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**ORIGINAL ARTICLE / ARAŞTIRMA YAZISI** Surgical Diseases Nursing/Cerrahi Hastalıklar Hemşireliği

# Work-Related Musculoskeletal Disorders and Ergonomic Risk Profiles Among Surgical Intensive Care Nurses

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**ABSTRACT**

**Background:** This study examined the relationship between ergonomic risk factors, postural behaviors, lifestyle habits, and the presence of work-related musculoskeletal disorders (WMSDs) among surgical intensive care nurses.

**Methods:** This descriptive cross-sectional study included 227 surgical intensive care nurses in Türkiye. Data were collected using an online Nurse Assessment Form and analyzed using descriptive statistics, chi-square tests, and binary logistic regression analysis.

**Results:** Most nurses reported inadequate sleep (64.4%) and irregular sleep patterns. The prevalence of WMSDs increased significantly with age and professional experience—from 18.1% among nurses ≤30 years to 54.5% among those ≥41 years (p<0.001). Nurses with WMSDs reported significantly lower use of correct body mechanics (25.5% vs. 46.5%; p=0.004) and lower physical activity levels (p=0.018). WMSDs were significantly more prevalent among nurses working in second-level ICUs compared with those working in third-level ICUs (44.8% vs. 21.2%; p=0.008). Binary logistic regression analysis identified age and correct use of body mechanics as significant predictors of WMSDs.

**Conclusion:** Surgical intensive care nurses experience substantial ergonomic risk exposure that may contribute to the development of WMSDs. Continuous ergonomics training, improved shift scheduling, posture-supportive workplace practices, and the promotion of regular physical activity may help reduce musculoskeletal strain and improve occupational well-being. These findings highlight the importance of integrated ergonomic strategies to enhance nurse well-being and patient safety in surgical intensive care settings.

**Keywords:** Ergonomics, work-related musculoskeletal disorders, intensive care units, surgical nurses, body mechanics

**ÖZET**

**Amaç:** Bu çalışma, cerrahi yoğun bakım hemşirelerinde ergonomik risk faktörleri, postür davranışları, yaşam tarzı alışkanlıkları ve işle ilişkili kas-iskelet sistemi bozukluklarının (WMSD) varlığı arasındaki ilişkiyi incelemeyi amaçlamıştır.
**Yöntem:** Tanımlayıcı ve kesitsel tipte yürütülen bu çalışma Türkiye'de çalışan 227 cerrahi yoğun bakım hemşiresi ile gerçekleştirilmiştir. Veriler çevrim içi olarak uygulanan Hemşire Değerlendirme Formu aracılığıyla toplanmış ve tanımlayıcı istatistikler, ki-kare testleri ve ikili lojistik regresyon analizi kullanılarak analiz edilmiştir.
**Bulgular:** Hemşirelerin büyük çoğunluğu yetersiz uyku süresi (%64,4) ve düzensiz uyku düzeni bildirmiştir. WMSD prevalansı yaş ve mesleki deneyim ile anlamlı şekilde artmıştır; ≤30 yaş grubunda %18,1 iken ≥41 yaş grubunda %54,5 olarak bulunmuştur (p<0,001). WMSD bulunan hemşirelerde doğru vücut mekaniği kullanımı daha düşük (%25,5'e karşı %46,5; p=0,004) ve fiziksel aktivite düzeyi daha düşük bulunmuştur (p=0,018). WMSD prevalansı ikinci düzey yoğun bakım ünitelerinde çalışan hemşirelerde üçüncü düzey yoğun bakım ünitelerinde çalışanlara göre daha yüksek bulunmuştur (%44,8'e karşı %21,2; p=0,008). Lojistik regresyon analizinde yaş ve doğru vücut mekaniği kullanımı WMSD gelişimi ile ilişkili anlamlı belirleyiciler olarak saptanmıştır.
**Sonuç:** Cerrahi yoğun bakım hemşireleri önemli düzeyde ergonomik risklere maruz kalmakta olup bu durum WMSD gelişimine katkıda bulunabilmektedir. Sürekli ergonomi eğitimi, uyku sağlığını destekleyen vardiya planlaması, doğru postürü destekleyen çalışma ortamları ve düzenli fiziksel aktivitenin teşvik edilmesi hemşirelerin kas-iskelet sağlığını ve mesleki iyilik halini geliştirebilir. Bu bulgular cerrahi yoğun bakım ortamlarında hemşire sağlığını ve hasta güvenliğini artırmaya yönelik bütüncül ergonomik stratejilerin geliştirilmesi gerektiğini göstermektedir.
**Anahtar Kelimeler:** Ergonomi, işle ilişkili kas-iskelet sistemi bozuklukları, yoğun bakım üniteleri, cerrahi hemşireleri, vücut mekaniği

Ergonomics is an interdisciplinary field that aims to optimize the adaptation of work to individuals and individuals to work by considering their physical and psychological characteristics. Among healthcare professionals, nurses constitute one of the occupational groups most frequently exposed to ergonomic risks due to complex care processes and high physical demands. Reports from the International Council of Nurses (ICN) emphasize that the work environments of nurses involve a high level of occupational hazards (1–3).

Ergonomic risk factors in the work environment may initially manifest as temporary pain relieved by rest but may progress over time into musculoskeletal disorders (MSDs), which can reduce work capacity and lead to long-term functional limitations (4,5). According to data from the Social Security Institution (SGK) in Türkiye, musculoskeletal problems constituted a substantial proportion of occupational diseases reported in 2023 (6). At the international level, joint WHO/ILO estimates highlight the considerable global burden of ergonomic overload on worker health (4,7).

