# The Impact of Work-Related Musculoskeletal Pains on Routine Tasks Among Operating Room Nurses: A Cross-Sectional Study

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ABSTRACT

*Purpose:* To determine work-related musculoskeletal pain (MSP) among 105 operating room nurses (ORNs) and its effect on their routine work.
*Design:* Multicenter cross-sectional design.
*Methods:* This study was conducted with 105 nurses working in operating rooms of five different hospitals between December 15, 2024, and February 15, 2025. Data were collected using the "Nordic Musculoskeletal Questionnaire." SPSS 27.0 was used for data analysis, and a significance level of $p < .05$ was established.
*Results:* Among the nurses, 75.2% were female, 78.1% had undergraduate education, and 59% worked >40 hours/week. In the previous 12 months, 69.5% of ORNs experienced lower back pain; 68.6%, neck pain; and 61.9%, back pain. The duration spent working as a scrub nurse increased the possibility of experiencing pain in the hands, wrists, back, shoulders, and lower back region ($p < .05$), and women had an increased risk of lower back and back pain ($p < .05$). Neck, lower back, back, wrist, and hand pain increased the risk of being unable to perform daily tasks ($p < .05$).
*Conclusions:* Extended work hours as a scrub nurse increase the risk of MSP, including lower back region, neck, and back pain among ORNs. Women have a higher risk of lower back and back pain. Addressing musculoskeletal issues in this profession is crucial.
*Clinical Implications:* Addressing musculoskeletal discomfort is vital because of its impact on nurses' job performance and potential patient harm. Providing ergonomic equipment, training nurses on musculoskeletal health, and raising awareness can help. It is also important to encourage regular breaks.

Key Practice Points

- Operating-room nurses (ORNs) experience a high prevalence of work-related musculoskeletal system (MSS) pain.
- Three-quarters of ORNs complained of work-related MSS pain in the past 12 months and within the past 7 days.
- Age, body mass index, operating room experience, and working as a scrub nurse in the operating room contributed to this pain.

## Introduction

Musculoskeletal pain (MSP) is a major global concern affecting approximately 1.71 million people in 2023 according to the World Health Organization (WHO). Currently, the prevalence of MSP is high and is projected to increase further (World Health Organization, 2023). MSP imposes substantial direct and indirect burdens on individuals and governments (Asghari et al., 2019). Work-related MSP reduces work productivity, increases disability rates, and elevates social and economic burdens due to absenteeism and sick leave (Choi & Brings, 2015; Rypicz et al., 2020). Resultant actions, such as early retirement may have long-term economic impacts (Rypicz et al., 2020).

Many occupational dangers in operating rooms have the potential to cause MSP among healthcare staff (Martí-Ejarque et al., 2021). Several occupational diseases have been associated with

MSP (Anderson & Oakman, 2016) and are thus considered important sources of morbidity among operating room nurses (ORNs) (Asghari et al., 2019; Jacquier-Bret & Gorce, 2023). A comprehensive analysis found that between 33% and 88% of nurses reported having discomfort in any part of their bodies (Soylar & Özer, 2018). In a recent meta-analysis, the prevalence of lower back pain among ORNs was 55% (Tavakkol et al., 2020).

ORNs face increased physical and biomechanical dangers during their everyday work, increasing the risk of MSP. One of the most prominent risk factors for work-related MSP is static stress. Rapid movements during crises and holding the same posture for an extended period, nonergonomic positions during surgery, and the performance of continuous repetitive, monotonous movements, depending on the type and duration of surgery could play a role. This scenario can lead to constant static loading and postural stress on ORNs. Exposure to dynamic stresses in the workplace, such as pushing, pulling, or lifting heavy objects involving patients and surgical equipment, can trigger work-related MSP (Choobineh et al., 2010; Asghari et al., 2019). The physical and ergonomic risks that ORNs encounter at work may cause functional impairments in the musculoskeletal system and a decline in their quality of life (Beaudart et al., 2018). Sociodemographic characteristics also increase the risk of work-related MSP (Choi & Brings, 2015; Karimi et al., 2018; Rosa et al., 2021). Female sex, high body mass index (BMI), and obesity placed individuals at higher risk (Choi & Brings, 2015; Karimi et al., 2018; Rosa et al., 2021). According to a recent meta-analysis, full-time female ORNs had a higher risk of work-related MSP (Clari et al., 2019). The reduction in estrogen levels in women leads to muscle and bone loss, resulting in sarcopenia and osteoporosis. This condition causes functional loss and pain in the musculoskeletal system (Abidin, 2023).

