

# Occupational health and musculoskeletal symptoms among Indian Medical Laboratory technicians

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## Abstract

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**Background:** Musculoskeletal diseases are quite common among healthcare professionals including medical laboratory technicians. This cross-sectional study aimed to identify the prevalence of musculoskeletal symptoms and ergonomic risk factors in Indian medical laboratory technicians.

**Materials and Methods:** The study sample comprised of 130 male and female laboratory technicians from the Indian healthcare industry. Samples were selected based on convenient random sampling. Data was collected using the Nordic Musculoskeletal Questionnaire (NMQ) and Quick Exposure Checklist (QEC) to evaluate the ergonomic risk factors present in Indian medical laboratories. Statistical tools applied in the present study include frequencies, percentage, mean and standard deviations, independent t-test, and chi-square test.

**Results:** Results indicated that the major percentage of technicians (66.9%) had suffered from some kind of musculoskeletal symptoms during the last 12 months. The highest prevalence was reported in the back (44%), knees (20.7%), and neck region (18.4%). This indicated that musculoskeletal problems are prevalent among Indian medical laboratory technicians. The results showed that the levels of exposure to musculoskeletal risks were high or very high among 85.3% of technicians. The statistical analysis showed an insignificant association between the level of risk factors and the prevalence of musculoskeletal issues ( $P>0.05$ ). The most common risk factors found to be awkward postures, prolonged standing, inappropriate workstation arrangement.

**Conclusions:** Ergonomic interventions in terms of reducing risk factors, improving workstation design, eliminating awkward postures, and providing some physical training to improve upon their musculoskeletal fitness level are recommended.

**Keywords:** Healthcare Industry, Medical Laboratory Technicians, Musculoskeletal Pain, Risk Factors, Posture

## Introduction

Musculoskeletal disorders (MSDs) are the most common occupational health problems in every country, regardless of its degree of industrialization. MSDs not only generate suffering and disability for workers and their families, but also result in high costs for society, considering losses in productivity and wages, benefits paid to workers, and medical expenses (1). In the present scenario, MSDs are one of the

most important occupational health problems around the world (2). In many countries, the prevention of MSDs among workers is considered a national priority (3).

MSDs are a concern in both industrialized countries (ICs) and industrially developing Countries (IDCs). In IDCs, issues related to

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workplace injuries are comparatively serious (4) due to their high impact rate on disability, personal suffering, and absence from work, and the direct and indirect costs to the health care system (5). Poor working conditions and the absence of an effective work injury prevention program in IDCs has resulted in a very high rate of MSDs (6).

According to the World Health Organization (WHO) reports, the global prevalence of MSD ranges from 14% to 42% (7). Though India has seen tremendous developments in its economy and industrialization, still it has a high incidence rate of musculoskeletal disorders. The prevalence of musculoskeletal problems in Northern India has been reported to be as high as 59.4% (8).

Literature has revealed several factors associated with MSDs. Greater evidence is related to physical demands, especially the handling of loads, incorrect posture, and repetitiveness. High psychological demands have shown the strongest evidence of association with low back MSD, although there has also been evidence of association with MSD in upper extremities. Individual characteristics and activities outside work have also been found to be critical factors associated with MSDs, and thus, should always be investigated, as they could operate as confounding factors in the relationship between MSD and occupational factors (9).

In the healthcare industry, medical laboratory testing plays a crucial role in the detection, diagnosis, and treatment of disease in patients. Medical laboratory technology is one of the most rapidly expanding health care fields. Medical laboratory technicians are a unique group of healthcare professionals who are at risk for developing work-related musculoskeletal symptoms (10).

It is well established that there are ergonomic challenges in the clinical or medical laboratory. These challenges can originate from simple physical challenges that result in

musculoskeletal disorders and diseases in the upper limbs, back, and lower limbs. More complex ergonomic issues often associated with human factors can challenge laboratory technicians when they have to perform sophisticated operations in a short amount of time resulting in possible errors that could compromise the quality of the work performed (11).