Ergonomic risks in nursing are not limited to physical conditions; the literature consistently shows that MSDs reduce work efficiency, impair care quality, increase error propensity, and contribute to burnout and turnover intention (8–10). Thus, ergonomics also represents a critical patient safety concern. Musculoskeletal strain and fatigue may compromise nurses' ability to perform clinical tasks safely, increasing the likelihood of patient handling errors, delayed care, and reduced adherence to safety protocols. This risk is further amplified in intensive care units, where care processes frequently involve high physical exertion—such as continuous patient monitoring, positioning, transfer, intubation, and suctioning—typically performed under repetitive, time-pressured, and non-ergonomic postures (11).

Surgical intensive care units (ICUs) impose greater physical demands than other ICUs due to their high density of technological equipment, extensive monitoring requirements, frequent invasive procedures, and significant need for critical patient mobilization. Recent studies and meta-analyses indicate that surgical ICU nurses experience higher rates of back and neck pain, lower extremity fatigue, and postural problems compared to nurses in other units (11–15). Ergonomics training programs have also been shown to reduce MSD symptoms, increase correct posture use, and improve care performance (15,16). However, data on ergonomic practices and awareness among surgical ICU nurses in Türkiye remain limited.

Surgical intensive care units (ICUs) present a distinct ergonomic risk profile compared to other clinical settings due to the intensity and complexity of care delivered. Nurses working in these units are frequently required to perform early and repeated patient mobilization, often involving critically ill or sedated patients who require full physical assistance. Such activities impose substantial biomechanical loads on the musculoskeletal system, particularly affecting the lower back and upper extremities. In addition, surgical ICU nurses are routinely involved in invasive procedures such as endotracheal suctioning, positioning during postoperative care, and the management of multiple life-support devices, which are often performed under time pressure and in constrained postures (11,28). The high density of technological equipment in these units further limits available workspace, contributing to awkward body positioning and restricted movement patterns (11). Consistent with these contextual factors, previous research has shown that intensive care environments are associated with increased physical workload, greater ergonomic strain, and a higher prevalence of work-related musculoskeletal disorders among nurses (20,28). More recent evidence further supports that high-acuity clinical settings and patient-handling demands significantly increase biomechanical load and WMSD risk among healthcare workers **(20,30).** These findings collectively underscore the importance of examining ergonomic risks within the specific context of surgical intensive care settings rather than generalizing findings from broader ICU populations.

A growing body of evidence highlights the effectiveness of ergonomics-based interventions in reducing work-related musculoskeletal disorders (WMSDs) among nurses. Systematic reviews have demonstrated that interventions such as ergonomics training programs, safe patient handling strategies, and workplace redesign can significantly reduce musculoskeletal symptoms and improve occupational safety outcomes (14,26). In particular, structured training programs focusing on correct body mechanics and posture awareness have been shown to enhance nurses' knowledge, promote safer movement behaviors, and decrease physical strain during patient care activities (15,16). More recent systematic evidence further indicates that participatory and multicomponent ergonomic interventions—combining education, physical activity, and organizational strategies—are more effective than single-component approaches in reducing WMSD risk among nurses **(26).** In addition, intervention-based research conducted in intensive care settings has demonstrated that posture regulation training can significantly reduce musculoskeletal symptoms and improve ergonomic awareness among nurses **(16).** In high-acuity environments such as intensive care units, these interventions are particularly important, as nurses are frequently exposed to repetitive movements, heavy lifting, and time-constrained procedures. Despite this growing evidence base, the implementation and effectiveness of ergonomics-focused interventions in surgical intensive care settings remain insufficiently explored, particularly in the context of developing countries.

Despite the growing body of research on work-related musculoskeletal disorders among nurses, existing studies largely focus on general nursing populations or mixed intensive care settings, with limited attention to the unique clinical and ergonomic demands of surgical intensive care units. Furthermore, previous research has often examined individual risk factors in isolation, without comprehensively addressing the combined effects of ergonomic awareness, postural behaviors, and lifestyle habits. In the context of Türkiye, data specifically focusing on surgical ICU nurses remain scarce. Therefore, this study aims to provide a comprehensive evaluation of work-related musculoskeletal disorders by integrating individual, behavioral, and work-related factors within a surgical intensive care setting, thereby contributing to the development of context-specific ergonomic strategies.

Accordingly, the aim of this study was to examine the relationship between ergonomic risk factors, lifestyle habits, postural behaviors, and work-related musculoskeletal disorders (WMSDs) among surgical ICU nurses. The study sought to answer the following research question: "Are the demographic and professional characteristics, ergonomic awareness levels, and lifestyle habits of surgical intensive care nurses associated with WMSDs?"

## Methods

### *Study Design*

This research was conducted as a descriptive and cross-sectional study.

### *Research Question*

The study aimed to address the following primary research question: "Are the demographic and professional characteristics, ergonomic awareness levels, and lifestyle habits of surgical intensive care nurses associated with work-related musculoskeletal disorders (WMSDs)?"

### *Research Hypotheses*

**H1:** Increasing age and longer professional experience are associated with a higher likelihood of work-related musculoskeletal disorders (WMSDs) among surgical intensive care nurses.

**H2:** Nurses who do not apply proper body mechanics and who have lower levels of ergonomic awareness are more likely to develop WMSDs.

**H3:** Unhealthy lifestyle habits, including irregular sleep patterns and low levels of physical activity, are associated with an increased risk of WMSDs.

### *Study Setting and Time Frame*

The study was conducted between May and August 2025 among surgical intensive care nurses working across Türkiye.

