

The incidence of musculoskeletal system occupational diseases among tuberculosis laboratory workers

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ABSTRACT

Objective. Health care workers are exposed to various kinds of professional risks like needle stick injuries, lower back and back problems, allergies, violence and stress. Health care workers in tuberculosis laboratory are exposed to both infection and musculoskeletal system occupational disease risks because of using Class II, Type B biological safety cabinets and laboratory vortex equipment. This study was carried out to determine incidence rates and causes of the musculoskeletal system occupational diseases among health care workers in tuberculosis laboratories of two State hospitals in Ankara. **Methods.** Study population was composed of 16 laboratory workers in tuberculosis laboratories of two State hospitals in Ankara. Data was collected using a questionnaire. **Results.** Thirteen (81.2%) laboratory workers were male and three (18.8%) were female. The mean age of the subjects was 40.1 ± 7.0 years and average duration of occupation of subjects was 208.3 ± 11.6 month. According to the data, of the 16 personnel, 10 (62.5%) had occupational disease. Incidence rates of occupational diseases were as follows; 62.5% shoulder pain, 25.0% wrist pain and 18.8% elbow pain. Duration of their occupation was significantly associated with elbow pain ($p = 0.037$). There was a significant relationship between hand and wrist pain and smoking ($p = 0.042$). Seventy-five per cent of laboratory workers did not think they had enough information on occupational diseases, and 68.8% of them wanted to have information about occupational diseases. **Conclusions** The most prevalent occupational diseases among the tuberculosis laboratory workers in our sample were shoulder, elbow and wrist pains. Duration of occupation and smoking were associated with the incidence of occupational diseases.

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Introduction

Musculoskeletal system diseases (MSDs) are “work-related” diseases or conditions in musculoskeletal system as described by International

Occupational Health and Safety Committee. “Work-related” term has been used by World Health Organization for describing scientific cause of a

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multifactor condition arising from the effect of two factors such as performing a work and working environment. MSDs develop as a result of repetitive motions such as twisting, stretching, gripping, holding, pressing and reaching, which lead to damage in tendons, muscles, nerves and other soft tissues [1]. Occupational disease-related MSDs arise as a result of damaging effect of repetitive physical motions on tendons, muscles, nerves and other soft tissues. The main complaint is pain in upper extremities, neck, shoulder, hand wrists and lower back. Etiological factors are bad postures and motions, excess load on muscles during work, speed, duration and repetitive characters of work, excess labor during motion, vibration, heat and use of tools with poor ergonomics. Thirty five million health workers worldwide constitute 12% of all working population [2]. Job accidents and occupational diseases are among the major problems of working life. According to work safety studies, 98% of work accidents are preventable. For the prevention of occupational diseases and job accidents, continuous health checks have been introduced for workers [3]. MSDs are common among health workers. It has been reported that MSDs have considerable effects on life quality, reduce working life, increase work limitation and necessitate changing the work of individual. It could lead to economic problems for individual and for society at large. A study revealed that MSDs affect lower back region most in health workers [4]. Incidence of the condition in upper extremity has been reported to be 16.2% for wrists/hands, 12.6% for shoulder and 7.1% for elbow. In addition to occupational risks exposed by workers in other sectors, health workers are subject to some extra risks unique to their work. These additional risk factors show a wide spectrum involving needle stick injuries, back and lower back problems, latex allergy, violence and stress. Hospital laboratories involve many hazards for health workers. Biological hazards are leading ones due to working with highly concentrated pathogens.

Tuberculosis laboratory is known as dangerous laboratory group and the primary aim of tuberculosis laboratories is to detect infectious pulmonary tuberculosis cases, to follow-up treatment and post-treatment patients. Tuberculosis laboratory is required to have at least one biosafety cabinets for culture and drug sensitivity studied. In addition to personal protective equipment, aerosol-forming processes (pipetting, vortexing, mixing, agitation, transferring) must be done in biosafety cabinets and specially designed centrifuges should be used for centrifugation.

Biological analysis laboratories such as a tuberculosis laboratory have health concerns due to presence of chemicals and medical apparatus and to ergonomic problems (inappropriate postures, heavy loads) in addition to concerns arising from pathogens. Biosafety cabins in the tuberculosis laboratory often cause musculoskeletal disorders.

Tuberculosis laboratory workers are exposed not only to bacteriological risks but also to MSDs. In the literature, there are not enough studies about this subject in tuberculosis laboratory workers. In the present study, MSDs, frequently diagnosed in workers of tuberculosis laboratories but rarely considered as occupational disease, and their reasons were studied.