Previous research has identified several factors that contribute to the development of MSP. These factors can be individual, biomechanical, and psychosocial (Asghari et al., 2019). MSP can be influenced by individual factors such as age, gender, genetics, nutrition, physical activity, weight, working conditions, psychological states, and chronic diseases. These range from genetic predispositions to lifestyle choices, with aging, poor nutrition, a sedentary lifestyle, and constant stress playing decisive roles in the development of pain. Research has examined the roles of biomechanical, physical, psychosocial, and organizational factors in the development of MSP. Bin Homaid et al. (2016) reported that risky activities contribute to back pain among ORNs. Such activities include lifting objects from lower back level, twisting the body while bearing weight, transferring patients to beds and chairs, pulling patients up in bed, and positioning patients in bed, all of which can increase back pain (Homaid et al., 2016). Rest and analgesics are among the recommended palliatives for such pains. Psychological work stress is an occupational risk factor contributing to the prevalence of work-related MSP among ORNs (Long et al., 2012). MSP in ORNs is often linked to inadequate organization of the work environment and poor working conditions (Bernal et al., 2015). While genetic and morphological factors are unchangeable, psychosocial, and biomechanical factors can be modified (Asghari et al., 2019). Choobineh et al. (2010) found that back pain is the most common problem for ORNs. Regarding working conditions, longer working hours, frequent shift changes, working on off days, mandated working hours, and limited rest periods significantly increase exposure to physical risks (Trinkoff et al., 2006).

Previous studies have measured the prevalence of work-related MSP among ORNs, but the impact of this pain on their daily work routines has not been analyzed (Abdollahi et al., 2020; Anderson & Oakman, 2016; Choobineh et al., 2010; Clari et al., 2019). There is limited data in the literature on whether the presence of MSP in any part of the body affects the daily work of ORNs. Determining the impact of occupational MSP on daily work life can help design necessary precautions and plan care routines. Therefore, this study aimed to identify work-related MSP among ORNs and its impact on their daily work routine.

## Material and Methods

### *Study Hypotheses*

*H0 hypothesis:* The descriptive characteristics of ORNs do not affect MSP.

*H1 hypothesis:* The descriptive characteristics of ORNs affect MSP.

### *Study Type*

Multicenter cross-sectional study.

### *Universe and Sample of the Study*

Using logistic regression to predict MSP risk factors, the sample size was determined using the G* Power 3.1.9.7 program (University of Dusseldorf/Germany). Assuming a 2.1 odds ratio, 0.05 $\alpha$ error, 0.20 $\beta$ error, and 80% power with a two-way hypothesis, the minimum number of participants needed was 100. Considering data loss, we included 105 participants. In determining the participants of the study, a simple random sampling method was used to ensure that each ORN had an equal chance of participating in the research. The study involved 130 nurses from five state hospitals and one private hospital. A total of 105 nurses from these hospitals volunteered, meeting the criteria, between December 15, 2021, and February 15, 2022, constituting 80% of the study population.

### *Sample Criteria*

#### *Inclusion criteria*

1) Working as a nurse in a private or public hospital.
2) Nurses who had been working in the operating room for the previous year according to the date of the study and volunteered to participate.

#### *Exclusion criteria*

1) Nurses who volunteer to participate in the study, but either choose not to answer survey questions or provide incomplete responses.
2) Nurses who had worked for less than a year.

### *Data Collection Tools*

The data were collected using the "Descriptive Information Form," which included the information of the individuals, and the "Nordic Musculoskeletal Questionnaire."

*Section I Introductory Information Form*: Introductory Information Form-15 questions covering age, gender, education, work style, hours, experience, role, standing time, breaks, height, weight, and BMI. Participants completed questionnaires individually.

*Section II Nordic Musculoskeletal Questionnaire:* The Nordic Musculoskeletal Questionnaire was used in the second part of the data collection to assess the nurses' views on musculoskeletal problems. The questionnaire was created by Dawson et al. (2009) to measure pain and activity avoidance in nine body regions. It evaluated lower back pain, neck, shoulder, and general musculoskeletal complaints using standardized questions. The questionnaire offered reliable information on disturbances in specific body areas

in the past 12 months and 7 days. Adapted into Turkish by Kahraman et al. (2016), it showed high internal consistency (Cronbach's alpha 0.896). In this study, Cronbach's alpha was 0.91. Permission to use the questionnaires was obtained.

*Collection of Study Data*

*Pilot study: We* conducted a pilot study involving 10 specialist nurses to ensure the clarity of the data collection form. No changes were needed, and thus pilot data were included.

ORNs in the operating room were informed about the study and they signed a voluntary form. The data for the study was collected via face-to-face surveys. The researcher visited the operating rooms where the nurses worked before the start of their shifts to distribute the survey questionnaires. To avoid the impact of fatigue on their responses, the nurses were asked to answer the survey questions before the start of their shifts. After completing the surveys, the ORNs were instructed to hand the data collection forms back to the researcher. To ensure that the responses were not influenced by others, the ORNs were asked to fill out the survey questions individually. ORNs completed the questionnaire, taking 10-15 minutes for both parts. The study was reported using the STROBE checklist (EQUATOR Network, in press) (https://www.equator-network.org/).

*All outcomes*

The results of this study identified the presence of MSP in the past 12 months and the past 7 days in ORNs. Additionally, the study determined whether MSPs in ORNs affect their daily routine tasks. Variables influencing pain risk and factors affecting the inability to perform daily routines in ORNs were also identified.

*Exposures*

*Physical load:* Standing for long periods, lifting heavy loads, bending, and stretching can cause MSP.

*Ergonomic risks:* Irregular placement of surgical equipment or inappropriate working heights can create unnecessary strain on the body.

*Repetitive movements:* Holding surgical tools for extended periods can lead to injuries, especially in the hands, wrists, and shoulders.