### *Population and Sample*

The target population of the study consisted of members of the Turkish Intensive Care Nurses Association (TICNA), of whom 1,450 were registered nurses and 550 were employed in surgical intensive care units. The sample size was calculated using the formula for studies with a known population ($n = N \times t^2 \times p \times q / [d^2 \times (N-1) + t^2 \times p \times q]$), with a population size of 550, a 5% margin of error, and a 95% confidence level. The minimum required sample size was determined to be 226. Between May and August 2025, a total of 227 surgical intensive care nurses who were informed about the study and provided online voluntary consent comprised the final sample.

### *Inclusion and Exclusion Criteria*

Nurses were eligible to participate in the study if they had been working in a surgical intensive care unit for at least one year. Nurses who had previously undergone musculoskeletal surgery were excluded from the study.

### *Data Collection Procedure*

Data were collected using a structured online self-report method. The survey link, containing the Nurse Identification Form, was distributed via email to TICNA members. Participation was voluntary and responses were recorded digitally.

## Data Collection Instrument:

*Nurse Identification Form*

The Nurse Identification Form is a 36-item descriptive tool developed by the researchers based on a comprehensive literature review and expert consultation. The form is not intended as a psychometric scale; rather, it gathers information on nurses' demographic characteristics, professional status, ergonomic awareness, lifestyle habits, sleep patterns, physical activity levels, body mechanics practices, and the presence or history of musculoskeletal disorders.

The development of the form was guided by existing literature on ergonomic risk factors, work-related musculoskeletal disorders, and occupational health in nursing, ensuring that the included items reflect commonly reported risk domains and clinically relevant variables.

*Content Validity and Preliminary Testing*

Content validity was assessed by five experts (three academics and two clinical specialists), who evaluated item clarity, relevance, and scope adequacy. Revisions were made based on their feedback.

To further enhance the clarity and applicability of the instrument, a pilot test was conducted with 10 nurses working in surgical intensive care units. Participants were asked to evaluate the comprehensibility, relevance, and ease of completion of each item. Minor revisions were made to wording and item structure based on participant feedback, particularly to improve clarity and reduce ambiguity. The average completion time of the form was approximately 10–12 minutes, indicating acceptable feasibility for clinical use.

Because the form does not measure latent constructs or produce subscale scores, psychometric analyses such as factor analysis or internal consistency testing (Cronbach's alpha) were not applicable.

This approach is consistent with previous descriptive studies utilizing structured data collection forms to explore multiple independent variables rather than to measure a single underlying construct.

*Ethical Considerations*

Institutional permission was obtained from the Turkish Intensive Care Nurses Association. Ethical approval was granted by the Non-Interventional Clinical Research Ethics Committee of Marmara University Faculty of Health Sciences (Date: April 25, 2024; Decision No: 72). All participants were informed about the study and provided electronic consent.

*Data Analysis*

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.0. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to summarize participant characteristics. Chi-square tests were conducted to identify relationships between categorical variables. Statistical significance was set at $p < 0.05$.

In addition, binary logistic regression analysis was performed to identify independent predictors of work-related musculoskeletal disorders (WMSDs). Variable selection for the multivariable model was guided by the results of the bivariate analyses and by factors identified as relevant in previous literature on ergonomic risks and WMSDs among nurses. Variables that were found to be significant in bivariate analyses ($p < 0.05$) or considered clinically relevant based on the literature (e.g., age, professional experience, sleep patterns, physical activity, body mechanics use, and ICU level) were included in the regression model. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the strength of associations.

Model fit was assessed using appropriate goodness-of-fit indicators, and multicollinearity among independent variables was evaluated prior to analysis.

## Results

The daily sleep duration of participants was distributed as follows: 3–4 hours (8.5%), 5–6 hours (64.4%), and 7–8 hours (27.1%). Gender, age, and body mass index groups did not differ significantly in terms of sleep duration ($p>0.05$). Regular sleep patterns differed significantly across age groups ($p<0.001$): 10.6% among nurses aged ≤30 years, 24.4% among those aged 31–40 years, and 54.5% among those aged ≥41 years. Ergonomics training also varied significantly by age ($p=0.004$); 10.6% of nurses aged ≤30 years, 20.0% of those aged 31–40 years, and 36.4% of those aged ≥41 years had received ergonomics education **(Table 1)**.

Table 1. Lifestyle and Ergonomic Characteristics by Gender, Age, and Body Mass Index

| Variables | Category | Female n (%) | Male n (%) | p-value | ≤30 n (%) | 31–40 n (%) | ≥41 n (%) | p-value | Normal Weight n (%) | Overweight n (%) | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Daily Sleep Duration** | 3–4 hours | 16 (8.5) | 7 (17.9) | 0.203 | 19 (11.9) | 3 (6.7) | 1 (4.5) | 0.262 | 13 (7.8) | 10 (16.4) | 0.165 |
| | 5–6 hours | 121 (64.4) | 22 (56.4) | | 104 (65.0) | 27 (60.0) | 12 (54.5) | | 107 (64.5) | 36 (59.0) | |
| | 7–8 hours | 51 (27.1) | 10 (25.6) | | 37 (23.1) | 15 (33.3) | 9 (40.9) | | 46 (27.7) | 15 (24.6) | |
| **Do You Sleep Regularly?** | Yes | 31 (16.5) | 9 (23.1) | 0.222 | 17 (10.6) | 11 (24.4) | 12 (54.5) | <0.001 | 27 (16.3) | 13 (21.3) | 0.243 |
| | No | 157 (83.5) | 30 (76.9) | | 143 (89.4) | 34 (75.6) | 10 (45.5) | | 139 (83.7) | 48 (78.7) | |
| **Have You Received Ergonomics Training?** | Yes | 27 (14.4) | 7 (17.9) | 0.360 | 17 (10.6) | 9 (20.0) | 8 (36.4) | 0.004 | 22 (13.3) | 12 (19.7) | 0.160 |
| | No | 161 (85.6) | 32 (82.1) | | 143 (89.4) | 36 (80.0) | 14 (63.6) | | 144 (86.7) | 49 (80.3) | |
| **Do You Exercise Regularly?** | Very rarely | 69 (36.7) | 10 (25.6) | 0.024 | 51 (31.9) | 18 (40.0) | 10 (45.5) | 0.438 | 60 (36.1) | 19 (31.1) | 0.342 |
| | Rarely | 42 (22.3) | 8 (20.5) | | 38 (23.8) | 9 (20.0) | 3 (13.6) | | 40 (24.1) | 10 (16.4) | |
| | Regularly | 19 (10.1) | 11 (28.2) | | 18 (11.2) | 8 (17.8) | 4 (18.2) | | 21 (12.7) | 9 (14.8) | |
| | Never | 58 (30.9) | 10 (25.6) | | 53 (33.1) | 10 (22.2) | 5 (22.7) | | 45 (27.1) | 23 (37.7) | |
| **Use of Body Mechanics** | Yes | 70 (37.2) | 24 (61.5) | 0.005 | 61 (38.1) | 24 (53.3) | 9 (40.9) | 0.187 | 72 (43.4) | 22 (36.1) | 0.201 |
| | No | 118 (62.8) | 15 (38.5) | | 99 (61.9) | 21 (46.7) | 13 (59.1) | | 94 (56.6) | 39 (63.9) | |

