

# Incidence of work-related musculoskeletal disorders and postural stress among surgeons practicing in India

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**Abstract:** Work related musculoskeletal disorders (WMSDs) are a major reason for the loss of work efficiency, which is related to type of occupation or activity. Surgeons operate in a standing position with bent trunk and neck over operation table for prolonged period in long duration surgeries, along with physical workplace tasks which involves regular walks from ward to ward as well as constant bending over the bed while physically examining patients could be associated with considerable physical stress and a plethora of complaints relating to the musculoskeletal system. This study was conducted on 48 male surgeons working in various departments in hospitals in Mumbai and Kolkata. Tools were employed to ascertain WMSDs, magnitude of the musculoskeletal discomfort, workload assessment and specific postural stress. The results showed that the occurrence of WMSDs were most prevalent in body regions for last 12-months and last 7-days were lower back (40.23% and 23.33%), followed by ankles/feet (17.3% and 20.76%), knees (15.23% and 18.57%), and neck (15.23% and 13.8%). The analysis of Visual Analogue Scale (VAS) revealed significant differences in the morning and evening scores ( $p < 0.005$ ). Postural analysis system revealed that the risk level at trunk is harmful for most surgeons with distinctly harmful especially for general surgeons, gynecologist and orthopedicians and accordingly workload stress were evident from the findings of workload assessment. This study can be used as a pointer on improving work conditions, job redesign, increase of preventive strategies and proactively reduce the contribution of risk factors for the precipitation of WMSDs, thereby successfully leading to its attenuation.

**Keywords:** work related musculoskeletal disorders; surgeons; posture

## 1 Introduction

Musculoskeletal complaints affect a wide variety of workers in the healthcare industry and appear to be an imperative problem for surgeons (Kant et al 1992, Smith et al 2006, Szeto et al. 2009). Studies have revealed that the surgeons are vulnerable to musculoskeletal disorders (MSDs) during the course of their work routine (Bork 1996, Russo 2002, Szeto et al. 2009). The work of surgeons involve high levels of mental concentration synergized with very precise dexterous movements which place mild-to-moderate physical demands (Berguer et al 1997). Working in operating rooms involves a considerable amount of static posture which could be responsible for discomfort and disorders of the musculoskeletal system (Kant et al 1992). Surgeries, when done in a standing position with bent trunk and neck over operation table for prolonged period in long duration surgeries, causes significant strain on the neck and back. The diversity of operating skills imposes different demands of physical efforts on surgeons who may also be at high risk of WMSDs for different body parts,



apart from the neck and back, which may be common for all (Szeto et al 2009). It would be expected that surgeons are constantly exposed to both physical and psychosocial workplace demands, as they have to manage not only the physical work of performing surgery, but also to communicate with both the patients and their families (Szeto et al 2009). Prolonged posture, demands of the job, patients expectations, interruptions, practice administration, work-home interface and social life, dealing with death and dying, medical responsibilities for friends and relatives; all these precipitates in copious amounts of strain and stress among doctors (Das et.al. 2015). Surgeons are lifesavers, if they come under physical stress, their efficiency is reduced, which may affect the lives of large number of people whom they treat. Studies focusing on surgeons have indicated serious prevalence of MSDs in them. For surgeons performing patient-related functions, there is evidence that jobs or tasks with poor ergonomics characteristics not only result in higher levels of WMSDs and absenteeism but could also lead to lower levels of patient safety as well. This makes the surgeons an even more important group in which to study such ergonomics problems (Busse and Bridger, 1997). Other than these physical risk factors, other potential contributing risk factors for the development of WMSDs may be organizational, psychosocial and individual factors that may lead to ergonomic related problems.

Little effort has been expended in studying the postural analysis which may also acts as an ergonomic stressor leading WMSDs among surgeons. The hospital industry, subsuming the wide variety of medical practitioners like different specialty of surgeons performing patient examination and surgical procedures, provides a rich area for investigation to delineate risk more precisely. Studies on postural analysis have not been done in the past for identifying as one of the various causes of MSDs among surgeons working in Indian hospitals. Assessment of posture is an important consideration in the design of work method and workplaces, because it affects the ability of workers to reach, hold and use equipment, influences how long they can perform their work without adverse health effects such as discomfort, fatigue and MSDs. The association of poor working postures with pain or symptoms of MSDs has been reported in a number of studies (Armstrong et al. 1993). The improvement of postures through redesign of workplaces or work methods may reduce WMSDs and increase work productivity (Corlett and Bishop 1976). Since MSDs are a major reason leading to loss of work efficiency; therefore, there is an imperative need to explore the incidence of WMSDs among surgeons practicing in India along with postural analysis, to identify the ergonomic stressors that influence the risks of WMSDs.

