adults -ICU	**Adults Heart canter ICU**	**Pediatrics - ICU**	**Pediatrics Heart Center ICU**
Gender	Female	28 (90.3%)	27 (93.1%)	36 (97.3%)	10 (100.0%)
	Male	3 (9.7%)	2 (6.9%)	1 (2.7%)	0 (0.0%)
Age	20-29	3 (9.7%)	8 (27.6%)	8 (25.8%)	2 (20.0%)
	30-39	16 (51.6%)	6 (20.7%)	16 (51.62%)	0 (0.0%)
	40-49	12 (38.7%)	11 (37.9%)	10 (32.3%)	8 (80.0%)
	50-59	0 (0.0%)	4 (13.8%)	3 (9.7%)	0 (0.0%)
	60 and above	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Service years	11-15 years	12 (38.7%)	4 (13.8%)	6 (16.7%)	2 (20.0%)
	16 years and above	8 (25.8%)	12 (41.4%)	10 (27.8%)	2 (20.0%)
	5-10 years	11 (35.5%)	9 (31.0%)	21 (55.6%)	5 (50.0%)
	Less than 5	0 (0.0%)	4 (13.8%)	0 (0.0%)	1 (10.0%)
Marital status	Divorced	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

	Married	31 (100.0%)	23 (79.3%)	31 (83.8%)	9 (90.0%)
	Single	0 (0.0%)	6 (20.7%)	6 (16.2%)	1 (10.0%)
Rotations	Afternoon	6 (20.0%)	7 (25%)	10 (28.1%)	4 (44.4%)
shift	Morning	10 (32.0%)	11 (39.3%)	13 (34.4%)	2 (22.2%)
	Night	15 (48.0%)	10 (35.7%)	14 (37.5%)	4 (44.4%)

Musculoskeletal disorders (MSD) prevalence among ICU nurses

Figure 1 presents the prevalence of Musculoskeletal Disorders across different body regions and ICU departments. Overall, the highest prevalence of MSD symptoms was reported among nurses in the adult ICU, followed by the pediatrics ICU. Shoulder, hand/wrist, and lower back pain were the most frequently reported complaints across the investigated ICU.

In the adult ICU, shoulder pain showed the highest prevalence (84.8%), followed by hand/wrist pain (77.8%) and elbow pain (75.0%), while hip/thigh pain was the least reported symptom (50.0%). Among nurses in the adult heart center ICU, hip/thigh pain was the most reported complaint (57.1%), whereas knee pain showed the lowest prevalence (27.3%). In the pediatrics ICU, shoulder pain (73.3%) and hand/wrist pain (70.0%) were the most frequently reported MSD symptoms. Nurses in the pediatrics heart center ICU reported the highest prevalence of lower back pain (66.0%), followed by upper back and knee pain (60.0% each).