***Note:*** *Note: Chi-square test was used. Percentages are presented within each subgroup.*

Exercise habits differed significantly by gender (p=0.024). The application of body mechanics also differed significantly by gender (p=0.005) (Table 1). WMSD prevalence differed significantly across age groups (p<0.001): 18.1% among nurses aged ≤30 years, 31.1% among those aged 31–40 years, and 54.5% among those aged ≥41 years **(Table 2).**

**Table 2.** Musculoskeletal Disorders and Postural Assessments by Gender, Age, and Body Mass Index

| Variables | Category | Female n (%) | Male n (%) | p-value | ≤30 n (%) | 31–40 n (%) | ≥41 n (%) | p-value | Normal Weight n (%) | Overweight n (%) | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **WMSD (Diagnosed)** | Yes | 49 (26.1) | 6 (15.4) | 0.110 | 29 (18.1) | 14 (31.1) | 12 (54.5) | <0.001 | 37 (22.3) | 18 (29.5) | 0.171 |
| | No | 139 (73.9) | 33 (84.6) | | 131 (81.9) | 31 (68.9) | 10 (45.5) | | 129 (77.7) | 43 (70.5) | |
| **WMSD-related Surgery** | Yes | 12 (6.4) | 1 (2.6) | 0.311 | 6 (3.8) | 6 (13.3) | 1 (4.5) | 0.049 | 7 (4.2) | 6 (9.8) | 0.101 |
| | No | 176 (93.6) | 38 (97.4) | | 154 (96.2) | 39 (86.7) | 21 (95.5) | | 159 (95.8) | 55 (90.2) | |
| **Postural Assessment 1** | Correct posture | 75 (39.9) | 19 (48.7) | 0.200 | 63 (39.4) | 22 (48.9) | 9 (40.9) | 0.519 | 76 (45.8) | 18 (29.5) | 0.019 |
| | Incorrect posture | 113 (60.1) | 20 (51.3) | | 97 (60.6) | 23 (51.1) | 13 (59.1) | | 90 (54.2) | 43 (70.5) | |
| **Postural Assessment 2** | Correct posture | 95 (50.5) | 22 (56.4) | 0.312 | 81 (50.6) | 25 (55.6) | 11 (50.0) | 0.833 | 85 (51.2) | 32 (52.5) | 0.493 |
| | Incorrect posture | 93 (49.5) | 17 (43.6) | | 79 (49.4) | 20 (44.4) | 11 (50.0) | | 81 (48.8) | 29 (47.5) | |
| **Postural Assessment 3** | Correct posture | 49 (26.1) | 18 (46.2) | 0.012 | 45 (28.1) | 17 (37.8) | 5 (22.7) | 0.348 | 55 (33.1) | 12 (19.7) | 0.033 |
| | Incorrect posture | 139 (73.9) | 21 (53.8) | | 115 (71.9) | 28 (62.2) | 17 (77.3) | | 111 (66.9) | 49 (80.3) | |

*Note: Chi-square test was used for comparisons. Percentages are presented within each subgroup.*

Daily sleep duration differed significantly according to total work experience (p=0.014). Regular sleep was also associated with total work experience (p<0.001): 7.3% among nurses with 1–5 years, 20.4% among those with 6–10 years, and 19.2% among those with 11–15 years of experience. Regular sleep also varied significantly according to surgical intensive care experience (p<0.001): 8.1% for 1–5 years, 24.6% for 6–10 years, and 44.1% for ≥11 years. Regular sleep rates differed significantly by work schedule (p<0.001): 48.1% among nurses working permanent day shifts and 8.6% among those working rotating shifts.