Methods

Formal request was made to Public Health Laboratories of Ankara Public Health Directorate and in tuberculosis laboratory of Atatürk Training and Research Hospital for Chest Diseases and Surgery for visits to departments before the study, and permission was granted. Tuberculosis laboratory workers to participate in the study were informed in advance and interviews were made with ones willing to participate. Sixteen laboratory technicians working in tuberculosis laboratory constituted the study population. No sampling was made and all sixteen workers comprising the whole population was studied. Data were collected by a single investigator through face-to-face interviews and observation techniques. Data collection tool / questionnaire form of the study was conducted on a total of tuberculosis laboratory workers in order to determine what they know about MSDs.

Duty of a technician working in a tuberculosis laboratory is to search for the presence of *Mycobacterium tuberculosis bacillus* in material (pleura, sputum, tissue, urine, feces, etc.) sent to laboratory. In tuberculosis laboratory, following procedures are applied for each materials in Class II, Type B biological safety cabinet (air flow is from the room where user is located towards inside the cabinet so that user safety is ensured): a certain amount of sodium hydroxide is added into each material coming to laboratory in a container with a special lid and then lid is closed. Fifteen minutes later, material is mixed using vortex machine (a tool used for mixing laboratory tubes) for 1-2 minutes, buffer solution is added to adjust pH and the tube is centrifuged for 15



Figure 1. Working images of health personnel in tuberculosis laboratory by Class II, Type B safety cabinet and vortex machine.

minutes. Then materials are inoculated in Lowenstein Jensen medium and stained. All these processes are conducted by laboratory worker holding material with his/her hands and raising arms about shoulder level (Figure 1).

Questionnaire forms including questions categorized in six main groups about what MSDs which especially due to vibration, repetitive motion and poor posture disturbance are and what they should be careful about were directed to health workers and were completed by face-to-face method. Questionnaire technique was used in which cross-sectional and descriptive questionnaire was employed to collect data for the study. Based on the information in literature, questionnaire forms having 15 questions were prepared. Tuberculosis laboratory employees were asked questions about musculoskeletal disorders which especially due to vibration, repetitive motion and poor posture disturbance. The form contained questions about variables such as age, gender, marital status, clinic in which the technician was employed, duration and type of work, smoking, pain character in

the upper extremity area, medical treatment status as well as questions measuring the level of information about MSDs as occupational disease. Information was gathered from participants about whether they were hospitalized due to upper extremity complaints, whether they changed their works, whether they experienced pain in last week, month or year, whether the pain affect their work/family life, whether they visited a physician/physiotherapist, whether they used pain killers and whether they underwent an operation because of these complaints. The relationship between the duration of work and MSDs was investigated.

Statistical Analysis

Data were analyzed as frequency and percentage distribution using SPSS 18.0 statistical analysis software. Pearson Chi-Square, Fisher's Exact Test, Kruskal Wallis Test, Continuity Correction Test and Mann-Whitney U Test were used in analyses. Two sided p value was used in all analyses and $p < 0.05$ was considered significant.

Table 1. Demographic data of laboratory workers.

No.	Gender	Marital status	Duration of work (month)	Smoking	Shoulder pain	Elbow pain	Hand /hand wrist pain	Medical treatment
1	F	Married	120	Never	No	No	No	No
2	F	Married	252	Gave up	No	No	No	No
3	F	Married	352	Gave up	Yes	Yes	Yes	Medicine
4	F	Single	240	Smoking	Yes	No	Yes	No
5	M	Single	73	Never	No	No	No	No
6	M	Single	300	Smoking	Yes	No	No	No
7	F	Married	288	Never	Yes	No	No	Physiotherapy and medicine
8	F	Married	249	Gave up	Yes	No	No	No
9	F	Married	278	Never	Yes	No	No	No
10	F	Single	312	Gave up	Yes	Yes	Yes	Physiotherapy and medicine
11	F	Married	30	Never	Yes	No	No	No
12	F	Married	22	Smoking	Yes	No	No	No
13	F	Married	36	Never	No	No	No	No
14	F	Married	264	Smoking	Yes	Yes	Yes	Physiotherapy and medicine
15	M	Single	278	Never	No	No	No	No
16	F	Single	240	Smoking	No	No	No	No

F = female, M = male

Results

Thirteen (81.2%) of the 16 tuberculosis laboratory workers were women and three (18.8%) were men. Average age was 40.1 ± 7.0 years and average duration of occupation was 208.3 ± 11.6 months. In terms of smoking, nine workers (56.25%) never smoked and seven (43.7%) were actually smoking or had smoked in the past and gave up. Demographic data about participants were given in Table 1.

Results showed that 10 out of 16 workers (62.5%) had MSDs. Occupational diseases detected among tuberculosis laboratories were shoulder pain (62.50%), hand wrist pain (25.00%) and elbow pain (18.75%) (Figure 2). There was a significant correlation between the duration in occupation and elbow pain ($p = 0.037$) (Figure 3.). Another significant correlation was found between smoking and elbow pain ($p = 0.049$) (Figure 4).