*Psychological stress:* The fast pace and high stress of the operating room environment can exert extra pressure on nurses, leading to physical and emotional fatigue.

*Long working hours and insufficient rest:* Extended working hours and lack of rest can cause fatigue, decreased attention, and reduced movement coordination.

*Operating room positions:* Challenging positions during surgical procedures can lead to excessive strain on specific muscle groups and cause pain.

*Predictors*

*Demographic information:* Factors such as age, gender, job experience, and education level.

*Previous musculoskeletal problems:* Presence of prior musculoskeletal issues.

*Health behaviors:* Frequency of exercise, posture habits, and other health-related lifestyle factors.

*Potential confounders*

*General health status:* Other health conditions or related health issues.

*Socioeconomic status:* Income level, social support, and job security.

*Work environment:* Stress levels at work, relationships with colleagues, and management support.

*Effect modifiers*

*Use of personal protective equipment:* For example, proper footwear or supportive belts.

*Education and awareness programs:* Training on musculoskeletal health and ergonomics.

*Lifestyle and personal habits:* Smoking, alcohol use, and overall level of physical activity.

*Ethical Aspect*

Approval was obtained from the Ethics Committee of Hasan Kalyoncu University (Approval No. 2021/033). Nurses provided written informed consent after being informed about the study (Emanuel et al., 2004). Withdrawal was allowed at any stage. The research adhered to international guidelines and the Declaration of Helsinki.

In the study, nurses experiencing MSP might be more inclined to participate. To prevent sample selection bias, the research was planned as a cross-sectional study. To avoid measurement bias, the "Nordic Musculoskeletal Questionnaire," was utilized which has been used globally in numerous studies. To ensure that the nurses' workload during the day does not affect their responses to the survey questions, they were asked to answer the survey questions individually and before starting their shift.

*Statistical Analysis*

The dependent variables of the study are whether ORNs experienced MSP in the last 12 months and the last 7 days, as well as the effect of MSPs on their ability to perform daily routine tasks. The independent variables of the study included the ORNs' age, gender, education level, work timings in the operating room, participation in operations, BMI, years of nursing experience, years of experience in operating room nursing, daily standing time (hours), working time as a scrub nurse in the operating room (hours), and working time as a circulating nurse in the operating room. Surveys that were incompletely filled out were excluded from the sample and were not included in the study.

Data were analyzed using SPSS software (version 20.0; IBM Inc., Canada). Discrete values are represented by numbers ($n$) and percentages (%), while continuous values are presented as mean $\pm$ standard deviation. The chi-square test compared categorical variables. Logistic regression analyzed how ORN characteristics influenced work-related MSP risk. Significance was set at $p < .05$.

## Results

ORNs' mean age was 36.55 $\pm$ 8.51 years, with 41% being $\leq$41 years old, 75.2% were women, 81.9% had undergraduate or postgraduate education, and 18.1% had vocational health degrees. Among the ORNs, 83.3% worked day and night in ORs, and 75.2% did both scrubbing and circulating. Mean BMI was 25.35 $\pm$ 3.69 kg/m$^2$, with 47.6% $\geq$26 kg/m$^2$. Nursing experience averaged 14.11 $\pm$ 9.40 years; 57.1% had $\leq$11 years. ORNs experience was 10.05 $\pm$ 7.92 years; 44.8% $\leq$11 years. Weekly work was 49.15 $\pm$ 10.48 hours, 59% $\leq$41 hours. Daily standing time was 7.78 $\pm$ 2.35 hours, 71.4% $\geq$8 hours. Scrub nursing averaged 6.51 $\pm$ 4.73 hours, with 61.9% $\geq$4 hours. Circulating nursing averaged 5.04 $\pm$ 4.73 hours, 60% $\leq$5 hours (Table 1).

It was found that 82.9% of ORNs had pain in at least one area in the past 12 months, and the pain affected daily routine work in 70.5% of ORNs. In addition, 79% of the ORNs experienced pain in at least one area in the past 7 days (Fig. 1).