Ergonomics education differed significantly according to total work experience **(p=0.002)** and surgical intensive care experience **(p=0.009).** Exercise frequency differed significantly according to surgical intensive care experience (p=0.022) and work schedule (p=0.013). The use of body mechanics differed significantly by total work experience (p=0.015) and surgical intensive care experience (p=0.008) **(Table 3).**

**Table 3.** Lifestyle and Ergonomic Factors by Work Characteristics

| Variables | Category | 1–5 Years n (%) | 6–10 Years n (%) | 11–15 Years n (%) | p-value | ICU 1–5 Years n (%) | ICU 6–10 Years n (%) | ICU ≥11 Years n (%) | p-value | Day Shift n (%) | Shift Work n (%) | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Daily Sleep Duration** | 3–4 hours | 16 (13.0) | 6 (12.2) | 0 (0.0) | 0.014 | 17 (12.5) | 6 (10.5) | 0 (0.0) | 0.110 | 1 (1.9) | 22 (12.6) | 0.004 |
| | 5–6 hours | 79 (64.2) | 30 (61.2) | 21 (80.8) | | 85 (62.5) | 38 (66.7) | 20 (58.8) | | 29 (55.8) | 114 (65.1) | |
| | 7–8 hours | 28 (22.8) | 13 (26.5) | 5 (19.2) | | 34 (25.0) | 13 (22.8) | 14 (41.2) | | 22 (42.3) | 39 (22.3) | |
| **Do You Sleep Regularly?** | Yes | 9 (7.3) | 10 (20.4) | 5 (19.2) | <0.001 | 11 (8.1) | 14 (24.6) | 15 (44.1) | <0.001 | 25 (48.1) | 15 (8.6) | <0.001 |
| | No | 114 (92.7) | 39 (79.6) | 21 (80.8) | | 125 (91.9) | 43 (75.4) | 19 (55.9) | | 27 (51.9) | 160 (91.4) | |
| **Ergonomics Training** | Yes | 10 (8.1) | 8 (16.3) | 6 (23.1) | 0.002 | 13 (9.6) | 11 (19.3) | 10 (29.4) | 0.009 | 10 (19.2) | 24 (13.7) | 0.221 |
| | No | 113 (91.9) | 41 (83.7) | 20 (76.9) | | 123 (90.4) | 46 (80.7) | 24 (70.6) | | 42 (80.8) | 151 (86.3) | |
| **Exercise Frequency** | Very rarely | 42 (34.1) | 16 (32.7) | 7 (26.9) | 0.500 | 44 (32.4) | 21 (36.8) | 14 (41.2) | 0.022 | 23 (44.2) | 56 (32.0) | 0.013 |
| | Rarely | 27 (22.0) | 13 (26.5) | 5 (19.2) | | 27 (19.9) | 18 (31.6) | 5 (14.7) | | 3 (5.8) | 47 (26.9) | |
| | Regularly | 12 (9.8) | 8 (16.3) | 6 (23.1) | | 15 (11.0) | 6 (10.5) | 9 (26.5) | | 9 (17.3) | 21 (12.0) | |
| | Never | 42 (34.1) | 12 (24.5) | 8 (30.8) | | 50 (36.8) | 12 (21.1) | 6 (17.6) | | 17 (32.7) | 51 (29.1) | |
| **Use of Body Mechanics** | Yes | 41 (33.3) | 26 (53.1) | 16 (61.5) | 0.015 | 46 (33.8) | 33 (57.9) | 15 (44.1) | 0.008 | 19 (36.5) | 75 (42.9) | 0.258 |
| | No | 82 (66.7) | 23 (46.9) | 10 (38.5) | | 90 (66.2) | 24 (42.1) | 19 (55.9) | | 33 (63.5) | 100 (57.1) | |

*Note: Chi-square test was used. Percentages are presented within each subgroup.*

WMSD prevalence differed significantly by total work experience (p<0.001), surgical intensive care experience (p=0.002), and work type (p<0.001) **(Table 4).**

A significant difference was observed between daily sleep duration and WMSD presence (p=0.008); 14.5% of those with WMSDs reported sleeping 3–4 hours compared to 8.7% of those without WMSDs. Regular sleep differed significantly according to WMSD status (p=0.011): 29.1% among those with WMSDs versus 14.0% among those without. Exercise frequency was also significant (p=0.018): "very rarely" exercising was reported by 49.1% of nurses with WMSDs compared to 30.2% of those without. The use of body mechanics differed significantly according to WMSD status (p=0.004): 25.5% of nurses with WMSDs versus 46.5% of those without.

**Table 4.** Musculoskeletal Disorders and Postural Assessments by Work Characteristics

| Variables | Category | 1–5 Years n (%) | 6–10 Years n (%) | 11–15 Years n (%) | p-value | ICU 1–5 Years n (%) | ICU 6–10 Years n (%) | ICU ≥11 Years n (%) | p-value | Day Shift n (%) | Shift Work n (%) | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WMSD (Diagnosed)** | Yes | 20 (16.3) | 12 (24.5) | 7 (26.9) | <0.001 | 24 (17.6) | 15 (26.3) | 16 (47.1) | 0.002 | 23 (44.2) | 32 (18.3) | <0.001 |
| | No | 103 (83.7) | 37 (75.5) | 19 (73.1) | | 112 (82.4) | 42 (73.7) | 18 (52.9) | | 29 (55.8) | 143 (81.7) | |
| **Postural Assessment 1** | Correct posture | 44 (35.8) | 28 (57.1) | 11 (42.3) | 0.080 | 52 (38.2) | 28 (49.1) | 14 (41.2) | 0.375 | 17 (32.7) | 77 (44.0) | 0.097 |
| | Incorrect posture | 79 (64.2) | 21 (42.9) | 15 (57.7) | | 84 (61.8) | 29 (50.9) | 20 (58.8) | | 35 (67.3) | 98 (56.0) | |
| **Postural Assessment 2** | Correct posture | 59 (48.0) | 26 (53.1) | 15 (57.7) | 0.648 | 69 (50.7) | 29 (50.9) | 19 (55.9) | 0.860 | 35 (67.3) | 82 (46.9) | 0.007 |
| | Incorrect posture | 64 (52.0) | 23 (46.9) | 11 (42.3) | | 67 (49.3) | 28 (49.1) | 15 (44.1) | | 17 (32.7) | 93 (53.1) | |
| **Postural Assessment 3** | Correct posture | 31 (25.2) | 20 (40.8) | 8 (30.8) | 0.243 | 33 (24.3) | 24 (42.1) | 10 (29.4) | 0.046 | 10 (19.2) | 57 (32.6) | 0.044 |
| | Incorrect posture | 92 (74.8) | 29 (59.2) | 18 (69.2) | | 103 (75.7) | 33 (57.9) | 24 (70.6) | | 42 (80.8) | 118 (67.4) | |

*Note: Chi-square test was used. Percentages are presented within each subgroup.*

WMSD prevalence differed significantly by ICU level (p=0.008), with 44.8% of nurses in level 2 units and 21.2% in level 3 units reporting WMSDs. WMSD prevalence also differed significantly by ICU type (p=0.015): 21.0% in anesthesia–reanimation ICUs and 39.0% in surgical ICUs.