Laboratory procedures are highly repetitive and involve several risk factors. Laboratory technicians are at risk of repetitive motion injuries during routine laboratory procedures such as pipetting, operating the microscope and microtomes, using cell counters, and video-display terminals. Repetitive motion injuries develop over time; they occur when muscles and joints are stressed, tendons are inflamed, nerves are pinched, and blood flow is restricted (12). Standing and working in awkward positions in biological safety cabinets can also cause ergonomic issues (12). Laboratory technicians are reported to have high levels of strain in the neck and shoulders, due to prolonged static loadings, which leads to high prevalence of neck and shoulder pain (13, 14).

Today, technological advancements, like automated processes for centrifugation, chemical and biological assays and processing have exposed people who work inside high-tech laboratories to hazards they had previously not experienced, such as tendonitis, carpal tunnel syndrome, and back disorders. Medical laboratories, therefore, are forced to give attention to the issues of ergonomics to prevent work-related musculoskeletal disorders (WMSDs) (12).

In general, MSD is the most prevalent occupational health problem in manufacturing and heavy labor industries. Apparently, few epidemiological studies have investigated MSD risk factors among healthcare professionals. The literature is mostly based on nurses, surgeons, and dentists and their occupational risk factors in

the healthcare industry. However, limited literature is available on other healthcare professionals particularly in medical laboratories.

Studies focusing on ergonomic issues among medical laboratory technicians to determine the prevalence of MSDs and to assess physical exposure to musculoskeletal risks are scanty. Hence, the present study was conducted in medical laboratories to evaluate the pervasiveness of MSD among medical laboratory technicians and to assess the level of worker's exposure to MSD risk factors.

### **Materials and Methods**

The present study was carried out in 5 different medical laboratories located in Western (Mumbai) and Eastern (Kolkata) India. The sampling technique used in the current study was convenient random sampling in which the technicians were chosen from different parts of the country. The study was conducted on 130 laboratory technicians employed in different units of the medical laboratories in the year of 2013 and were selected on a random basis and according to subject availability. They worked in different shifts. In this study, the subjects with at least 1 year of job tenure were randomly selected and included in the study. Subjects with background diseases or those who had experienced occupational or non-occupational accidents affecting the musculoskeletal system were excluded from the study. Data were collected using questionnaires and the observation technique. The socio-demographic characteristics questionnaire used in this study consists of 2 sections and includes the following items: a) personal and professional details (including weight, height, age, job tenure, working hours, work shifts and overtime); and b) musculoskeletal problems in different body regions.

A voluntary consent form was signed by each of the respondent prior to the study. The procedure of the study was explained in detail to the participants. The study had approval from the Institutional Human Ethical Committee, India.

The prevalence of MSDs was determined using the Nordic Musculoskeletal Questionnaire (NMQ) (15). Reported cases of MSDs among technicians were identified and laboratory personnel were questioned by considering the period prevalence (12 months), point prevalence, and intensity of musculoskeletal symptoms (i.e. aches, pain, discomfort, numbness, or tingling) in different anatomical areas (i.e. neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs/buttocks, knees, and ankles/feet) based on the NMQ. All the departments of the medical laboratory were visited and the questionnaires were completed by interviewing the subjects individually.

In order to assess physical exposure to musculoskeletal risks, the Quick Exposure Checklist (QEC), known as a pen-paper observational method, was used (16). The technique includes the assessment of the back, shoulder/arm, wrist/hand, and neck regarding their postures and repetitive movement. It is performed using the observation technique and video recording. Studies have shown that QEC is a sensitive, suitable method for assessing physical exposure to musculoskeletal risks in the workplace with fair inter-/intra-observer reliability (17). To conduct the assessment using the QEC system, all the technicians were videotaped during their routine job activities for nearly 15 minutes demonstrating the shift activities to find the most awkward postures of the body regions. For each subject, working postures were analyzed by reviewing the tapes in laboratory and the QEC score was calculated.

Through statistical analysis, frequencies, percentage, and mean and standard deviations were calculated to answer the various questions relevant to the objectives of the study. The

independent t-test and chi-square test were used to study the associations between personal and occupational characteristics, and reported musculoskeletal symptoms.

