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ORIGINAL ARTICLE

# Prevalence and Impact of Musculoskeletal Occupational Injuries among Orthopedic Surgeons: A Cross-Sectional Study

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## Abstract

**Introduction** Occupational musculoskeletal injuries (MSOI) are a significant concern among orthopedic surgeons due to the demanding nature of their profession. Existing guidelines for ergonomic practices often face implementation challenges, resulting in heightened injury prevalence. This study aimed to determine the prevalence and characteristics of MSOI among orthopedic surgeons, focusing on their impact on surgical practice and overall well-being.

**Methods** A cross-sectional survey invited 5000 orthopedic surgeons, of whom 15.84% ($n = 792$) successfully participated. Data included demographic information, work practices, subspecialties, and injury patterns. Injury severity and response were analyzed using descriptive statistics.

**Results** Respondents were predominantly male (98.9%) with a mean age of 31.4 years. The majority (84.1%) were early career surgeons (<5 years of practice), and 73.8% worked in teaching institutions. Weekly surgical load varied, with 39.8% operating <12 h and 21.6% operating >36 h. Injuries predominantly affected the lower back (58%) and neck (47.7%), with an average involvement of 2.4 regions per surgeon. Despite 85.2% reporting injuries, only 13.6% sought treatment, primarily physiotherapy. Work absenteeism was reported by 6.8%, while 17% reduced surgical load for recovery. Notably, 37.5% perceived a lasting impact on career performance.

**Conclusion** MSOI among orthopedic surgeons is prevalent and significantly affects surgical practice and daily activities. These findings emphasize the need for targeted interventions to improve ergonomic awareness and reduce occupational risks.

**Keywords** Musculoskeletal injury · Occupational injury · Surgeons · Productivity · Recovery

## Introduction

According to the Occupational Safety and Health Administration (OSHA), any damage or wound to the body resulting from an event in the work environment resulting in or aggravated a pre-existing condition is defined as work-related occupational injury [1, 2]. There are various aspects of occupational hazards such as radiation, chemical, psychological, and musculoskeletal (MSK) injuries [2]. The orthopedic surgical environment has a mix of all these aspects and remains one of the major factors responsible for occupation hazards to surgeons [3]. Spine surgeons have been reported to have a 25-fold increase in the incidence of thyroid cancer which is mostly attributed to radiation exposure [4]. Polymethylmethacrylate (PMMA) cement, which has been commonly used in orthopedic surgery since the 1950s, has toxic effects on the skin, respiratory system, and nervous system [5]. Inhalation of smoke from electrocautery has an exposure greater

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than second-hand smoking [6]. Work demands as well as the loss of sleep that follows were found to have an impact on the physicians' emotional health [7, 8]. Of all these occupational risks, MSK injuries take a greater toll in impacting the health of the surgeons [2, 9, 10].

Generally, work-related disorders of the MSK system are secondary to highly repetitive vocational demands as well as working in awkward positions, as experienced commonly by manual laborers [11, 12]. Surgeons, especially orthopedic surgeons, have a high degree of resilience along with a strong work ethic, like an athlete [13, 14]. Yes, these traits sound great, but due to these demanding qualities, orthopedic surgeons are predisposed to overuse injuries throughout their careers, especially disorders of the MSK system [9, 15–17]. Literature suggests that among different subspecialties of surgery, orthopedic surgeons are at higher risk of work-related injuries [18, 19].

Despite various guidelines for ergonomic operating environments being available [20–24], lack of awareness [25–27], and difficulty in their application [27] contribute to their ineffectiveness. Prolonged standing and repetitive movements while using tools, all this while operating in sustained and nonergonomic positions, increase the load on the bones and muscles [3]. Studies were done among orthopedic surgeons, different subspecialties [2, 10, 17, 28], and even among residents in orthopedic surgery [16, 29] to look for the prevalence and impact of occupational MSK injuries on their health and surgical work.

To our knowledge, none of the studies were done to estimate the prevalence of musculoskeletal occupational injuries (hereafter referred to as MSOI) among orthopedic surgeons in the South Indian population. Ethnic differences may account for the varied prevalence and severity of the reported symptoms. Hence, the study aimed to determine the prevalence and characteristics of MSOI among the orthopedic surgeons of Tamil Nadu and their impact on the surgical practice.