Posture self-assessment (second evaluation) differed significantly according to WMSD status (p=0.003): correct posture was reported by 14.5% of nurses with WMSDs versus 34.3% of those without **(Table 5).**

**Table 5.** Ergonomic and Postural Variables by ICU Characteristics and MSD Status

| Variables | Category | Level 2 n (%) | Level 3 n (%) | p-value | Reanimation n (%) | Surgical ICU n (%) | p-value | WMSD Yes n (%) | WMSD No n (%) | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| **Daily Sleep Duration** | 3–4 hours | 5 (17.2) | 18 (9.1) | 0.370 | 18 (9.7) | 5 (12.2) | 0.599 | 8 (14.5) | 15 (8.7) | 0.008 |
| | 5–6 hours | 16 (55.2) | 127 (64.1) | | 120 (64.5) | 23 (56.1) | | 25 (45.5) | 118 (68.6) | |
| | 7–8 hours | 8 (27.6) | 53 (26.8) | | 48 (25.8) | 13 (31.7) | | 22 (40.0) | 39 (22.7) | |
| **Do You Sleep Regularly?** | Yes | 8 (27.6) | 32 (16.2) | 0.109 | 31 (16.7) | 9 (22.0) | 0.275 | 16 (29.1) | 24 (14.0) | 0.011 |
| | No | 21 (72.4) | 166 (83.8) | | 155 (83.3) | 32 (78.0) | | 39 (70.9) | 148 (86.0) | |
| **Ergonomics Training** | Yes | 4 (13.8) | 30 (15.2) | 0.554 | 24 (12.9) | 10 (24.4) | 0.057 | 11 (20.0) | 23 (13.4) | 0.163 |
| | No | 25 (86.2) | 168 (84.8) | | 162 (87.1) | 31 (75.6) | | 44 (80.0) | 149 (86.6) | |
| **Exercise Frequency** | Very rarely | 11 (37.9) | 68 (34.3) | 0.674 | 63 (33.9) | 16 (39.0) | 0.635 | 27 (49.1) | 52 (30.2) | 0.018 |
| | Rarely | 4 (13.8) | 46 (23.2) | | 40 (21.5) | 10 (24.4) | | 5 (9.1) | 45 (26.2) | |
| | Regularly | 5 (17.2) | 25 (12.6) | | 27 (14.5) | 3 (7.3) | | 6 (10.9) | 24 (14.0) | |
| | Never | 9 (31.0) | 59 (29.8) | | 56 (30.1) | 12 (29.3) | | 17 (30.9) | 51 (29.7) | |
| **Use of Body Mechanics** | Yes | 13 (44.8) | 81 (40.9) | 0.418 | 78 (41.9) | 16 (39.0) | 0.436 | 14 (25.5) | 80 (46.5) | 0.004 |
| | No | 16 (55.2) | 117 (59.1) | | 108 (58.1) | 25 (61.0) | | 41 (74.5) | 92 (53.5) | |
| **WMSD (Diagnosed)** | Yes | 13 (44.8) | 42 (21.2) | 0.008 | 39 (21.0) | 16 (39.0) | 0.015 | — | — | — |
| | No | 16 (55.2) | 156 (78.8) | | 147 (79.0) | 25 (61.0) | | — | — | — |
| **Postural Assessment 1** | Correct | 7 (24.1) | 87 (43.9) | 0.032 | 77 (41.4) | 17 (41.5) | 0.564 | 37 (67.3) | 80 (46.5) | 0.005 |
| | Incorrect | 22 (75.9) | 111 (56.1) | | 109 (58.6) | 24 (58.5) | | 18 (32.7) | 92 (53.5) | |
| **Postural Assessment 2** | Correct | 19 (65.5) | 98 (49.5) | 0.078 | 93 (50.0) | 24 (58.5) | 0.207 | 8 (14.5) | 59 (34.3) | 0.003 |
| | Incorrect | 10 (34.5) | 100 (50.5) | | 93 (50.0) | 17 (41.5) | | 47 (85.5) | 113 (65.7) | |
| **Postural Assessment 3** | Correct | 4 (13.8) | 63 (31.8) | 0.033 | 57 (30.6) | 10 (24.4) | 0.276 | 10 (18.2) | 57 (33.1) | 0.008 |
| | Incorrect | 25 (86.2) | 135 (68.2) | | 129 (69.4) | 31 (75.6) | | 45 (81.8) | 115 (66.9) | |

*Note: Chi-square test was used. Percentages are presented within each subgroup. Postural assessments were self-reported.*

Binary logistic regression analysis identified age (OR=1.06, 95% CI: 1.00–1.11, p=0.041), use of body mechanics (OR=0.30, 95% CI: 0.14–0.63, p=0.002), and ICU level (OR=0.33, 95% CI: 0.14–0.82, p=0.017) as significant factors associated with WMSDs. Regular sleep (p=0.434) and work type (p=0.096) were not statistically significant in the multivariable model **(Table 6).**

