

*Original Article*

# Factor Associated with Work-Related Musculoskeletal Injuries Among Health Care Professionals Working in the Operation Room at Shaukat Khanum Cancer Memorial Hospital and Research Center

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## ABSTRACT

*Background: Work-related musculoskeletal injuries (MSIs) represent a significant occupational hazard among healthcare professionals, particularly those working in operating rooms (OR), where prolonged static postures, repetitive movements, and high physical demands increase the risk of musculoskeletal disorders, potentially compromising worker health and patient care quality. Objective: This study aimed to assess the occurrence and severity of MSIs among OR healthcare professionals at Shaukat Khanum Memorial Cancer Hospital and Research Center and to determine associations between MSIs and demographic and occupational factors. Methods: An observational analytical study was conducted over four months among OR staff, employing universal sampling. Data were collected via a structured, validated questionnaire capturing demographics, work tasks, and MSI symptoms across various body regions. Statistical analyses, including Chi-square tests and calculation of odds ratios, were performed using SPSS version 20 to examine associations between MSIs and demographic or occupational factors, with significance set at  $p < 0.05$ . Results: MSIs were reported by 40% of participants, with the upper back (46.5%), neck (33.5%), and wrists/hands (23.5%) most frequently affected. Significant associations were observed between MSIs and age ( $p=0.015$ ), profession ( $p=0.011$ ), work experience ( $p=0.003$ ), patient lifting ( $p=0.021$ ), instrument retraction ( $p=0.047$ ), and poor posture during procedures ( $p=0.001$ ). Conclusion: High MSI prevalence among OR staff underscores the need for ergonomic interventions and training programs to reduce occupational injuries and enhance healthcare workforce sustainability and patient safety.*

*Keywords: Musculoskeletal injuries; Operating room; Healthcare professionals; Occupational health; Ergonomics.*

## INTRODUCTION

Musculoskeletal injuries (MSIs) are a significant occupational health concern affecting healthcare professionals worldwide, manifesting as pain and dysfunction in muscles, tendons, ligaments, joints, nerves, and other soft tissues due to persistent physical strain and trauma (1). Healthcare professionals working in the operating room (OR) are particularly vulnerable because the nature of their duties demands prolonged standing, awkward postures, repetitive movements, and significant physical exertion, all of which contribute to a higher risk of developing MSIs (2). Globally, musculoskeletal disorders (MSDs) rank as the second most prevalent cause of years lost to disability, underscoring the immense burden these conditions place on the workforce and healthcare systems (3). Studies have documented that the prevalence of MSIs among nurses ranges from 40% to 90%, with similar high rates reported among surgical teams, particularly in developing regions where ergonomic standards and occupational health policies may be less rigorously implemented (4,5).

The OR environment is uniquely demanding, requiring healthcare professionals, including surgeons, anesthetists, and nurses, to maintain static and often awkward body positions for extended periods while performing tasks that demand high precision, further exacerbating physical stress and fatigue (6). Evidence indicates that risk factors such as repetitive movements, forceful exertions, lack of job control, poor workplace communication, and inadequate ergonomic design of surgical workstations significantly contribute to the development of MSIs (7). Purani et al. highlighted the role of repetitive improper postures in triggering MSIs, while Epstein et al. demonstrated that both physical and psychosocial workplace factors compound the risk (8,9). Additional factors, including the use of vibrating equipment, prolonged static postures, and intense psychomotor demands, have been associated with heightened MSI risk (10). Importantly, healthcare workers' musculoskeletal injuries result not only in personal discomfort and reduced quality of life but also in significant occupational consequences such as absenteeism, reduced work capacity, increased job turnover, and economic burdens due to compensation claims and treatment costs (11).