## Materials and Methods

After obtaining institutional ethics clearance [IEC/2022/EC/23], we invited 5000 members of the Tamil Nadu Orthopedic Association (TNOA) via the official social network group of the association to answer an anonymous web-based survey. The invitation mentioned that the study would be used to evaluate the impact of MSOIs among orthopedic surgeons on their surgical practice. No incentives were offered to the participants. Two reminders apart from the original invite were sent over 8 weeks to request participation from non-respondents.

*Survey:* Previously developed surveys to evaluate physician injury were cross-referenced to develop a 25-item, web-based survey administered through Google Forms. The survey instrument was developed through a rigorous validation process. Content validity was ensured by consulting a panel of experts, including orthopedic surgeons, epidemiologists, and research methodologists, to review the relevance and clarity of the questionnaire items. Construct and face validity were evaluated by piloting the survey with a sample group of surgeons to confirm the representation of targeted domains and the comprehensiveness of the questions. A pilot study and pre-testing on representative samples helped refine the questionnaire further, addressing ambiguities and optimizing clarity. Simple, direct questions were used to minimize the respondent burden. The survey consisted of three sets of questions to be answered. First, demographic data such as age, hand dominance, working hours, and years in orthopedic practice were obtained. The second set consisted of the Nordic Musculoskeletal questionnaire to assess the musculoskeletal disorder in various regions of the body and the treatment undergone for the same. The final set included the assessment of the impact of these injuries on their surgical practice. The questionnaire presented to the respondents is given in *Supplementary File 1*.

*Statistical analysis:* We used statistical software SPSS 26.0 (IBM SPSS Inc., Chicago, IL) to perform descriptive statistics. Fisher exact tests and analysis of variance (ANOVA) tests were used to determine the significant associations between various factors that contributed to MSOIs. A p value of $<0.05$ was considered significant.

## Results

*Demographics:* A total of 5000 orthopedic surgeons were invited to participate in the survey, out of whom 15.84%($n$ = 792) completed the survey during the data collection period. The mean age of the respondents was 31.4($\pm$7.2) years, 98.9% ($n$ = 783) were male surgeons, and 1.1% ($n$ = 9) were female surgeons. The characteristics of the respondents are given in Table 1. 2.3% ($n$ = 18) surgeons were left-hand dominant, while the rest 97.7% ($n$ = 18) were right-hand dominant.

*Practice:* Of the 792 surgeons, 84.1% ($n$ = 666) were early career surgeons with a practice of <5 years, while 11.3% ($n$ = 90) were established surgeons with >10 years of practice. We noted that the majority of the surgeons worked in teaching institutions (73.8%, $n$ = 585), while the rest of the surgeons were working in non-teaching government (19.4%, $n$ = 153) and private institutions (6.8%, $n$ = 54).

*Subspecialty:*All orthopedic subspecialties were represented among the survey participants. The participating surgeons ranged from practicing single subspecialty (33%, $n$ = 261) to multiple subspecialty domains of orthopedics

**Table 1** Demographic data of the participants and part of the first set of questions in the survey

| Variable | | Number of respondents |
|---|---|---|
| Sex | Female | 9 |
| | Male | 783 |
| Age | 25–34 | 666 |
| | 35–44 | 54 |
| | 45–54 | 54 |
| | 55–64 | 18 |
| Years of practice | 1–5 years | 666 |
| | 5–10 years | 36 |
| | 10–15 years | 36 |
| | 15–20 years | 18 |
| | 20–25 years | 9 |
| | >25 years | 27 |
| Type of practice | Medical college hospital | 504 |
| | Private teaching hospital | 81 |
| | Headquarters government hospital | 90 |
| | Taluk government hospital | 63 |
| | Private non-teaching hospital | 54 |
| Hours per week | <6 h | 99 |
| | 6–12 h | 216 |
| | 12–24 h | 234 |
| | 24–36 h | 72 |
| | 36–48 h | 54 |
| | >48 h | 117 |
| Operating position | Both | 117 |
| | Sitting position | 9 |
| | Standing position | 657 |
| Visual aids | Glasses | 261 |
| | Glasses, operating microscope | 9 |
| | Operating microscope | 9 |
| | None | 513 |
| Lead apron usage | No | 18 |
| | Routinely | 558 |
| | Sometimes | 216 |

including trauma surgery, arthroplasty, spine surgery, arthroscopy, pediatric orthopedics, orthopedic oncology, and hand surgery.