**Table 1**
Descriptive Characteristics of Operating Room Nurses ($N = 105$).

| Descriptive Characteristics | *n* | (%) |
|---|---|---|
| **Age** (mean ± SD[a] = 36.55 ± 8.51, minimum: 22-maximum: 51) | | |
| ≤30 | 37 | 35.2 |
| 31-40 | 25 | 23.8 |
| ≥41 | 43 | 41.0 |
| **Sex** | | |
| Female | 79 | 75.2 |
| Male | 26 | 24.8 |
| **Educational status** | | |
| Health vocational high school and associate degree | 19 | 18.1 |
| Undergraduate and postgraduate | 86 | 81.9 |
| **Work timings in the operating room** | | |
| Daytime only | 17 | 16.2 |
| Night and daytime | 88 | 83.3 |
| **Participation in operations** | | |
| Circulating nurse | 6 | 5.7 |
| Scrub nurse | 20 | 19.0 |
| Scrub and circulating nurse | 79 | 75.2 |
| **BMI** (mean ± SD[a]; 25.35 ± 3.69, Min: 17.97-Max: 34.01) | | |
| ≤25 | 46 | 43.8 |
| ≥26 | 50 | 47.6 |
| **Experience in nursing (years)** (mean ± SD[a]: 14.11 ± 9.40, Min: 1-Max: 32) | | |
| ≤5 | 29 | 27.6 |
| 6-10 | 16 | 15.2 |
| ≥11 | 60 | 57.1 |
| **Experience in operating room nursing (years)** (mean ± SD[a]: 10.05 ± 7.92, Min: 1-Max: 31) | | |
| ≤5 | 44 | 41.9 |
| 6-10 | 14 | 13.3 |
| ≥11 | 47 | 44.8 |
| **Weekly working time (hours) (**mean ± SD[a]: 49.15 ± 10.48, Min: 24-Max: 72) | | |
| ≤40 hours | 43 | 41.0 |
| ≥41 hours | 62 | 59.0 |
| **Standing time per day (hours)** (mean ± SD[a]: 7.78 ± 2.35, Min 1-Max 24) | | |
| ≤8 hours | 75 | 71.4 |
| ≥9 hours | 30 | 28.6 |
| **Working time as a scrub nurse in the operating room (hours) (**mean ± SD[a]: 6.51 ± 4.73, Min: 1-Max: 8) | | |
| ≤4 hours | 65 | 61.9 |
| ≥5 hours | 40 | 38.1 |
| **Working time as a circulating nurse in the operating room (hours) (**mean ± SD[a]: 5.04 ± 4.73, Min: 1-Max: 12) | | |
| ≤4 hours | 42 | 40.0 |
| ≥5 hours | 63 | 60.0 |

[a] Mean ± SD: Mean ± standard deviation.

BMI = body mass index.

**Table 2**
Frequency of Pain Among Operating Room Nurses According to Body Regions ($N = 105$).

| Pain region | Presence of MSP in the Last 12 Months *n* (%) | Effect of MSP in the Last 12 Months on Daily Routine Work *n* (%) | Presence of MSP in the Last 7 Days *n* (%) |
|---|---|---|---|
| **Lower back** | 73 (69.5) | 50 (47.6) | 58 (55.2) |
| **Neck** | 72 (68.6) | 42 (40.0) | 43 (41.0) |
| **Back** | 65 (61.9) | 38 (36.2) | 48 (45.7) |
| **Shoulder** | 60 (57.1) | 35 (33.3) | 32 (30.5) |
| **Knee** | 49 (46.7) | 23 (21.9) | 27 (25.7) |
| **Wrist/hands** | 45 (42.9) | 27 (25.7) | 24 (22.9) |
| **Ankle/foot** | 43 (41.0) | 27 (25.7) | 25 (23.8) |
| **Hip/thigh** | 33 (31.4) | 16 (15.2) | 14 (13.3) |
| **Elbow** | 20 (19.0) | 9 (8.6) | 9 (8.6) |

MSP = musculoskeletal pain.

Last year (2022), ORNs experienced pain in the lower back region (69.5%), neck (68.6%), back (61.9%), shoulder (57.1%), knee (46.7%), hand/wrist (42.9%), foot/ankle (41%), hip/thigh (31.4%), and elbow (19%). Pain affecting daily work was seen in the lower back region (47.6%), neck (40%), back (36.2%), shoulder (33.3%), knee (21.9), wrist/hand (25.7%), ankle/foot (25.7%), hip/thigh (15.2%), and elbow (8.6%). In the past 7 days, pain occurred in the lower back region (55.2%), back (45.7%), neck (41%), shoulder (30.5%), knee (25.7%), ankle/foot (23.8%), wrist/hand (22.9%), hip/thigh (13.3%), and elbow (8.6%) (Table 2).

When comparing work-related MSP in ORNs between the past 12 months and the past 7 days by age groups, no difference was seen in the past 7 days. However, in the past 12 months, MSP was higher among ORNs aged 41 and over, with the difference being statistically significant ($p = .001$, $p < .05$). No significant differences were found for biological sex, education, work style, and participation as a circulation nurse or scrub nurse in operations concerning work-related MSP ($p > .05$). BMI showed significant differences between the past 12 months and the past 7 days ($p = .001$, $p = .013$). The nursing experience yielded no significance, but the operating