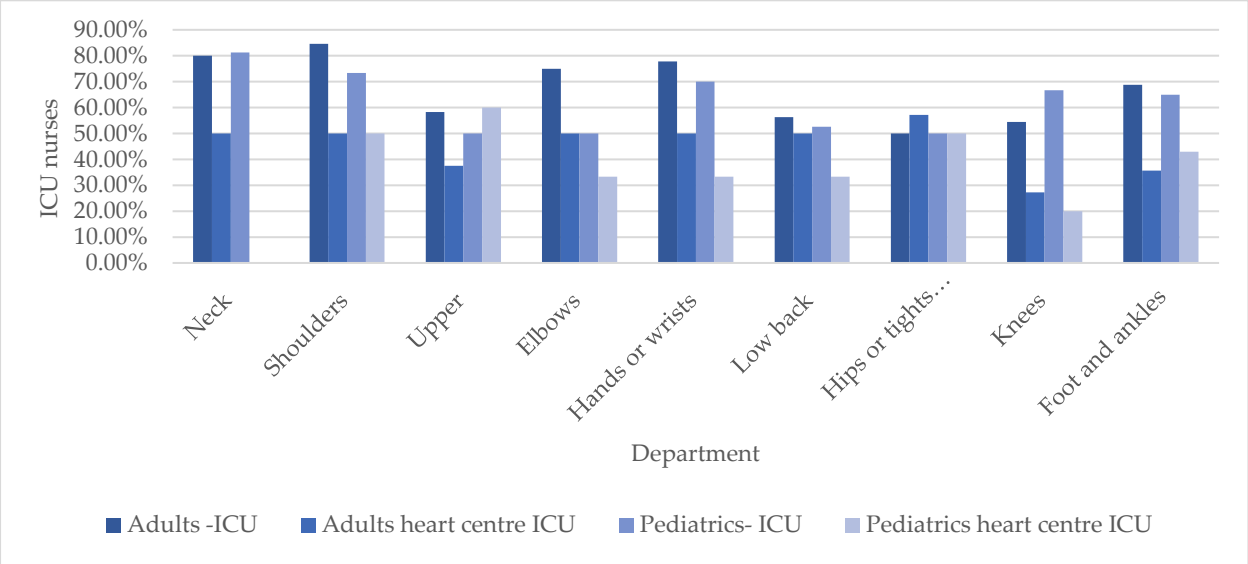

Figure 1: Prevalence of MSD across the four ICU departments.

Figure 2 shows that the nurses aged 40–49 years reported the highest prevalence of MSD symptoms, followed by nurses aged 30–39 years. Surprisingly, nurses aged 50–59 years reported the lowest prevalence rates. The highest symptoms of pain reported by nurses aged 40–49 were observed in the hands, wrists, shoulders, lower back, and feet and ankles.

The female nurses reported higher prevalence rates of MSD symptoms compared to male nurses across all body parts. The highest prevalence was reported in their hands, wrists, feet, ankles, shoulders, and knees. However, this finding should be interpreted with caution, as the number of male nurses is much lower than that of female nurses.

Figure 3 presents the distribution of safe work practices and training related to Musculoskeletal Disorders prevention across the four ICU departments. Overall, a high proportion of nurses across all ICUs reported following safe work procedures when handling patients, with the highest adherence observed in the adult heart center ICU and adult ICU. In contrast, the

proportion of nurses reporting training on reducing MSD was lower in most departments. The adult heart center ICU had the highest percentage of nurses receiving MSD-related training, whereas pediatrics and pediatrics heart center ICU showed the lowest training levels.

Finally, several nurses reported that they received treatment for MSD conditions, underwent surgical procedures, changed their jobs or considered early retirement because of MSD pain.