*Surgical load:*We have a spectrum of surgeons based on their duration of cumulative weekly operating hours ranging from limited operating surgeons with <12 h per week (39.8%, $n = 315$) to busy surgeons operating >36 h per week (21.6%, $n = 171$). Of the participating surgeons, 83% ($n = 657$) operate only in a standing position, while only 14.8% of surgeons combine both sitting and standing positions during their surgeries. Moreover, 70.5% ($n = 558$) routinely use lead aprons during their surgeries.

*Areas of injury:* Figure 1 shows the percentage of respondents sustaining an injury in specific areas of the body. The lower back was the most involved area, affecting 58% ($n = 459$) of the participating surgeons, followed by the neck in 47.7% ($n = 378$) surgeons. Overall, the participating surgeons had a mean involvement of >2.4 regions with injury with a mean cumulative severity score of 4.47 (±4.14).

*Post-injury response:*Although 85.2% of surgeons perceived injury in one region or the other, only 13.6% ($n = 108$) received treatment for the same, of which physiotherapy (86.4%) was the common modality of management employed. 6.8% ($n = 54$) of the surgeons had to skip work due to the above-mentioned injuries. 17% ($n = 135$) considered these ailments to reduce their surgical load during the recovery process. 19.3% ($n = 153$) considered the ailments to affect their activities of daily living. 27.3% ($n = 216$) were suffering from one of the injuries during the past 7 days of the survey, wherein 52.3% ($n = 414$) attributed the injury to the work they ere involved in, and 37.5% ($n = 297$) considered their ailments to have a lasting effect on their career performance.

## Discussion

Overall, a high percentage of surgeons who completed the survey reported an MSOI during their practice, with 13.6% ($n = 108$) requiring treatment for the injury and 6.8% ($n = 54$) requiring time off because of the injury. These alarmingly high numbers indicate that orthopedic surgeons are at a high risk of occupational hazards associated with the operating environment and surgical equipment.

In one of the first reported studies in the literature, Davis *et al.* have described the prevalence of occupational injuries in orthopedic surgeons in their study published in 2013 [9]. They had a 28% ($n = 140$) response rate for their survey from AAOS registered orthopedic surgeons practicing in Tennessee, USA, whereas in our survey, it was 15.84% ($n = 792$). In their study, 44% reported at least one MSOI in contrast to 85.2%, which is almost double. The hand (25%) was the most involved body part, followed by the lower back (19%), whereas in our study the lower back (58%) and neck (47.7%) were most affected. They even found a significant association between years of performing surgery and the prevalence of injury ($p = 0.03$), and surgeons with 21– 0 years of practice reported the greatest number of injuries. Along with that, 38% reported that their institutions had no resources available to support them in their recovery.

With a larger sample size, in a more recent publication in 2023, Yakkanti *et al.* presented their findings on 1645 surgeons. They studied varied occupational hazards, including, but not entirely, MSOI [30]. As described by

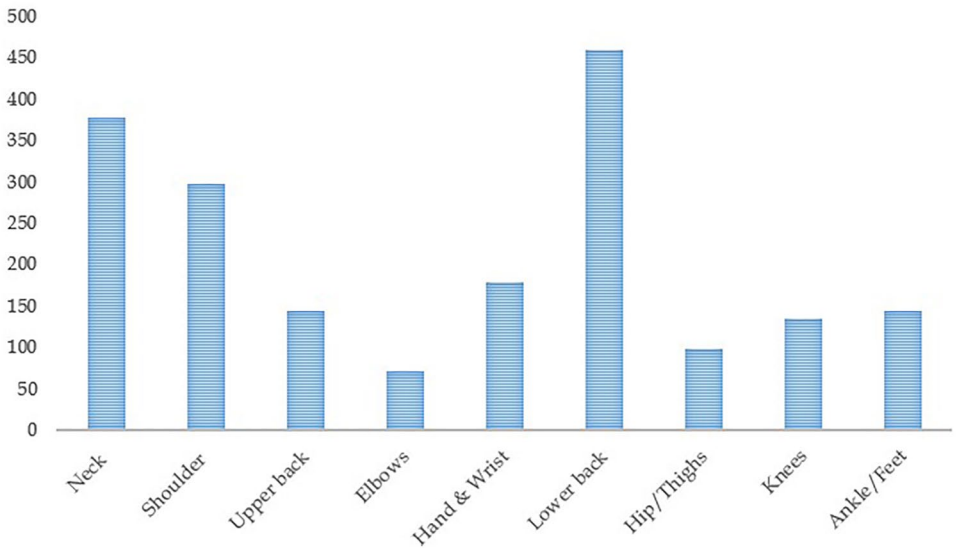



**Fig. 1** Regional distribution of musculoskeletal occupational injury among the survey respondents

Davis *et al.*[9] in their study, Yakkanti *et al.*[30] also found that the hand and wrist (39.8%) were the most involved areas, followed by the lower back in 35.7%. In contrast to these, our study population had a higher involvement of the lower back in 58% ($n = 459$) followed by the neck in 47.7% ($n = 378$).