## 2 Objectives of the study

The study was conducted in four medical institutions in Mumbai and Kolkata, India, with the following objectives:

- To decipher the incidences of WMSDs among surgeons.
- To measure the magnitude of the musculoskeletal discomfort experienced by the surgeons.
- To analyze the workload among various specialty of surgeons working in Indian hospitals.
- To evaluate the variant working postures adopted by the surgeons while performing their duties.
- To compare the potential postural risk factors among various specialty of surgeons (intra group variability).

### 3 Methodology

**3.1. Study population:** A cross sectional study was conducted among 48 male surgeons with mean age of 44.43 ( $\pm 3.96$ ) yrs, height 169.06 ( $\pm 7.33$ ) cms and weight 75.76 ( $\pm 12.16$ ) kgs who were randomly selected from 4 different medical institutions. The study was approved by the Ethics Committee of a multi-specialty hospital involved in this study, prior to commencement of any procedure. A written informed consent was obtained from all the respondents wherein, the confidentiality clause as well as the details of the study, explained. The work posture of different specialties of surgeons may vary depending on the type of operation being performed, therefore, six surgical specialties were included: orthopedics (n=15), general surgery (n=12), ENT (n=9), ophthalmology (n=6), Obstetrics & Gynecology (n=3) and anesthesiology (n=3). Data relating to number of observations and surgeons whose variant working postures were evaluated while performing their duties were general surgeons (n=4), orthopaedicians (n=3), gynecologists (n=3), ENT (n=3), ophthalmologist (n=2), anesthetist (n=2).

**3.2. Measures and Procedures:** Standard instruments were used as a tool to extract information keeping in mind the objective and design of study. All the instruments selected were widely used and its reliability has been established.

MSD assessment was done by employing the Nordic Musculoskeletal Questionnaire (NMQ) during personal interview to find the prevalence of WMSDs in nine anatomical regions. These are three upper limb segments (shoulder, elbows, wrist/hands), three lower limb segments (hip/thighs, knees, ankle/feet) and three trunk segments (neck, upper back, lower back). The questionnaire involved information including the location of symptoms in the past 12 months, past 1 week and whether it interfered with daily activities in the previous 12 months. NMQ has been widely used as a screening tool for WMSDs and found to have good reliability and validity (Kuorinka et.al.1987).

A Visual Analogue Scale (VAS) is a tool that measures the characteristics or attitude that is believed to range across a continuum of values. For example, the intensity of pain that a participant experience ranges across a continuum from none to an extreme intensity of pain (Gould et al. 2001). Operationally a VAS is a horizontal line, 100 mm in length, anchored by word descriptors at each end. After evaluation with NMQ, the respondents who reported symptoms of MSD were asked to mark on the line the point that they feel represents their perception of their current state; this was done before starting the work and after finishing their work.

Ovako Working Posture Analyzing System (OWAS), which is based on work sampling (sampling at regular or variable intervals) and records the frequency of each posture, was developed by Ovako Steel Company in the Finland which describes the stress load on the musculoskeletal system due to poor work postures using action categories (Karhu et al. 1977, 1981; Kant et al. 1990; Das and Mukhopadhyay, 2014). The position of the back (4 positions), arm (3 positions), leg (7 positions) and head (5 positions) were recorded for each observation; shown in Table-2, 3, 4, 5. Subsequently, the work postures of the parts of the body were selected, calculated as a percentage of the total number of observations and classified into four action categories (AC). AC1 is normal posture, no action required. AC2 is slightly harmful. Action to change the posture should be taken in the near future. AC3 is distinctly harmful. Action to change the posture should be taken as soon as possible. AC4 is