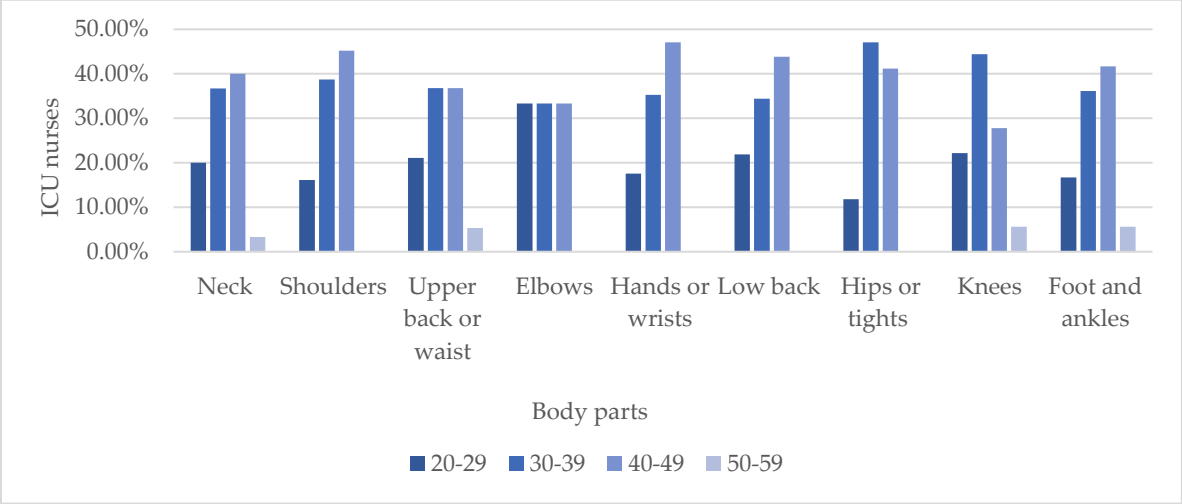

Figure 2: Prevalence of MSD symptoms by body parts and age groups

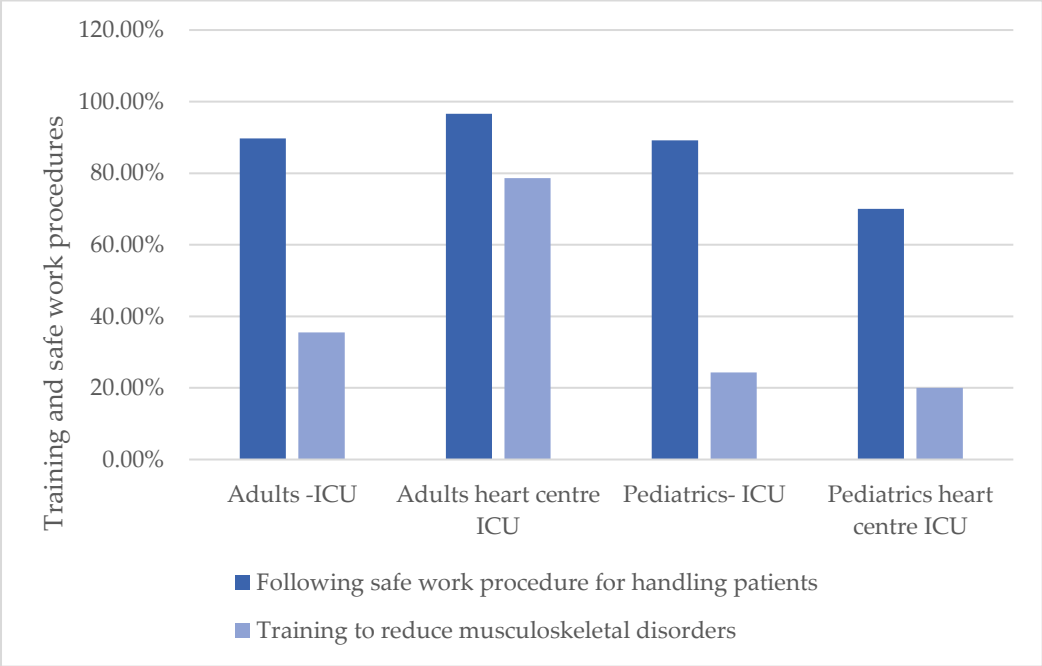

Figure 3: Perception of training and safe work procedure.

Risk Factors associated with musculoskeletal disorders

The Chi-square analysis reveals several significant associations between work-related MSD symptoms and demographics. See Table 3. For example, department type, service years, and rotating shift are significantly associated with neck, foot, and knee pain, respectively. Affecting one body part. Age and manual handling affect two body parts simultaneously. While the age of a nurse is found to have an association with the increase in shoulder pain and lower back pain, manual handling is linked to shoulder and foot pain. On the other hand, following safe work procedures is found to be significantly associated with lower pain in nurses' shoulders, backs, feet,

and ankles. However, the p-values presented in Table 3 should be interpreted as an exploratory study, given the multiple Chi-square comparisons performed. Therefore, emphasis was placed on overall patterns of association rather than isolated statistically significant findings.