Similar studies were published by orthopedic surgeons from different countries [2, 9, 31, 32] and different subspecialties in orthopedics, such as hand [17], spine [10, 33, 34], arthroplasty [35], orthopedic oncology [36], pediatric orthopedics [28, 37], and trauma surgeons [2]. Some studies have published their findings exclusively on female surgeons [38, 39] and some on orthopedic residents [29]. So, a number of studieson varied populations have been published to date. But to our knowledge, this is the first study published about the orthopedic surgeons' practice in the Indian subcontinent.

A recent systematic literature published by Vasireddi *et al.* in 2023 has reviewed 24 studies, which included 4876 orthopedic surgeons with a mean age of 48 years [14], whereas our study included a younger population with a mean age of 31.4 (±7.2) years. This trend of younger surgeons may be because of the shorter duration of post-graduate training, i.e., 3 years in India in contrast to a longer time in other countries [40–42]. They noted that 79% men compared to 98.9% in this study, which shows that orthopedics is still vastly dominated by men in India [43, 44]. The areas of the body involved were the head and neck and lower back with a very wide range of prevalence, similar to our results. They reported that some surgeons even had to take early retirement.

The likely culprits for the high rate of musculoskeletal occupational injuries found in this study are the operating room ergonomics, workflow, and surgical equipment. As shown in the previously published literature [14, 17, 18, 27, 45–47], ergonomics in the operating room plays a major role in the high prevalence of musculoskeletal injuries. In addition to the operating room being ergonomically optimal, the surgeons need to be aware of the ergonomics [18, 48, 49] that have to be followed to decrease the chance of MSK injuries while performing operations. Buddle *et al.* found that 43.6% of the respondents were aware of the OR ergonomics, but only 30.9% took the initiative to make their OR more ergonomic [48]. Dairywala *et al.* have proposed ergonomics and strength training for cardiothoracic surgeons, in whom work-related MSK conditions were also reported to be highly prevalent [49].

There are several limitations to our study. First, it is based on self-reported measures whose validity and reliability have not been fully established since they suffer from recall bias. Physician reports of injuries and the consequences of these injuries may include errors because of recall bias. Furthermore, respondents may be biased to report a higher number of injuries to draw attention to the issue of physician wellness. Conversely, physicians may have underreported injuries because of the culture of providing optimal treatment to patients regardless of their health. We suggest that future studies examining physician injury include questions about the nature of reported injuries (e.g., lacerations, fractures, or sprains). Surgeons were asked to report a single subspecialty, although many surgeons work across different subspecialties, so subspecialty-specific data should be interpreted with caution. Future surveys should add a category of “no pain” to the question involving the frequency of pain. Response bias may be present, as only 15.8% responded. This study targeted only orthopedic surgeons who were currently practicing, so it may have underestimated the prevalence

of injury because of the *healthy worker effect*. It may also underestimate the lost productivity resulting from workplace injury, as the performance of fewer procedures during recovery from injury was not captured in the survey. Estimation of the national prevalence of surgeon injury based on this statewide study should be conducted with caution.

## Conclusion

Our study, to our knowledge, is the first of its kind in which the prevalence of MSOI is estimated among orthopedic surgeons practicing in India. More than 80% of surgeons faced at least one episode of MSOI throughout their career, which shows how big the burden is on the orthopedic community. We propose that ergonomics and workflow in the operating room should be included in orthopedic training.

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s43465-025-01402-9.

**Author Contribution** A) Conceptualization—SM, GC, and MJ. b) Manuscript writing—SM and NJ. c) Manuscript revision—MJ and GC. d) Data acquisition—SM, GC, AC, SV, and NJ. f) Supervision—SM and MJ. All authors have agreed to the final version to be published and agree to be accountable for all aspects of the work.

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**Data availability** Data will be made available upon reasonable request to the corresponding author.

## Declarations

**Conflicts of interests** Nil.

**Ethical Approval** IEC/2022/EC/23

**Informed Consent** For this type of study informed consent is not required

**Patient Consent** Not applicable.

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