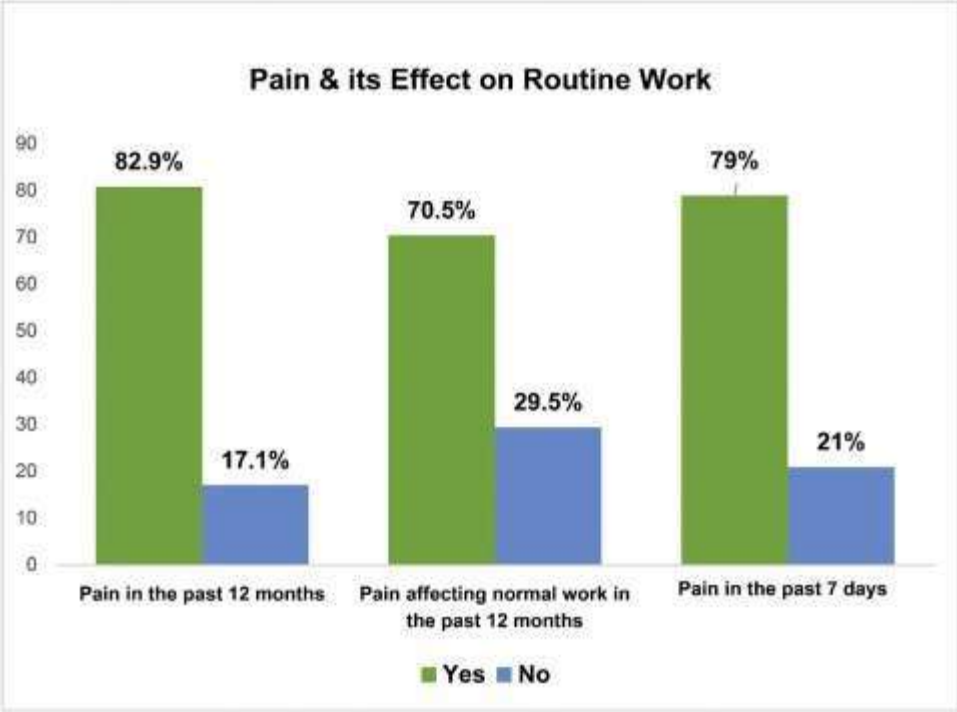


**Figure 1.** Effect of pain in at least one area in the past 12 months, in the past 7 days, and the effect of pain in the past 12 months ($N = 105$) on daily routine work.

room experience did ($p = .035$, $p = .001$, $p < .05$). Weekly work and daily standing times were not significant ($p > .05$). Scrub nursing time was significant ($p = .001$, $p = .002$, $p < .05$), but circulating nursing was not ($p > .05$) (Table 3).

The results of the bivariate logistic regression of the factors influencing MSP in different body regions of ORNs are presented in Table 4. The number of hours worked daily as a scrub nurse significantly affected MSP in the lower back region, neck, back, shoulder, and wrist/hand ($p = .001$, .001, .001 .030, .025, respectively). Sex and BMI of the ORN significantly affected MSP in the lower back region ($p = .035$ and .048, respectively) and back ($p = .038$ and .040, respectively). In addition, the lower back region was significantly affected by the manner of participation in surgeries (scrub) during the day ($p = .012$) and the duration of standing during the day ($p = .016$). Further, neck pain was influenced by years of experience in operating room care, attending surgeries per day as a scrub nurse, and hours worked per week ($p = .007$, .009, and .042, respectively) (Table 4).

The bivariate logistic regression results of the MSPs that affect the daily routine tasks of ORNs are presented in Table 5. The most significant factors were pain in the neck, lower back, upper back, hand/wrist, and shoulder ($p = .001$, .001, .004, .010, .025, respectively) (Table 5).

## Discussion

In this study, we aimed to determine work-related MSP among ORNs and its impact on their daily routine tasks and obtained important results. The study's key finding is that over two-thirds of ORNs reported having MSP in any part of their body in the past 12 months. Furthermore, MSPs pose a risk of interfering with the daily routine tasks of ORNs. Preventing work-related MSP among nurses has become a global health and safety goal supported by the WHO. It was been emphasized that urgent improvement measures need to be developed (Lucchini & London, 2014). However, due to the high prevalence of MSPs, measures to reduce work-related MSPs are inadequate, contrary to the WHO recommendations (Anderson & Oakman, 2016; Clari et al., 2021; Telaprolu & Anne, 2014). One study reported that ORNs represent a high-risk group for work-related MSP (Bos et al., 2007). Work-related musculoskeletal diseases should be recognized as occupational diseases, and protective measures should be implemented. Work-related musculoskeletal disorders and MSPs are conditions that arise due to the physical challenges healthcare professionals encounter while performing their jobs. These conditions, particularly due to repetitive and static postures, can cause pain and loss of function in specific body areas (Jacquier-Bret & Gorce, 2023). The International Labor Organization's Guide to Workplace Improvement Measures suggests looking for ergonomic solutions to address musculoskeletal problems among nurses (International Labour Organization, 2012). The present study results suggest that interventions addressing physical and ergonomic risks posed by the operating room environment are inadequate for ORNs.

In this study, individuals aged ≥41 years reported a higher incidence of experiencing pain in any body part over the past 12 months. However, logistic regression analysis did not indicate an association between age and the risk of MSP, potentially due to the analysis being based on regional pain or an insufficient sample size. Contrary to this, Bin Homaid et al. (2016) identified advancing age as a risk factor for worsening back pain and other MSPs, and Moscato et al. (2010) observed an increased frequency of lower back pain in ORNs older than 35 years. On the other hand, Kandemir et al. (2019) found that MSPs might be more prevalent in younger individuals, possibly because young nurses more frequently work in operating rooms. These discrepancies could be attributable to varying working conditions. Comparisons should be made in large-scale studies to determine MSP among nurses in different age groups. More evidence is needed to clarify the association between age and MSPs.