Table 3: Summary of Chi-square test

Likelihood Ratio	Neck pain, numbness or discomfort	Shoulder pain, numbness or discomfort	Low back pain, numbness or discomfort	Knee pain, numbness or discomfort	Foot and ankle pain, numbness or discomfort
Department	***0.004***	0.080	0.131	0.233	0.087
Age	0.071	***0.003***	***0.034***	0.616	0.211
Service years	0.204	0.518	0.073	0.095	***0.046***
Rotating-shift	0.074	0.336	0.519	***0.004***	0.099
Manual handling procedure	0.337	***0.014***	***0.037***	0.186	***0.022***

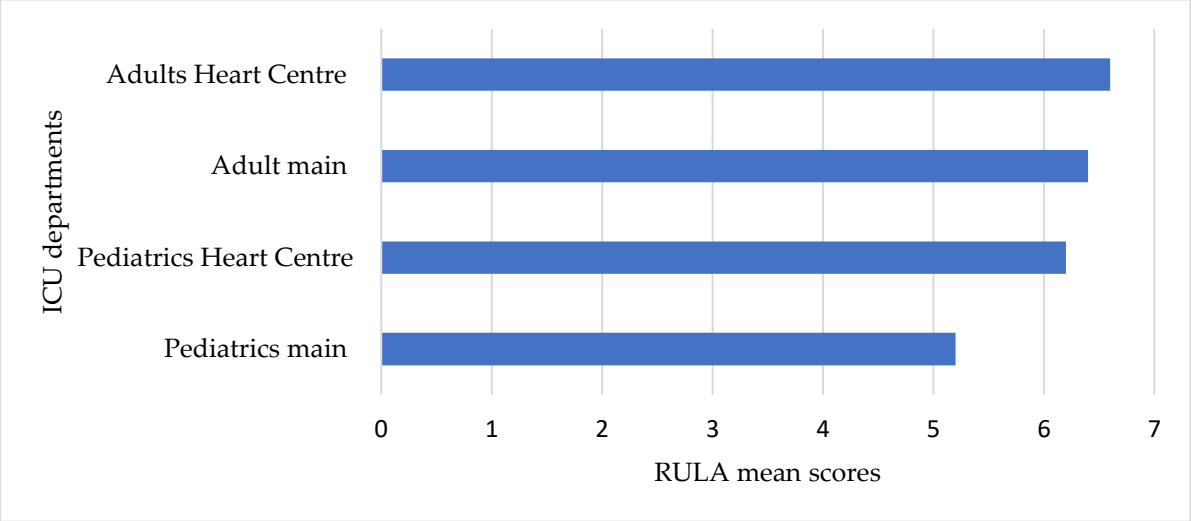

Figure 4: Mean score across 4 ICU departments.

The impact of nursing activities on different body parts

The distribution of RULA scores observed during different activities across the four ICU departments is grouped into five main categories. Namely: bedside treatment, bed preparation and patient transfer, medication preparation, treatment procedures, and patient care. The bedside treatment activities included inserting urinary catheters, medication and medical rounds. Bed preparation involved transferring and repositioning patients between beds, chairs, and departments. Treatment procedures included suctioning, blood collection, emptying urine bags, handling oxygen cylinders, and raising bedside rails, while patient care activities mainly involved holding and feeding babies. Out of the 48 nurses observed, 19 were involved in bedside treatment tasks, 11 in bed preparation and patient transfer, 9 in patient repositioning, 5 in medication preparation, and 4 in infant care activities. The RULA average mean score of the nursing activities across the four ICU depicts that the adult heart center unit is the highest (6.6), followed by the adult main (6.4) and pediatrics heart center (6.2). The main ICU pediatrics scored the least among the four departments (5.2) RULA score. See Figure 4. The reported mean RULA scores across the ICU

tasks indicated moderate-to-high ergonomic risk levels. In particular, the adult heart center ICU recorded the highest mean RULA score, followed by the adult and pediatric ICU. According to RULA action levels, scores above 5 indicate that the observed postures are likely to place nurses at increased risk of developing Musculoskeletal Disorders and require further ergonomic investigation and prompt intervention. These findings suggest that several routine ICU nursing activities involve awkward postures, repetitive movements, and physical strain that may contribute to MSD development if corrective ergonomic measures are not implemented.

Discussion

To the authors' knowledge, limited studies have examined the prevalence of Musculoskeletal Disorders (MSD) among ICU nurses in Oman. The findings of the cross-sectional study and the concurrent observational ergonomic assessment highlight the substantial burden of MSD symptoms among ICU nurses. The study also emphasizes the importance of ergonomic and occupational health interventions within ICU settings in Oman and similar healthcare environments.