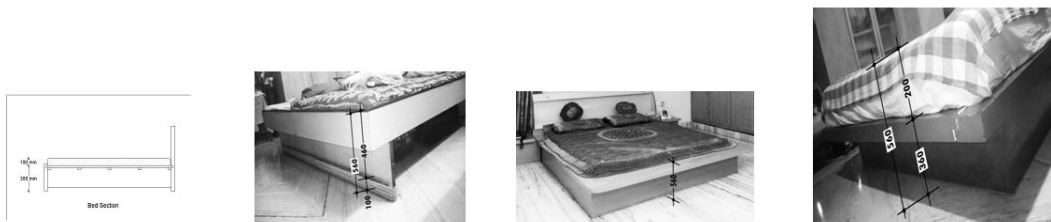
extremely harmful. Action to change the posture should be taken immediately. Around 1760 minutes of recording of the surgeons performing surgery was done. Altogether from the 17 recorded video samples of surgery, 425 pictures were cropped out, 25 from each of the 17 videos were used for data analysis. Thereafter OWAS evaluation was performed to obtain the postural analysis scores for each of the pictures.

## 4 Data Analysis

Data were summarized using the descriptive statistics of mean, standard deviations ( $\pm$ SD) and percentages. MSD prevalence rates at different anatomical regions were calculated as a percentage of all the respondents. Paired t-test was used to see the work exposure among the surgeons experiencing the strain using SPSS Ver. 20. The p-value of  $<0.05$  was considered as statistically significant.

## 5 Results

**5.1. Characteristics of work-related musculoskeletal disorders:** The surgeons reported high prevalence (89%) of work related musculoskeletal symptoms (MSS). The 12-month and 7-days prevalence rates of WMSDs reported by surgeons are presented in Fig 1.



The above figure shows that most of the respondents have reported low back trouble (40.23% and 23.33%) in last 12-months and last 7-days, followed by ankles/feet (17.3% and 20.76%), knees (15.23% and 18.57%), neck (15.23% and 13.8%), upper back (6.61% and 12.5%), shoulders (3.69% and 7.09%) and finally the wrist/hands (1.71% and 3.95%). Majority (86%) of the respondents had reported work as the cause for their MSS while very few (9%) reported accidents as the causal factor for their MSS.

**5.2. Workload among various specialty of surgeons:** The data was collected from different surgeons ( $n=48$ ) who were working in departments that included Orthopedics (31.3%), General Surgery (25%), ENT (18.8%), Ophthalmology (12.5%), Anesthesiology (6.3%), Obstetrics & Gynecology (6.3%). The average number of operations performed by surgeons was  $7.83 \pm 5.228$  per week, averaging  $10.66 \pm 4.22$  hours of work in the operation theatre, per

week. The average number of operations performed by surgeons of different specialties and their average operating hours taken per week are presented in Fig.2.

5	To give a review on the topic: accidental injury caused due to fall in geriatric population	Alok Kumar et. al., 2011[9]	India	Guidelines for Physical Exercises	Review Based 14 papers (1977-1991)	Walking is most applicable aerobic exercise and before aerobic body should be warm up for 10-15 minutes. Water exercises are best allowing movement with low impact on diseased joints & bones.
6	Group sessions of moderate-intensity exercise to improve balance	Barnett, Et. al., 2003 [26]	South-west Sydney, Australia	Group exercise to improve balance	Participants: 165 Age: 65 years and above Total of 37, 1-hr.	Within the 12-month trial period, the rate of falls in the intervention group was 40% lower than that

**5.3. Magnitude of the musculoskeletal discomfort among the surgeons:** Visual Analogue Scale (VAS) was used to measure the magnitude of the musculoskeletal discomfort experienced by the surgeons. It was used to analyze the musculoskeletal strain in different body parts as perceived by the surgeons. They rated the strain before and after their work exposure. The pre and post-test exposure for the participants are represented in table 1.

Name	Minimum	Maximum
volume	6220160mm <sup>3</sup>	
Mass	9.404 kg	
Von mises stress	0 MPa	65.7282MPa
1st principal stress	-7.32789 MPa	54.8644MPa
3rd principal	-57.8842MPa	4.54135MPa

The analysis of the above table shows that there is a significant difference between the pre and post work exposure scores. The negative t value shows that the intensity of pain has increased in these regions from pre work exposure to post work exposure.