In this study, we observed that individuals with a BMI ≥26 kg/m$^2$ exhibited a higher rate of MSP. Logistic regression analysis identified BMI as a risk factor for back and lower back pain,

**Table 3**
Comparison of Musculoskeletal Pain Among Operating Room Nurses in the Last 12 Months and Last 7 Days According to Descriptive Characteristics ($N = 105$).

| Descriptive Characteristics | MSP in the Last 12 Months | | | MSP in the Last 7 Days | | |
|---|---|---|---|---|---|---|
| | Yes *n* (%) | No *n* (%) | Test/*p* | Yes *n* (%) | No *n* (%) | Test/*p* |
| **Age** | | | | | | |
| ≤30 | 22 (21.0) | 15 (14.3) | **$X^2 = 15.484$** | 28 (26.7) | 9 (8.6) | $X^2 = 2.117$ |
| 31-40 | 20 (19.0) | 5 (4.8) | **$p = .001$** | 22 (21.0) | 3 (2.9) | $p = .347$ |
| ≥41 | 41 (39.0) | 2 (1.9) | | 37 (35.2) | 6 (5.7) | |
| **Sex** | | | | | | |
| Female | 67 (63.8) | 12 (11.4) | $X^2 = 0.857$ | 61 (58.1) | 18 (17.1) | $X^2 = 0.647$ |
| Male | 20 (19.0) | 6 (5.7) | $p = .355$ | 22 (21.0) | 4 (3.4) | $p = .421$ |
| **Educational status** | | | | | | |
| Health vocational high school and associate degree | 16 (15.2) | 3 (2.9) | $X^2 = 0.030$ | 14 (13.3) | 5 (4.8) | $X^2 = 0.403$ |
| Undergraduate and postgraduate | 71 (67.6) | 15 (14.3) | $p = .863$ | 69 (65.7) | 17 (16.2) | $p = .526$ |
| **Work timings in the operating room** | | | | | | |
| Daytime only | 15 (14.3) | 2 (1.9) | $X^2 = 0.413$ | 16 (15.2) | 1 (1.0) | $X^2 = 2.781$ |
| Night and daytime | 72 (68.6) | 16 (15.2) | $p = .520$ | 67 (63.8) | 21 (20.0) | $p = .095$ |
| **Participation in operations** | | | | | | |
| Circulating nurse | 6 (5.7)) | - | | 5 (4.6) | 1 (1.0) | |
| Scrub nurse | 18 (17.1) | 2 (1.9) | $X^2 = 2.498$ | 18 (17.1) | 2 (1.9) | $X^2 = 1.973$ |
| Scrub and circulating nurse | 63 (60.1) | 16 (15.2) | $p = .287$ | 60 (57.1) | 19 (18.1) | $p = .373$ |
| **BMI** | | | | | | |
| ≤25 | 31 (29.5) | 16 (15.2) | **$X^2 = 17.108$** | 32 (30.5) | 15 (14.3) | **$X^2 = 6.174$** |
| ≥26 | 56 (53.3) | 2 (1.9) | **$p = .001$** | 51 (48.6) | 7 (6.7) | **$p = .013$** |
| **Experience in nursing (years)** | | | | | | |
| ≤5 | 16 (15.2) | 13 (12.4) | $X^2 = 0.674$ | 20 (19.0) | 9 (8.6) | $X^2 = 5.450$ |
| 6-10 | 11 (10.5) | 5 (4.8) | $p = .714$ | 14 (13.3) | 2 (1.9) | $p = .066$ |
| ≥11 | 56 (53.3) | 4 (3.8) | | 53 (50.5) | 7 (6.7) | |
| **Experience in operating room nursing (years)** | | | | | | |
| ≤5 | 27 (25.7) | 17 (16.2) | **$X^2 = 14.313$** | 32 (30.5) | 12 (11.4) | **$X^2 = 6.790$** |
| 6-10 | 13 (12.4) | 1 (1.0) | **$p = .001$** | 14 (13.3) | - | **$p = .035$** |
| ≥11 | 43 (41.0) | 4 (3.8) | | 41 (39.0) | 6 (5.7) | |
| **Weekly working time (Hours)** | | | | | | |
| ≤40 hours | 34 (32.4) | 9 (8.6) | $X^2 = 0.735$ | 37 (35.2) | 6 (5.7) | $X^2 = 2.154$ |
| ≥41 hours | 53 (50.5) | 9 (8.6) | $p = .391$ | 46 (43.8) | 16 (15.2) | $p = .142$ |
| **Standing time per day (hours)** | | | | | | |
| ≤8 hours | 64 (61.0) | 11 (10.5) | $X^2 = 1.133$ | 62 (59.0) | 13 (12.4) | $X^2 = 2.076$ |
| ≥9 hours | 23 (21.9) | 7 (6.7) | $p = .287$ | 21 (20.0) | 9 (8.6) | $p = .150$ |
| **Working time as a scrub nurse in the operating room (hours)** | | | | | | |
| ≤4 hours | 29 (27.6) | 13 (12.4) | **$X^2 = 9.398$** | 24 (22.9) | 18 (17.1) | **$X^2 = 20.279$** |
| ≥5 hours | 58 (55.2) | 5 (4.8) | **$p = .001$** | 59 (56.2) | 4 (3.8) | **$p = .002$** |
| **Working time as a circulating nurse in the operating room (hours)** | | | | | | |
| ≤4 hours | 54 (51.4) | 11 (10.5) | $X^2 = 0.006$ | 53 (50.5) | 12 (11.4) | $X^2 = 0.639$ |
| ≥5 hours | 33 (31.4) | 7 (6.7) | $p = .939$ | 30 (28.6) | 10 (9.5) | $p = .424$ |

MSP = musculoskeletal pain; BMI = body mass index.
Bold value shows Statistically significant.