The findings demonstrated varying associations between sociodemographic factors and MSD symptoms among ICU nurses. It indicates that the duration of occupational exposure associated with ICU activities varies by nurse age and years of experience. The results indicate that MSD affects nurses to the extent that they receive regular treatment and surgical procedures. Some nurses report considering a job change or early retirement due to their MSD experience.

However, the MSD problem is not without a solution. The results indicate that effective safety procedures, training that raise nurses' awareness, and safety communication are associated with lower levels of pain across body parts. These results highlight the importance of proactive safety management practices in reducing MSD symptoms among ICU nurses. Differences in MSD exposures were observed in the ICU departments. These differences may be related to variations in activities and workload demands. However, although nurses in the pediatric ICU appeared to report lower MSD exposure, previous literature studies indicated that they are exposed to frequent task changing and multitasking demands.[10] The Rapid Upper Limb Assessment (RULA) findings were generally consistent with the questionnaire results and indicated moderate-to-high ergonomic risk levels across several ICU nursing activities.

Observed tasks commonly involved awkward postures, prolonged standing, repetitive movements, and manual patient handling, which may increase ergonomic strain among ICU nurses. The results of this study show that although adherence to safe patient-handling procedures is high among ICU nurses, formal ergonomic and MSD prevention training may be insufficient in some ICU departments. The variation across departments may reflect differences in workplace safety practices, training availability, or organizational emphasis on ergonomic risk management.

Given that the effective implementation of safety management practices, including risk assessment, safety training, effective communication, workers' involvement and leadership commitment, is associated with reduced occupational incidents and enhanced workplace safety performance.[33] It is crucial that the ICU departments adopt a variety of proactive safety management practices to manage workers' exposure early. It is essential to raise awareness among nurses about the impact of MSD on health, safety, well-being and the quality of nurses' lives. The findings of this study will support the integration of occupational health and safety practices into ICU work environments, aiming to reduce physical strain and prevent long-term MSD. It further enables policymakers, safety practitioners, and regulators to promote occupational health and safety among ICU nurses.

Limitations

The findings of this study suggest that specific demographic and workplace factors are associated with the prevalence of Musculoskeletal Disorders among ICU nurses and highlight the importance of targeted ergonomic interventions to reduce pain and discomfort in ICU settings. However, several limitations should be considered when interpreting the findings. The cross-sectional design and relatively small sample size may limit the generalizability of the results.

Although the sample met the minimum recommended for both methods, it may not fully represent the diversity of participants. Secondly, the study was conducted in a single hospital in Oman, which may limit the generalizability of the results to other healthcare institutions or ICU settings. The use of self-reported symptoms may introduce recall and response bias, as participants' perceptions of pain and discomfort may vary. Therefore, future research should use longitudinal designs with larger, more diverse samples drawn from several hospitals. Only then can results be robust, valid and generalizable.

Conclusion

This study highlights the prevalence of Musculoskeletal Disorders among ICU nurses. It also emphasizes the importance of ergonomic and occupational safety interventions within ICU settings.

Among several nursing activities, safe patient-handling practices are linked with lower levels of shoulder, low back, foot and ankle pain, indicating the potential value of reinforcing safe work procedures in critical care environments. The study underscores the need for healthcare organizations to strengthen ergonomic training, patient-handling strategies, and workplace safety measures. These proactive safety practices will support nurses' safety, health and well-being and improve overall healthcare performance. The integration of occupational health and safety practices into ICU work environments enables policymakers, safety practitioners, and regulators to promote safety among ICU nurses.

Declaration of Competing Interest

The authors used Grammarly to assist with grammar, spelling, punctuation, and language editing of the manuscript. The authors confirm that Grammarly was used solely for linguistic refinement and did not contribute to the study's scientific content, data analysis, interpretation, or conclusions. Otherwise, we declare that there are no known competing personal relationships or financial interests that could have influenced the work reported in this study.

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