## Results

A total of 130 laboratory technicians working at 5 hospital laboratories of Western and Eastern

India were enrolled in the study. The average age, height, and weight of the medical laboratory technicians were  $32.7 \pm 10.2$  years,  $162.11 \pm 11.43$  cm, and  $59.64 \pm 11.4$  kg, respectively. The average age, height, and weight was comparatively higher in males than in females. Table 1 illustrated the demographic and occupational characteristics of the respondents who participated in the study.

**Table 1: Socio-demographic and occupational characteristics of medical laboratory technicians (n = 130)**

Variables		Female (n = 48)	Male (n = 82)	Total (n = 130)
Age (years)	Mean	27.72	35.60	32.7
	SD	(8.0)	(10.3)	(10.2)
	Range	19-60	21-60	19-60
Height (cm)	Mean	153.35	167.23	162.11
	SD	(11.2)	(7.8)	(11.43)
	Range	121.92-167.64	132-185.4	121.92-185.4
Weight (kg)	Mean	52.37	63.90	59.64
	SD	(11.2)	(9.2)	(11.4)
	Range	35-88	40-88	35-88
Job tenure	Mean	6.51	11.81	9.85
	SD	(7.8)	(9.3)	(9.1)
	Range	1-36	1-34	1-36
Work hours per week	Mean	49.68	49.91	49.98
	SD	(3.4)	(2.6)	(2.9)
	Range	30-54	40-56	30-56
<b>Shift System</b>				
General shift	N (%)	15 (31.25)	34 (41.46)	49 (37.7)
Shift duty	N (%)	33 (68.75)	48 (58.53)	81 (62.3)
<b>Overtime</b>				
Yes	N (%)	25 (52.08)	41 (50)	66 (50.76)
No	N (%)	23 (47.91)	41 (50)	64 (49.23)

Note: Shift duty includes morning, afternoon and night shifts

Regarding employment characteristics, the average work experience for medical laboratory technicians was  $9.85 \pm 9.1$  years and average working hours per week was  $49.98 \pm 2.9$ . The majority of technicians (62.3%) were working in shifts and half of them (50.76%) had to do

overtime, especially senior laboratory technicians, due to additional responsibilities.

### Prevalence of musculoskeletal issues

In the present study, the overall prevalence of musculoskeletal issues among medical

laboratory technicians was 66.9%. Figure 1 demonstrates the prevalence of MSD symptoms in different body regions of laboratory technicians during the previous 12 months. As figure 1 shows, the most commonly affected body regions among the medical laboratory technicians were the lower back (32.5%), knees (20.7%), neck (18.4%), upper back (11.5%), and shoulders (11.5%) in the previous 12 months. Moreover, it was found that the 12-month prevalence was comparatively higher in

comparison to the 7-day prevalence in all body regions. Furthermore, it indicated that 57% of technicians reported work as the cause of their musculoskeletal discomfort; however, the percentage of absenteeism (11.5%) was low among them.

Table 2 summarizes the prevalence of musculoskeletal issues with respect to gender, age, work experience, and working hours among medical laboratory technicians.