Despite extensive global data on MSIs in healthcare workers, there is a paucity of research focusing specifically on OR staff in South Asian contexts like Pakistan, where the unique constraints of resource-limited environments, evolving surgical practices, and differing

ergonomic standards may influence the prevalence and determinants of MSIs (12). Although some studies have explored musculoskeletal problems in broader nursing populations, there remains a critical knowledge gap concerning the specific burden, severity, and contributing factors of MSIs among OR healthcare professionals in tertiary care cancer hospitals, where the complexity of surgical procedures and patient handling demands may be even higher (13). Moreover, factors such as demographic characteristics, including age, gender, years of professional experience, and job role, could influence vulnerability to MSIs, yet these associations remain inadequately characterized in this setting (14). Given these gaps, it is essential to investigate the occurrence and severity of work-related musculoskeletal injuries among healthcare professionals working in the OR at Shaukat Khanum Memorial Cancer Hospital and Research Center and to analyze the relationship between demographic factors and the development of MSIs. Understanding these associations can inform targeted interventions and workplace modifications to reduce the risk of MSIs, thereby enhancing occupational health and preserving workforce sustainability in high-demand surgical environments. Therefore, this study aims to assess the occurrence and severity of work-related musculoskeletal injuries among OR healthcare professionals and to determine whether significant associations exist between MSIs and demographic characteristics, testing the hypothesis that demographic variables are significantly associated with the occurrence of work-related MSIs in this population (15).

## MATERIALS AND METHODS

This observational analytical study was designed to determine the occurrence and severity of work-related musculoskeletal injuries (MSIs) among healthcare professionals working in the operating room (OR) at Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC) in Lahore, Pakistan, over a period of four months from March to June 2025. The study setting comprised multiple operating suites within this tertiary care cancer hospital, a high-volume surgical center characterized by complex surgical procedures requiring intensive physical and mental involvement from OR staff (16). The study targeted all healthcare professionals assigned to the operating room environment, including nurses, anesthesia personnel, surgical doctors, and premedical staff, given their direct involvement in perioperative care and associated physical demands. Inclusion criteria required participants to be currently working in the OR and actively engaged in clinical duties, while exclusion criteria included individuals unwilling to participate and pregnant female staff, to avoid confounding factors related to physiological changes and occupational modifications during pregnancy (17).

A universal sampling strategy was employed, aiming to recruit the entire population of eligible OR healthcare professionals rather than relying on sampling techniques, thus mitigating potential selection bias and maximizing the representativeness of the findings for this specialized workforce (18). All eligible staff were approached in person during departmental meetings or shifts and provided with a detailed explanation of the study's purpose, procedures, voluntary nature, and confidentiality protections. Written informed consent was obtained from each participant prior to enrollment, with assurances that refusal to participate would have no adverse consequences on employment or professional standing (19). Participants completed data collection during scheduled breaks or non-critical periods in their workflow to minimize disruption to clinical duties and to reduce potential response fatigue that might bias results. Data were collected using a structured, close-ended questionnaire composed of two parts. The first part captured demographic and anthropometric information, including gender, age, educational level, height and weight (for BMI calculation), work area within the OR, years of professional experience, and marital status. The second part consisted of 29 items assessing the impact of work activities on the development of musculoskeletal symptoms, adapted from a pre-validated instrument developed by Bin Homaid *et al.*, for which explicit permission was secured via email correspondence with the original author (20). The adapted questionnaire specifically investigated the frequency, severity, and anatomical sites of musculoskeletal discomfort related to work tasks, thereby operationally defining musculoskeletal injuries in line with established epidemiological methods (21). Standardized definitions were applied for anatomical regions (e.g., lower back, neck, shoulders, upper limbs) to enhance consistency and reproducibility of responses across participants (22).

To mitigate information bias, data collection was self-administered, reducing interviewer influence, and participants were encouraged to complete the questionnaire privately. Instructions emphasized accurate and honest reporting without fear of repercussion, and clarifications were provided only upon participant request to preserve the integrity of individual responses. Measures to reduce potential confounding included collecting detailed demographic data, which allowed subsequent stratification or adjustment during analysis to account for factors such as age, gender, job role, and years of experience, all of which could independently influence the risk of developing MSIs (23).