**Table 4**
Bivariate Logistic Regression for Factors Affecting Musculoskeletal Pain in Different Body Regions Among Operating Room Nurses.

| Body Region | Variable | Odds Ratio | 95% CI | *p* Value |
|---|---|---|---|---|
| Lower back | Working time as a scrub nurse in the operating room per day (hours) | 4.350 | 1.550-2.820 | .001 |
| ($n = 73$) | Participation in operations per day (scrub) | 2.327 | 0.798-3.454 | .012 |
| | Standing time per day (hours) | 2.100 | 0.976-3.762 | .016 |
| | Gender | 1.632 | 0.903-3.101 | .035 |
| | BMI | 1.480 | 0.843-4.122 | .048 |
| Neck ($n = 72$) | Working time as a scrub nurse in the operating room per day (hours) | 3.260 | 1.590-6.670 | .001 |
| | Experience in operating room nursing (years) | 2.447 | 0.976-3.542 | .007 |
| | Participation in operations per day (scrub) | 2.357 | 0.960-2.670 | .009 |
| | Weekly working time (hours) | 1.692 | 0.960-4.247 | .042 |
| Back ($n = 65$) | Working time as a scrub nurse in the operating room per day (hours) | 4.100 | 1.446-3.112 | .001 |
| | Gender | 1.428 | 0.879-3.831 | .038 |
| | BMI | 1.721 | 0.896-2.841 | .040 |
| Shoulder ($n = 60$) | Working time as a scrub nurse in the operating room per day (hours) | 1.528 | 0.927-3.103 | .030 |
| Wrist/hands ($n = 45$) | Working time as a scrub nurse in the operating room per day (hours) | 1.841 | 1.102-3.345 | .025 |

CI = confidence interval; BMI = body mass index.

**Table 5**
Bivariate Logistic Regression for Musculoskeletal Pain that Most Significantly Affects the Daily Routine Work of Operating Room Nurses.

| | Variable | Odds Ratio | 95% CI | *p* Value |
|---|---|---|---|---|
| Pain interfering with daily routine work | Neck | 19.375 | 4.309-87.143 | .001 |
| | Lower back | 7.071 | 2.592-19.290 | .001 |
| | Back | 4.738 | 1.644-13.656 | .004 |
| | Wrist/hands | 4.345 | 1.102-3.345 | .010 |
| | Shoulder | 4.000 | 1.385-11.553 | .025 |

CI = confidence interval.

supporting the findings by Clari et al. (2021), who noted that increased BMI contributes to musculoskeletal problems. However, no statistical relationship between BMI and MSP was established upon regression analysis. Given the physical and ergonomic risks associated with ORN work schedules and operating room conditions, individual risk factors like BMI could potentially heighten the rate of work-related MSP. It is suggested that the relationship between BMI and MSP should be further investigated in studies with larger sample sizes.

Logistic regression analysis revealed that female sex increased the risk of back and neck pain. Similarly, Asghari et al. (2019) found that female sex influences the risk of MSP in ORNs. A meta-analysis conducted by Clari et al. (2019) reported that full-time employment and female sex among ORNs increased the risk of MSP. We found that the most common pain areas in ORNs were the lower back, neck, back, and shoulder regions, consistent with previous study results (Abdollahi et al., 2020; Aljeesh & Nawajha, 2011; Bin Homaid et al., 2016; Choobineh et al., 2010; Clari et al., 2019). Moreover, the prevalence of MSP was higher among scrub nurses who worked in a static position for ≥5 hours compared to those who worked shorter shifts. Additionally, logistic regression analysis revealed that working in a static position as a scrub nurse for ≥5 hours increased the risk of experiencing pain in the lower back, neck, back, shoulder, wrist, and hands. Moreover, Clari et al. (2021) reported that being a scrub nurse was associated with an increased risk of work-related MSP.

The causes of MSP in ORNs often stem from both physical activity and immobility-related factors. Research in this area indicates that ORNs standing in a fixed position for long periods or repeating the same movements can have adverse effects on the musculoskeletal system. Prolonged static positions are usually more harmful than dynamic positions and are often associated with higher lactic acid accumulation (Wan et al., 2017). Remaining in the same position for a long time during surgical procedures increases tension in the upper extremities due to body tilt (Tamminen-Peter & Nygren, 2019). During surgery, ORNs continuously switch their gaze between the patient and the surgeon to quickly deliver the desired instruments. Therefore, nurses perform repetitive manipulative movements to access surgical materials and deliver surgical instruments to the surgeon, leading to strain in the upper extremities. In doing so, surgical nurses often bend their wrists and keep their elbows higher than necessary. This positioning may be due to the poor ergonomic design of surgical instruments (Kellahan et al., 2023).

To minimize physical strain and discomfort, upper extremity support should always be used. Surgical trays and instrument tables should be positioned correctly. The work of ORNs and rest periods should be regulated. A study by Tinubu et al. (2010) reported that the most important risk factor for work-related MSP in nurses (55.1%) was staying in the same position for an extended duration. The study found that individuals with ≥6 years of surgical experience had a higher rate of MSP. Working in operating rooms for long periods of time is a risk factor for MSP.