**Table 6.** Binary Logistic Regression Analysis of Factors Associated with Work-Related Musculoskeletal Disorders (WMSDs)

| Variable | OR | 95% CI | p-value |
|---|---|---|---|
| Age (years) | 1.06 | 1.00 – 1.11 | 0.041 |
| Regular sleep (Yes vs No) | 1.44 | 0.58 – 3.60 | 0.434 |
| Use of body mechanics (Yes vs No) | 0.30 | 0.14 – 0.63 | 0.002 |
| ICU level (Level 3 vs Level 2) | 0.33 | 0.14 – 0.82 | 0.017 |
| Work type (Shift vs Daytime) | 0.48 | 0.20 – 1.14 | 0.096 |

*Note: OR: Odds ratio; CI: Confidence interval. Binary logistic regression analysis was performed. p<0.05 was considered statistically significant.*

## Discussion

This study demonstrated that lifestyle habits, ergonomic awareness, postural behaviors, and working conditions play a significant role in the development of work-related musculoskeletal disorders (WMSDs) among surgical intensive care nurses. The findings reveal that these nurses are exposed to substantial ergonomic strain due to the physically demanding nature of their work. This result is consistent with recent studies showing a high prevalence of WMSDs among nurses, particularly in settings requiring continuous patient monitoring and frequent performance of invasive procedures (4,12,20). Recent evidence focusing specifically on intensive care environments also indicates that ICU nurses are exposed to multiple ergonomic stressors, including frequent patient mobilization, high equipment density, and sustained static postures, all of which substantially increase the risk of WMSDs (20). Exposure to multiple ergonomic stressors has been identified as a strong predictor of WMSDs among healthcare workers (5). In addition, recent systematic evidence indicates that nurses consistently represent one of the occupational groups with the highest prevalence of WMSDs across healthcare systems worldwide (12,30). Accordingly, the present study contributes meaningful data to the limited number of studies focusing specifically on surgical intensive care units (ICUs) in Türkiye.

The prevalence of WMSDs increased significantly with age and professional experience. This finding aligns with previous studies reporting that aging, cumulative mechanical load, and prolonged clinical exposure elevate the risk of musculoskeletal symptoms among nurses (21,22). Age-related declines in musculoskeletal flexibility and the increased likelihood that experienced nurses undertake more complex and physically demanding caregiving tasks may partially explain this association. Similar patterns identified in international nursing populations support the notion that both biological and occupational factors contribute substantially to elevated WMSD risk among older and more experienced nurses (13,21). The present findings therefore support the view that cumulative occupational exposure plays a critical role in the development of musculoskeletal disorders among nurses working in high-intensity clinical environments (5).

Sleep-related variables emerged as another influential factor in the development of WMSDs. Nurses with irregular or inadequate sleep had significantly higher rates of musculoskeletal symptoms, which is consistent with evidence indicating that shift work disrupts circadian rhythms, reduces sleep quality, and negatively affects physiological recovery processes (17–19). Circadian rhythm disruption has also been shown to exacerbate cognitive and physical stress responses among ICU nurses (19). Studies among night-shift healthcare workers also show that increased physical exertion combined with circadian rhythm disruption significantly impairs sleep quality (23). Insufficient sleep may elevate inflammatory markers and impair muscular recovery, thereby increasing susceptibility to pain and injury. In line with these mechanisms, musculoskeletal pain has been reported to be more common among nurses working night shifts due to increased physical load and reduced restorative sleep (24). These findings suggest that sleep quality and circadian rhythm stability may represent important but often overlooked factors influencing musculoskeletal health among ICU nurses. Although shift work was not identified as an independent predictor in the regression model, previous studies suggest that rotating shifts may still contribute indirectly to musculoskeletal strain through sleep disruption and cumulative fatigue (17–19).

Low levels of physical activity and infrequent exercise were also associated with a higher prevalence of WMSDs. This is consistent with studies indicating that insufficient physical activity weakens postural control, reduces muscle strength, and diminishes the body's resilience to ergonomic stress (25). Given the high physical demands of surgical ICUs, the protective role of regular exercise acquires particular importance. The finding that more than half of the nurses reported rarely or never exercising highlights a modifiable risk factor warranting attention in workplace health promotion programs. Encouraging regular physical activity may therefore represent a practical strategy to enhance musculoskeletal resilience among nurses exposed to continuous physical workload.

Correct body mechanics and postural behaviors demonstrated a strong protective effect. Previous research has shown that ergonomic training and posture-focused interventions effectively reduce musculoskeletal symptoms and improve patient care performance (15,16,26). Interventional studies conducted in intensive care settings further demonstrate that structured posture-regulation and ergonomic training programs can significantly decrease musculoskeletal symptoms and fatigue among ICU nurses (16). Studies examining patient-handling tasks have also documented the high biomechanical load experienced during patient transfers, emphasizing the importance of proper posture during routine clinical tasks (27). Patient transfer and repositioning activities have been identified as some of the most physically demanding nursing tasks, generating substantial biomechanical load on the spine and upper extremities (27). The lower prevalence of correct body mechanics among nurses with WMSDs in this study supports the existing evidence and suggests that practice-based ergonomic training should be prioritized.

Differences in WMSD prevalence across ICU levels underscore the contribution of environmental and organizational factors. Nurses working in third-level ICUs had substantially higher WMSD rates than those working in second-level units. These units involve a heavier workload, greater technological complexity, and more frequent mobilization of critically ill patients. Prior studies similarly report that environmental constraints, equipment ergonomics, patient acuity, and workflow intensity significantly influence musculoskeletal strain (11,28). High-acuity intensive care environments often require prolonged standing, repetitive patient handling, and rapid response to clinical emergencies, which collectively increase physical workload and ergonomic risk exposure (20,28). This highlights the need for systemic, environment-focused ergonomic improvements in high-acuity ICUs.