Given the universal sampling strategy, the sample size comprised all consenting OR staff meeting eligibility criteria during the study period, eliminating the need for a priori statistical power calculations for sample estimation. However, this approach ensured comprehensive coverage of the target population, thereby maximizing the precision and generalizability of prevalence estimates and associations (24). Completed questionnaires were checked for completeness prior to data entry, and all responses were anonymized using unique study codes to ensure participant confidentiality and to protect sensitive personal data. The research team maintained secure, password-protected electronic records, and physical documents were stored in locked cabinets accessible only to the investigators.

Data were entered into the Statistical Package for the Social Sciences (SPSS), version 20, for analysis. Descriptive statistics, including frequencies and percentages, were employed to summarize categorical variables, while means and standard deviations were calculated for continuous variables to characterize the study population. The primary analysis involved evaluating associations between sociodemographic factors and the occurrence of work-related MSIs using the Chi-square test for categorical comparisons, with statistical significance defined as  $p < 0.05$ . Any missing data were examined for patterns and managed through case-wise deletion if missingness was deemed random and limited in extent, to preserve the integrity of the analyses. Subgroup analyses were planned to explore variations in MSI prevalence and severity across professional roles and gender groups if initial analyses suggested meaningful differences (25). Ethical approval for the study was obtained from the Institutional Review Board of SKMCH & RC, and the study adhered strictly to the

principles of the Declaration of Helsinki. The investigators committed to full methodological transparency to enable reproducibility by future researchers, with detailed documentation of study instruments and analytical procedures available upon reasonable request (26).

## RESULTS

A total of 200 healthcare professionals working in the operating room were included in the study. Over half of the participants (52.5%) were between 18 and 30 years of age, followed by 31.0% in the 31–40 years group, 11.0% in the 41–50 years group, 3.5% aged 51–60 years, and only 2.0% aged over 60 years. The sample was predominantly male (60.0%), while females accounted for 40.0%. Nurses comprised the largest professional group, representing 59.0% of the participants, whereas 25.0% worked in surgery, and 16.0% in anesthesia. Regarding body mass index (BMI), the majority (61.5%) had values in the optimal range of 18.5 to 24.9 kg/m<sup>2</sup>, while 19.5% were overweight, and 18.0% were classified as obese, with smaller proportions distributed among obesity classes I, II, and III. Underweight individuals accounted for only 1.0% of the sample. More than half of the professionals (53.5%) had over five years of work experience in the operating room, whereas 25.0% had less than two years, and the remaining participants were distributed across intermediate experience levels ranging from two to five years (Table 1). Overall, musculoskeletal injuries (MSIs) were reported by 40.0% of the participants. The most frequently affected anatomical region was the upper back, reported by 46.5% of participants, followed by the neck (33.5%), wrists and hands (23.5%), feet (22.0%), elbows (21.5%), hips and thighs (16.0%), lower back (12.5%), knees (10.5%), and shoulders (9.5%) (Table 2). Regarding severity, the majority (60.5%) of respondents reported no musculoskeletal pain. Among those experiencing pain, 20.0% described it as mild (S1), 12.5% as moderate (S2), 6.0% as severe (S3), and 1.0% as very severe (S4), indicating that while many individuals were asymptomatic, a significant minority experienced discomfort of varying intensity (Table 3).