Similar to our study results, Moscato et al. (2010) reported increased lower back pain with increasing experience. The WHO announced that musculoskeletal problems significantly limit mobility and manual dexterity, leading to early retirement, reduced well-being, and decreased social interaction (https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions). ORNs are exposed to various job-specific risk factors, such as carrying heavy loads, frequent bending and twisting, sudden and repetitive movements, and prolonged periods in the same position. They have excessive workloads and insufficient rest time (Akıncı et al., 2014; Long et al., 2012; Vieira et al., 2016; Wu et al., 2021). We recommend providing ORNs with in-service training on the risk factors for work-related MSP. They should be informed about proper positioning, equipment use, and lifting heavy objects. We suggest improving workplace policies and working conditions.

One of the study's key findings is that approximately one-third of ORNs have work-related MSPs that impact their daily routine tasks. In addition, neck, back, hand, wrist, and shoulder pain increase the risk of daily routine tasks being affected. ORNs with MSP may request more job modifications and seek assignments outside of the operating room. Additionally, ORNs may need to change positions more frequently during surgeries due to prolonged immobility, and they may require more frequent and longer breaks. Previous studies have shown that work-related MSPs in ORNs impact their daily routine tasks and family life (Choobineh et al., 2010; Kandemiret al., 2019; Moreira et al., 2014; Sheikhzadeh et al., 2009). Nurses with work-related MSPs often resort to medication to alleviate symptoms and frequently seek medical and surgical treatments (Choobineh et al., 2010). Choobineh et al. (2010) reported that more than half of the nurses might consider changing jobs. Various studies have reported that back pain (31%) and knee-ankle pain (24%) are the reasons for ORNs leaving the profession. Work-related MSP can be reduced by improving operating room conditions and increasing work productivity (Sheikhzadeh et al., 2009). ORNs with work-related MSP should be able to make job and task changes as needed.

ORNs experiencing MSP can significantly impact their daily routine tasks. These pains, particularly during tasks that require standing for long periods or handling heavy equipment and materials, can lead to decreased performance. Nurses may struggle with rapid and precise movements required during surgery due to these pains. Additionally, the intensity of these pains may increase during lengthy surgeries when they are required to stay in the same position, leading to decreased concentration and increased fatigue. Therefore, ORNs with MSP, especially during physically demanding tasks, may find it challenging to perform their duties effectively. This situation can negatively affect nurses' job satisfaction and overall work efficiency. Additionally, ORNs experiencing MSP may have difficulty in performing tasks with the necessary speed and precision, which can compromise the quality of care provided to patients. This reduction in performance can lead to longer surgery times and potentially increase the risk of complications. Consequently, patient safety and satisfaction could be adversely affected, impacting overall treatment outcomes. To reduce the impact of MSP on the ORNs' daily routine tasks, a constant review of operating room conditions and implementation of improvement processes are required. Nurses' feedback on MSPs should be considered as part of these processes. We recommend that future studies measure the rates of job turnover and workforce losses among nurses due to work-related MSP.

Surgical tables, lights, and other equipment should be easily adjustable to accommodate users of different heights, reducing the need for prolonged bending or reaching, thus preventing neck, back, and leg pains. Operating rooms should be spacious, allowing all equipment to be comfortably placed and facili-

tating easy interaction between healthcare workers and the equipment; cramped spaces can lead to accidents and crowding. Floors should be equipped with slip-resistant and fatigue-reducing coverings, and lighting should be adequate and properly positioned to minimize shadows and reflections. Surgical tools should be ergonomically designed to fit comfortably in the user's hand and not cause discomfort during prolonged use. These adjustments make operating rooms safer and the work environments more efficient, enhancing the performance of healthcare workers and reducing work-related health issues.

*Limitations*

The study findings were limited to 105 ORN nurses working in six hospitals. Studies with larger samples can produce more accurate results. Another limitation is that participants were asked about their pain status in the past 12 months and the impact of this on their daily work. Participants may not remember their past experiences of pain or may not want to report that their pain interfered with their daily functioning. The inability to compare standing durations according to types of surgeries is a limitation of the study. Nevertheless, our findings are valuable because they reflect the results of ORNs working in six hospitals in Gaziantep, a province in southeastern Turkey.

## Conclusions

This study revealed a high prevalence of work-related MSP among ORNs. Age, BMI, operating room experience, and working as a scrub nurse in the operating room contributed to this pain. Approximately three-quarters of ORNs experienced work-related MSP in the past 12 months and within the past 7 days, which interfered with their daily work routines. ORNs most reported lower back pain. Increased age, BMI, operating room experience, and working time as a scrub nurse in the operating room were risk factors for work-related MSP among ORNs in the previous 12 months. The increased BMI and increased working hours as an ORN led to a rise in the work-related MSP in the previous 7 days. Reducing physical and ergonomic risks for ORNS can alleviate work-related MSP.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

## CRediT authorship contribution statement

**Aynur Koyuncu:** Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Kübra Kaya:** Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Onur Kaya:** Conceptualization, Data curation, Formal analysis, Writing – review & editing. **Ayla Yava:** Conceptualization, Data curation, Formal analysis, Writing – review & editing.


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