Finally, posture self-evaluations revealed that nurses with WMSDs were less likely to report correct posture, supporting the notion that ergonomic awareness and real-time postural behavior are interconnected. Previous research suggests that although knowledge of correct posture is important, workload intensity may impede its practical application (29). The present findings align with this interpretation, indicating that both knowledge and environmental support are necessary to promote sustained ergonomic behavior. Therefore, improving ergonomic awareness alone may not be sufficient unless supported by organizational measures that reduce excessive workload and facilitate the application of correct posture during clinical practice.

Overall, this study demonstrates that WMSDs among surgical ICU nurses result from the interplay of individual, behavioral, ergonomic, and environmental factors. The findings underscore the need for comprehensive strategies that include applied ergonomic training, supportive work environments, optimized shift scheduling, and physical activity promotion. These interventions have the potential not only to reduce WMSD risk but also to enhance nurse well-being, job satisfaction, and patient safety (14,26).

These findings suggest that ergonomic improvements, routine posture and body mechanics training, optimized shift scheduling, and programs aimed at promoting adequate sleep and physical activity may reduce the burden of WMSDs among surgical ICU nurses. Integrating these strategies into institutional policies and daily workflows could help enhance nurse well-being, reduce occupational injury risk, and ultimately strengthen patient safety in high-acuity intensive care environments (14,26).

## Conclusion

This study demonstrated that ergonomic risk factors, lifestyle habits, postural behaviors, and working conditions are significantly associated with work-related musculoskeletal disorders (WMSDs) among surgical intensive care nurses. Multivariable analysis further indicated that increasing age, lower use of proper body mechanics, and intensive care unit level were independently associated with WMSD occurrence. The findings also indicate that sleep patterns, physical activity levels, ergonomics training, and postural behaviors are related to musculoskeletal health among nurses working in high-intensity clinical environments. The higher prevalence of WMSDs observed in third-level ICUs highlights the potential influence of environmental workload and organizational characteristics on musculoskeletal strain.

These results highlight the need for multifaceted strategies to support the well-being of surgical intensive care nurses. In particular, strengthening the application of correct body mechanics, improving ergonomic awareness, and addressing workload-related environmental factors may help mitigate musculoskeletal strain in intensive care settings. Interventions such as applied ergonomics training, shift scheduling practices that promote sleep health, posture-supportive approaches integrated into daily workflows, and initiatives that encourage regular physical activity may contribute to improved musculoskeletal health and care quality. Such approaches may also support safer patient handling practices and contribute to the sustainability of the nursing workforce in high-acuity care environments.

In conclusion, protecting the musculoskeletal health of surgical intensive care nurses requires an integrated ergonomic approach that addresses individual, organizational, and environmental factors together. The findings of this study provide an essential foundation for developing evidence-based ergonomic interventions tailored to surgical intensive care settings and highlight opportunities for future longitudinal and interventional studies aimed at reducing WMSD risk among intensive care nurses.

## Limitations

This study has several limitations. First, the use of self-reported data may introduce recall and social desirability biases. The presence of WMSDs was based on participant reports rather than clinical assessment, which may have contributed to subjective variability. Similarly, posture evaluations and the use of body mechanics were assessed through self-report, which may not fully reflect actual ergonomic practices during clinical tasks.

Second, the sample consisted of members of the Turkish Intensive Care Nurses Association, which may limit the generalizability of the findings and introduce potential selection bias. Participants who are members of professional associations may differ from the broader nursing population in terms of professional engagement, training exposure, or awareness of ergonomic practices.

Third, the Nurse Identification Form served as a descriptive data collection tool; therefore, psychometric analyses such as construct validity or internal consistency testing were not applicable, which may limit the measurement strength of some variables. Ergonomic awareness was assessed indirectly through self-reported ergonomics training status rather than through a comprehensive validated scale, which may have limited the depth of ergonomic knowledge assessment. The form also did not include detailed assessments of environmental ergonomic factors (e.g., patient transfer frequency, equipment ergonomics, floor conditions), nor did it capture workload-related indicators such as staffing ratios or patient acuity, which may have excluded certain contextual determinants of WMSDs. In addition, the absence of participants in the obese body mass index (BMI) category prevented the evaluation of obesity as a potential risk factor for WMSDs in this study.

Finally, as a cross-sectional study, the design does not allow for causal inference between variables. Although regression analyses were performed to explore associations between selected factors and WMSDs, unmeasured variables and residual confounding cannot be ruled out. Future research employing longitudinal and interventional designs, as well as advanced statistical modeling, would provide deeper insight into the causal mechanisms underlying WMSDs and the effectiveness of ergonomic interventions.

## Declarations

### *Funding*

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### *Conflict of Interest*

The authors declare that they have no conflict of interest.

### *Ethics Approval*

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee of Marmara University Faculty of Health Sciences (Date: April 25, 2024; Decision No: 72). Institutional permission was obtained from the Turkish Intensive Care Nurses Association. All procedures were conducted in accordance with the Declaration of Helsinki, and informed consent was obtained electronically from all participants prior to data collection.

### *Availability of Data and Material*

The datasets generated and/or analyzed during the current study are not publicly available due to ethical and privacy considerations but are available from the corresponding author on reasonable request.

### *Author Contributions*

N.O.: Conceptualization, study design, data analysis, interpretation of data, and manuscript writing.

H.B.K.: Study design, supervision, and critical revision of the manuscript.

M.K.: Data collection, data organization, and contribution to manuscript drafting.

N.A.: Literature review, data interpretation, and manuscript editing.

All authors read and approved the final manuscript.

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