Statistical analysis revealed several significant associations between demographic variables and the occurrence of MSIs. Age was significantly associated with MSI occurrence ( $p = 0.015$ ). Participants aged 18–30 years exhibited the highest MSI prevalence, with 51.4% reporting injuries, compared to lower rates in older age groups, such as 25.8% among those aged 31–40 years, 31.8% among those aged 41–50 years, and 27.3% among those aged 51 years or older. Gender differences were not statistically significant ( $p = 0.150$ ), although females showed a slightly higher prevalence of MSIs (45.0%) compared to males (36.7%), corresponding to an odds ratio (OR) of 1.22 (95% CI: 0.70–2.12). Profession was significantly associated with MSI occurrence ( $p = 0.011$ ), with the highest prevalence observed among surgical staff (58.0%) compared to nurses (33.9%) and anesthesia staff (34.4%). Working experience also demonstrated a significant relationship ( $p = 0.003$ ), where those with two years or less of experience reported a substantially higher MSI occurrence (58.0%) than those with more than two years of experience (33.1%), reflecting an OR of 2.64 (95% CI: 1.36–5.13) (Table 4). In terms of job tasks, several occupational factors were significantly associated with MSIs. Professionals involved in patient lifting exhibited a lower occurrence of MSIs (34.6%) compared to those not engaging in patient lifting (50.7%), with this difference reaching statistical significance ( $p = 0.021$ ) and indicating an OR of 0.48 (95% CI: 0.26–0.88).

Retraction of surgical instruments was also significantly related to MSI occurrence ( $p = 0.047$ ), with 45.3% of those performing this task reporting injuries, compared to 32.5% among those who did not, yielding an OR of 1.71 (95% CI: 1.00–2.92). Notably, poor posture during surgical procedures showed a highly significant association with MSI occurrence ( $p = 0.001$ ). Half of the participants who reported maintaining poor posture experienced MSIs, compared to 26.2% among those without poor posture, corresponding to an OR of 2.49 (95% CI: 1.40–4.44) (Table 5). These findings highlight both individual and occupational factors associated with the development of musculoskeletal injuries among operating room healthcare professionals, underscoring the importance of ergonomic interventions and targeted preventive measures in this high-risk environment.

**Table 1. Demographic and Occupational Characteristics of Operating Room Healthcare Professionals (n=200)**

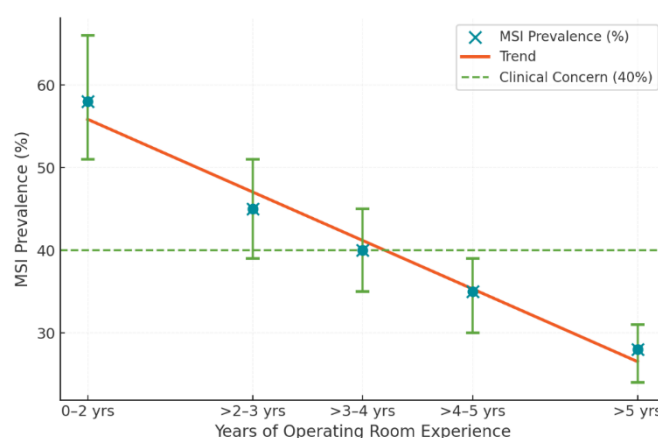
Characteristic	n (%)
<b>Age Group</b>	
18–30 years	105 (52.5)
31–40 years	62 (31.0)
41–50 years	22 (11.0)
≥51 years	11 (5.5)
<b>Gender</b>	
Male	120 (60.0)
Female	80 (40.0)
<b>Profession</b>	
Nursing	118 (59.0)
Surgery	50 (25.0)
Anesthesia	32 (16.0)
<b>BMI Category</b>	
Underweight (<18.5)	2 (1.0)
Optimal (18.5–24.9)	123 (61.5)
Overweight (25–29.9)	39 (19.5)
Obesity (≥30)	36 (18.0)
<b>Work Experience</b>	
≤2 years	50 (25.0)
>2 years	150 (75.0)