**5.4. Potential postural risk factors among various specialty of surgeons:** To investigate possible difference in ergonomic stress and work related activities, to gain better understanding of physical exposure factors, physical demands and relate to the different





areas of MSS between the six different categories of surgical specialties; calculations on postures of body part were executed by Ovako Working Posture Analysis System (OWAS). From the assessment through OWAS method, the action level in four different parts of the body i.e. trunk, arms, lower body, and neck was revealed. The ergonomic stress of general surgeons precipitated from their trunk posture, lower body and neck posture i.e. bent forward (distinctly harmful) classified as AC3, bent/twisted (slightly harmful), stand, 1 foot—legs straight (slightly harmful) and bent forward, >20 degrees (slightly harmful), classified as AC2. The ergonomic stress of gynecologist is precipitated from trunk posture, lower body and neck posture i.e. bent/twisted (distinctly harmful) classified as AC3, stand, 1 foot—legs straight (slightly harmful) and twisted >20 degrees (slightly harmful) classified as AC2. The ergonomic stress of orthopaedicians precipitated from trunk and neck posture i.e. twisted (distinctly harmful) classified as AC3, bent to side >20 degrees (slightly harmful) and twisted >20 degrees (slightly harmful) classified as AC2. However, the ergonomic stress of ophthalmologist and ENT surgeon's precipitates from trunk posture i.e. bent forward (slightly harmful) and lower body i.e. sitting (slightly harmful) classified as AC2. All the surgeons had an acceptable arm postures as well as the posture of anesthetist revealed no action required as intervention, which can be classified as AC1.

## 6. Discussion

The study was designed to decipher the prevalence of work related MSDs, magnitude of musculoskeletal discomfort, workload and postural stress of various specialties of surgeons precipitating WMSDs. In the present study, the overall prevalence of MSS in at least one anatomic segment in the last 12 months was high and MSDs were most commonly reported for low back, ankles/feet, knees, neck, and upper back. Moreover, most of them have reported that work as the principal cause or aggravating factor for precipitation of the symptoms. Studies have reported that low back pain is the most common MSD in adult and about 60-80% of all individuals will experience the condition at some stage in their life (Waddell and Burton 2001). Researchers have found that the neck, knees and ankles/feet as the most common body sites of WMSDs among health care practitioners (Smith et.al.2003, Devereux et. al. 2002). Our finding on the high prevalence of work related back, ankle, knee, and neck pain among the surgeons is consistent with the pattern reported in literature. These practitioners worked for long hours and major part of the time was spent in carrying out activities in standing posture. Surgeons are mostly in standing posture while performing surgeries, regular walking from ward to ward, attending indoor patients which may load forces over knees and ankle/feet. Surgeons worked exclusively in the standing position with mild to moderate bend trunk and neck over operation table for prolonged period especially in long duration surgeries may be causing significant strain on the neck, upper and lower back (Szeto et. al. 2009). Surgeons with different specialties adopt different working posture based on operational procedures leading to different ergonomic stresses. In the present study, ophthalmologist and ENT surgeons were seen to assume a sitting posture while operating, all the general surgeons and gynaecologists conducted operations in the standing posture, two orthopedic surgeries were conducted in standing posture and one was in sitting posture. Moreover, the average operating hours of anesthetist, ophthalmologists and ENT surgeons were lesser than others which could also be one of the reasons to postulate the difference

in postural stress load. These findings are in accordance with the observations made by Kant et.al. 1992, on the surgeons in Netherland where significant ergonomic stress load were observed between general surgeons and ENT surgeons.

## 7. Ergonomic Implications and Conclusion

The present study has shown high prevalence rates of low back, ankles/feet, knees, neck and upper back MSS in surgeons. Since MSDs are a major reason for the loss of work efficiency, future emphasis can be given on recommending suitable remedial solutions for attenuation of the WMSDs in surgeons. This study can be used by ergonomists to relate complaints to work conditions. This risk evaluation would increase the effectiveness of preventive measures to be undertaken and a basis for further research on contributing factors and subsequently can be used in long-term follow-up studies as well as intervention effectiveness studies. The study can also be repeated to quantify the risk factors for WMSDs in other group of health-care professionals. Despite the positive results of this study, certain limitations are still evident and need to be addressed, such as the study is limited to the specialties of surgeons taken up for the present research. The study is restricted to male participants with low sample size due to time constraints. However, future studies may overcome this to delineate the risk more precisely.

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