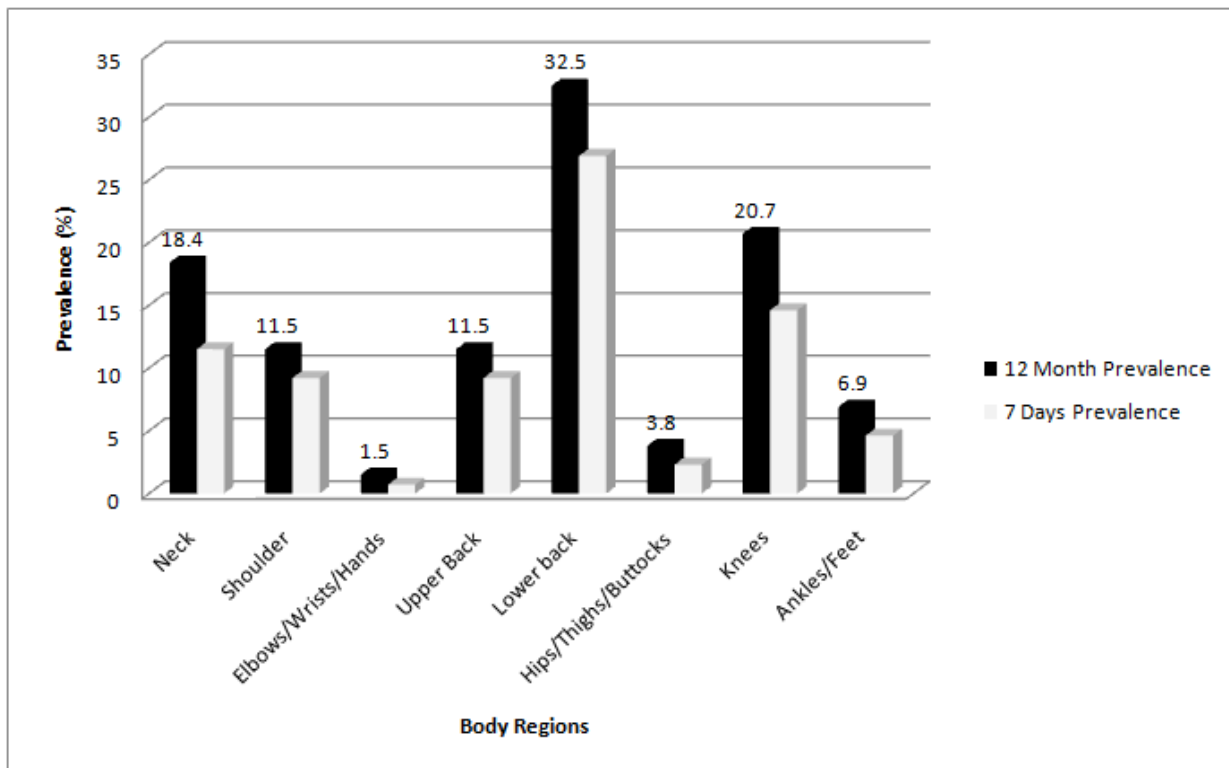


Figure 1. Frequency of reported musculoskeletal symptoms in different body regions during the 12 months prior to the study (n = 130)

**Table 2: Distributions of medical laboratory technicians with WMSDs according to sex, age, work experience, and hours per week in the medical laboratory**

Variables		Total	WRMSD (n)	%
Sex	Female	48	38	79.16
	Male	82	43	52.4
Age (years)	< 32	77	46	59.74
	≥ 32	52	35	67.3
Work experience (years)	< 9	79	47	59.4
	≥ 9	51	34	66.6
Working hours per week	< 49	56	37	66.07
	≥ 49	74	44	59.45

The results showed that females (72.16%) were more prone to musculoskeletal problems in comparison to males (52.4%) and the technicians who were in the older age group (67.3%) (i.e. more than 32 years of age) were more prone to musculoskeletal problems in comparison to younger age groups (59.74%). Similarly, technicians with more than 9 years of work experience reported higher number of musculoskeletal problems in comparison to those who had less than 9 years of experience. Moreover, the results indicated that more than half of the technicians (66.07%) working less than 49 hours per week, since they were mostly junior lab technicians, have also reported WMSDs.

Table 3 shows the association between the demographic variables and reported musculoskeletal problems in at least 1 body region. None of the independent variables showed a significant relationship with reported musculoskeletal problems ( $P > 0.05$ ). An insignificant relationship was found between age and job tenure, and musculoskeletal discomforts reported in various body regions ( $P > 0.05$ ).

**Assessment of ergonomic risk factors**

Table 4 displays the prevalence rate of reported symptoms at different levels of risk exposure among the technicians.