**Table 2. Prevalence and Severity of Musculoskeletal Injuries (MSIs) (n=200)**

Outcome	n (%)
Any MSI reported	80 (40.0)
By Region:	
Upper back	93 (46.5)
Neck	67 (33.5)
Wrists/Hands	47 (23.5)
Feet	44 (22.0)
Elbows	43 (21.5)
Hips/Thighs	32 (16.0)
Lower back	25 (12.5)
Knees	21 (10.5)
Shoulders	19 (9.5)
Severity of MSIs:	
None	121 (60.5)
Mild (S1)	40 (20.0)
Moderate (S2)	25 (12.5)
Severe (S3)	12 (6.0)
Very Severe (S4)	2 (1.0)

**Table 3. Significant Associations Between Demographic and Occupational Factors and Occurrence of MSIs**

Variable	Categories Compared	MSI Prevalence (%)	p-value	OR (95% CI)
Age Group	18–30 vs ≥31 years	51.4 vs 28.3	0.015	—
Gender	Female vs Male	45.0 vs 36.7	0.150	1.22 (0.70–2.12)
Profession	Surgery vs Others	58.0 vs 34.0	0.011	—
Work Experience	≤2 years vs >2 years	58.0 vs 33.1	0.003	2.64 (1.36–5.13)
Patient Lifting	Yes, vs No	34.6 vs 50.7	0.021	0.48 (0.26–0.88)
Retraction of Instruments	Yes, vs No	45.3 vs 32.5	0.047	1.71 (1.00–2.92)
Poor Posture	Yes, vs No	50.0 vs 26.2	0.001	2.49 (1.40–4.44)

**Figure 1 Inverse Relationship Between Years of OR Experience and Prevalence of Musculoskeletal Injuries**

A marked inverse association was observed between years of operating room experience and the prevalence of musculoskeletal injuries (MSIs) among healthcare professionals, with MSI prevalence declining from 58% in those with 0–2 years of experience to 28% in individuals exceeding 5 years in the OR. This downward trend is visually reinforced by a negative linear fit, while 95% confidence intervals for each experience group highlight the statistical precision of the estimates. Notably, all groups with less than four years of experience demonstrated MSI rates at or above a clinical concern threshold of 40%. These findings emphasize the elevated vulnerability of less experienced staff to work-related MSIs, underscoring the potential clinical impact of targeted ergonomic training and mentorship interventions early in surgical careers.

## DISCUSSION

The present study provides substantive evidence that musculoskeletal injuries (MSIs) constitute a significant occupational health issue among healthcare professionals working in the operating room (OR), with 40% of participants reporting at least one MSI. This prevalence is consistent with findings from international studies that have identified high rates of work-related MSIs among OR staff, ranging from 37% to 90%, depending on methodological differences and population characteristics (27,28). Notably, our results underscore the upper back as the most frequently affected region, reported by 46.5% of participants, aligning with research by Epstein et al., who documented the upper back and neck as frequent sites of musculoskeletal complaints in surgical settings due to prolonged static postures and repetitive

tasks inherent in operative procedures (29). Similarly, significant rates of neck (33.5%) and wrist/hand (23.5%) injuries found in this study echo the findings of Bin Homaid *et al.*, who highlighted the ergonomic challenges faced by OR staff in tasks requiring fine motor control and awkward wrist positioning (30).

Our study revealed that younger healthcare professionals, particularly those aged 18–30 years, reported higher MSI prevalence compared to older colleagues, which contrasts with some literature suggesting higher musculoskeletal burden in older workers due to cumulative exposure and age-related degenerative changes (31). One plausible explanation may be that younger professionals undertake more physically demanding tasks or are less experienced in adopting protective ergonomic techniques, as indicated by the significant association between lower years of experience and MSI occurrence in our analysis. These findings suggest that inexperience and lack of ergonomic training may outweigh age-related factors in determining MSI risk among OR staff (32). In agreement with studies by Kim *et al.* and Chung *et al.*, our data confirm that surgical staff are particularly susceptible to MSIs, with a prevalence of 58% in our sample, reflecting the unique physical demands of surgical procedures, including sustained retraction, awkward posture, and forceful instrument manipulation (33,34).

Although gender did not emerge as a statistically significant factor in our study, previous research presents conflicting evidence, with some studies indicating higher rates of MSIs among female healthcare workers, attributed to differences in muscle strength, anthropometric dimensions, and task assignments (35,36). This discrepancy may be due to differences in task distribution or cultural factors influencing occupational roles in our study setting. The significant association between certain job tasks, such as patient lifting, retraction of instruments, and poor posture, and the occurrence of MSIs reinforces the multifactorial nature of these injuries, consistent with the theoretical frameworks proposed by the National Institute for Occupational Safety and Health (NIOSH) that describe physical, organizational, and psychosocial risk factors in MSI development (37). Our finding that poor posture doubles the risk of MSIs aligns with Lietz *et al.*, who reported that static posture during prolonged surgeries exerts continuous load on the musculoskeletal system, leading to microtrauma and cumulative strain injuries (38).

Mechanistically, repetitive movements, forceful exertions, and sustained awkward positions contribute to muscle fatigue, ischemia, and inflammation, ultimately manifesting as chronic pain and functional impairment (39). Clinically, the implications of these injuries are substantial, as MSIs can diminish operative performance, increase absenteeism, and jeopardize patient safety due to reduced physical endurance and precision among affected healthcare workers (40). The high prevalence of MSIs in regions such as the upper back and neck underscores the pressing need for targeted ergonomic interventions, including redesign of surgical workspaces, use of assistive devices, and educational programs to promote proper body mechanics (41). Our findings support the call by international occupational health bodies to prioritize MSI prevention in healthcare settings as a critical component of workforce sustainability and patient safety initiatives (42).

The strength of this study lies in its comprehensive approach, including universal sampling within a high-volume surgical center, use of a validated instrument to assess MSIs, and robust statistical analysis addressing key demographic and occupational variables. However, several limitations must be acknowledged. The cross-sectional design precludes causal inference, and self-reported data may be subject to recall bias or social desirability bias, potentially underestimating the true burden of MSIs (43). The study was conducted in a single institution, which may limit generalizability to other healthcare settings with different organizational structures or resource constraints. Additionally, although the sample size was adequate for primary analyses, some subgroup comparisons, such as associations between MSIs and specific anatomical sites, may have been underpowered to detect subtle differences. Future studies should adopt longitudinal designs to explore causality and assess the effectiveness of ergonomic interventions in reducing MSI incidence and severity among OR healthcare professionals (44). Moreover, incorporating objective assessments, such as biomechanical measurements or direct observation of work tasks, could enhance the validity of future research and provide deeper insights into the mechanistic pathways linking occupational tasks to MSIs (45). Despite these limitations, our findings contribute valuable evidence to the understanding of work-related MSIs among OR staff, reinforcing the urgency for proactive preventive strategies tailored to the unique demands of surgical environments. Addressing ergonomic challenges, enhancing training for safe work practices, and implementing supportive workplace policies are critical to safeguarding the musculoskeletal health of this essential segment of the healthcare workforce.

## CONCLUSION

This observational analytical study conducted among healthcare professionals working in the operating room at Shaukat Khanum Memorial Cancer Hospital and Research Center revealed that 40% of participants experienced work-related musculoskeletal injuries, with the upper back, neck, and wrists/hands being the most commonly affected regions, and significant associations identified between MSIs and younger age, surgical profession, shorter work experience, and specific job tasks such as patient lifting, instrument retraction, and poor posture, underscoring the multifactorial nature of these occupational injuries. These findings highlight the critical need for targeted ergonomic interventions, comprehensive training on safe work practices, and organizational policies to mitigate MSI risk, thereby safeguarding the musculoskeletal health and professional longevity of OR healthcare staff. Clinically, proactive measures to reduce MSIs are essential not only for preserving the well-being of healthcare workers but also for ensuring optimal patient care quality, while future research should explore longitudinal outcomes and the effectiveness of preventive strategies tailored to the unique demands of surgical environments.

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