**Table 3: Associations between demographic variables and reported musculoskeletal problems among the participants (n = 130)**

Variables	Musculoskeletal problems				P value
	Reported		Not reported		
	M	SD	M	SD	
Age (year)	32.83	10.5	32.49	9.9	0.857
Weight (kg)	59.64	12.2	59.65	10.2	0.996
Height (cm)	161.53	10.9	163.06	12.3	0.463
Job tenure (year)	10.21	9.4	9.27	8.6	0.570

**Table 4: The prevalence rate of reported musculoskeletal symptoms at different levels of risk exposure among the participant (n = 130)**

Risk level (overall exposure score)	Musculoskeletal problems				N (%)
	Reported		Not reported		
	n	%	n	%	
<b>Low</b>	4	57.1	3	42.9	7 (5.4)
<b>Moderate</b>	8	66.7	4	33.3	12 (9.2)
<b>High</b>	62	62.0	38	38.0	100 (76.9)
<b>Very high</b>	7	63.6	4	36.4	11 (8.4)
<b>Total</b>	81	62.3	49	37.7	130 (100)

In table 4, the results of the assessment of physical exposure to musculoskeletal risks (16) show that:

- In 5.4% of the technicians studied, the calculated exposure level was less than 40%, indicating that the level of exposure to musculoskeletal risks was acceptable (low risk).
- In 9.2% of the technicians studied, the calculated exposure level was between 41% and 50%, indicating that the level of exposure to musculoskeletal risks needed consideration (moderate risk).
- In 76.9% of the technicians studied, the calculated exposure level was between 51% and 70%, indicating that the level of exposure to musculoskeletal risks was high and ergonomic interventions to decrease the exposure level seemed essential (high risk).
- In 8.4% of the technicians studied, the calculated exposure level was higher than 70%, indicating that the level of exposure to musculoskeletal risks was very high and immediate ergonomic interventions to decrease exposure level were essential (very high risk).

The chi-square test revealed an insignificant association between QEC risk level and the prevalence rate of reported musculoskeletal problems ( $P > 0.05$ ).

## Discussion

The present study aimed to determine the pervasiveness of musculoskeletal issues and how the prevalence varies across the individual (such as gender and age) and occupational characteristics (such as work experience and working hours) among medical laboratory technicians. The study also tried to examine the level of exposure to risk factors and its association with the prevalence of musculoskeletal discomfort among the technicians.

The NMQ showed that musculoskeletal problems were common among Indian medical laboratory technicians. The vast majority of the study population (66.9%) had experienced some form of symptoms of musculoskeletal issues during the previous 12 months (Figure 1). The overall prevalence (66.9%) in the present study is much higher than the study carried out in the Udipi district in India where the total reported prevalence of musculoskeletal issues was only 21.2% (18). However, in the study carried out by [19], the global report of musculoskeletal symptoms, a prevalence of 79% was found in the preceding 3 months in a group of 14 female laboratory technicians. Daily microscope users can be easily fatigued by awkward sitting positions and complicated controls. This affects many users in microbiology, cytology,



hematology, and pathology labs (20). Musculoskeletal conditions, including shoulder, neck, and back aches, are the most prevalent injuries, with more than 77% of users experiencing these issues (21).

The NMQ showed that the prevalence of musculoskeletal problems is high which indicates that the clinical laboratory technician occupation should be considered as a high risk occupation in terms MSDs (Figure 1).

This indicates that MSD among Indian medical laboratory technicians is a serious issue and needs appropriate attention. Back, knees, and neck symptoms were found to be the most prevalent problems among the technicians studied (Figure 1). This could be attributable to awkward working postures, scattered workplace which made them move continuously from one workplace to another, and prolonged standing which was common in almost all workstations and job activities observed. These findings are similar to those of the study conducted among 156 laboratory technicians where the overall prevalence was 72.4% and the most prevalent musculoskeletal complaints were low back and neck pain (22). Furthermore, 57% of technicians reported work as the cause of their musculoskeletal discomfort. Though they believed that their discomfort was occupation-related, this did not have much effect on the percentage of absenteeism which was found to be only 11.5%. This might be due to the fact that they were compelled to their workplace in spite of having musculoskeletal discomfort in various body regions. This implies that any interventional program for preventing or reducing MSDs among laboratory technicians should focus on reducing physical exposure to MSD risk factors.

In the present study, it was observed that females are more prone to musculoskeletal problems in comparison to males. It was also found that the technicians in the older age group (i.e. more than 32 years of age) and technicians

with more than 9 years of work experience are more prone to musculoskeletal discomfort. This indicates that as age and experience increase, the issues related to the musculoskeletal system tend to increase (Table 2).

In context of working hours, usually it is observed that technicians working more than 8 hours per day (i.e. more than 48-49 hours per week) are mostly senior lab technicians as they are given more administrative and supervisory duties and responsibilities. This might be the cause of increase in the prevalence of musculoskeletal discomfort among the technicians working less than 49 hours per week (Table 2). Moreover, this difference might be due to the working pattern among senior and junior lab technicians. Senior technicians were involved in more administrative and supervisory work in comparison to junior lab technicians who were continuously performing routine laboratory tasks.

The above results are very much similar to the findings reported in the literature. Gender differences are a key feature of the MSD epidemiology (23). This corresponds to findings from epidemiological surveys of MSDs in the general population (24, 25) or in occupational samples (26, 27) which have consistently found a higher prevalence among women (28).

Over the years, several cross-sectional studies on musculoskeletal complaints have reported a sharp increase in prevalence rates with advancing age for both male and female workers (29, 30). It can be hypothesized that several age-related factors are partially responsible for this age effect. First, biological changes related to the ageing process, e.g. degenerative changes of the intervertebral discs (31), are suggested to contribute to the pathogenesis of musculoskeletal disorders. Second, the increasing number of years in service during which ageing workers are exposed to harmful work demands have been associated with an



increased risk of musculoskeletal disorders (32, 33).

Age is not an independent risk factor for work-related MSD. Older workers are more susceptible to work-related MSD than younger workers because of decreased functional capacity (34). Loss of muscle mass (sarcopenia) is a process that starts around age 30 and progresses throughout life. From about age 30, the density of bones begins to diminish in men and women. This loss of bone density accelerates in women after menopause. As a result, bones become more fragile and are more likely to break (osteoporosis), especially in old age.

In regards to examining the association between demographic and occupational characteristics, and musculoskeletal discomfort, none of the variables showed a significant association with reported musculoskeletal problems ( $P > 0.05$ ) (Table 3). To the researcher, this was an unanticipated observation. This might be due to the fact that senior technicians are involved in more administrative duties and supervisory work. This resulted in them moving frequently from one workplace to another (approximately 60% of their work schedule), and thus, relieving from postural stress. However, younger technicians with less work experience performed more routine laboratory tasks. Thereby, an insignificant difference was found between age and work experience, and musculoskeletal problems.

As shown in table 4, it can be observed that the prevalence rate increased and remained stable with increased level of risk factors. Though there is an insignificant difference between risk level and the prevalence of MSD ( $P > 0.05$ ), it is clearly observed that the prevalence rate increased with higher level of risk factors (Table 4). This indicates that the tasks and the working conditions in the medical laboratories were the cause of developing MSDs. Therefore, ergonomic interventions were deemed necessary

to improve the working conditions and reduce the level of exposure to musculoskeletal risks.

The most commonly observed risk factors the technicians encountered were awkward working postures, repetitive movements, inappropriate seat designs, prolonged standing, limited leg space, heavy work load, high work pace, and lack of work rest schedule, and inappropriate work station design in terms of scattered workplace which causes much walking or movement from one workplace to another.

### **Conclusion**

The present study emphasized the high prevalence of WMSDs among Indian medical laboratory technicians. Although the effect of etiological mechanisms on MSDs is still poorly understood, studies have provided evidence that environmental, workplace, personal, and physiological factors have an impact on the occurrence of WMSDs. Thus, taking corrective measures to reduce the risk level seemed essential. An ergonomic intervention program should focus on eliminating awkward postures and repetitive movements, and designing appropriate seats and sitting-standing workstations in medical laboratories.

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