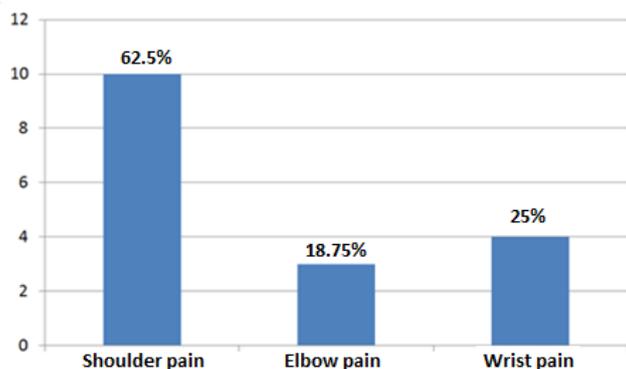


Figure 2. Incidence rate of musculoskeletal system diseases.

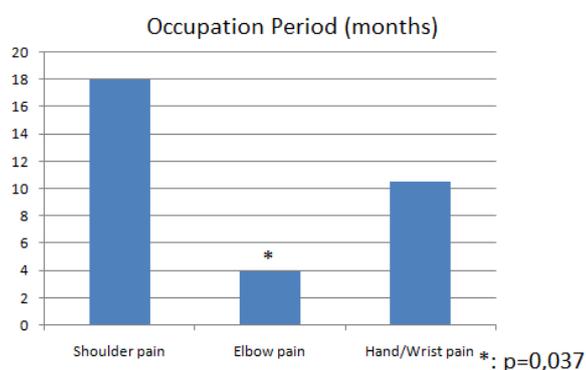


Figure 3. Relationship between duration of work and musculoskeletal system diseases among laboratory workers.

One person diagnosed with MSDs was treated with drug treatment (6.25%) and three with drug treatment plus physiotherapy (18.75%). No laboratory worker had history of surgery due to MSDs.

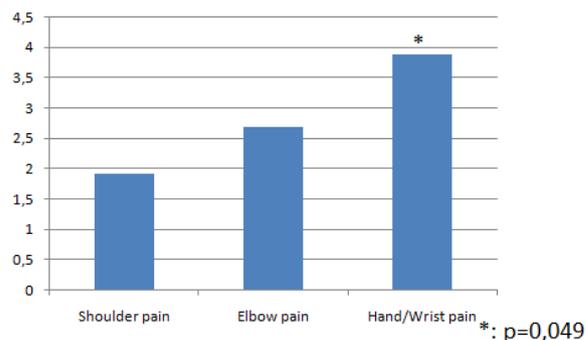


Figure 4. Relationship between smoking and musculoskeletal system diseases among laboratory workers.

Seventy-five of the laboratory workers considered themselves lacking sufficient amount of knowledge about occupational disease (Figure 5). Of all laboratory workers, 68.8% wanted to have detailed information about MSDs (Figure 6).

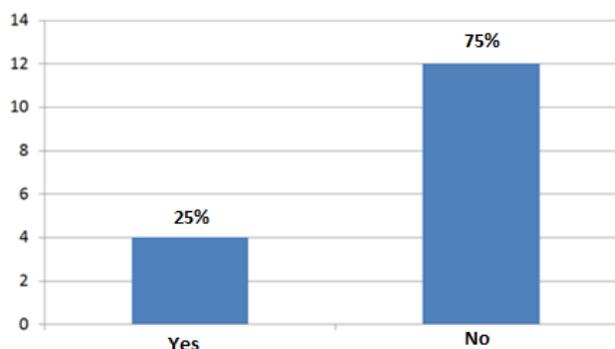


Figure 5. Percentage of laboratory workers who considered themselves informed enough about occupational diseases.

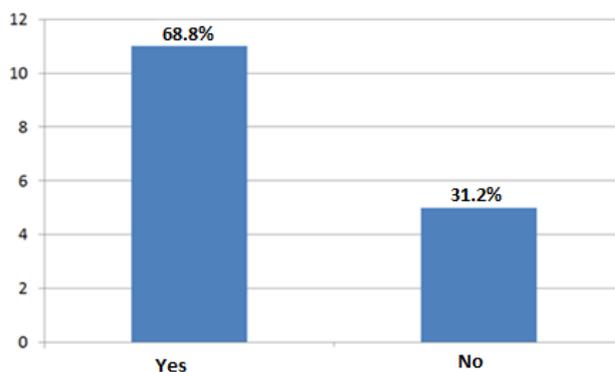


Figure 6. Percentage of laboratory workers who wanted to get detailed information about occupational diseases.

Discussion

MSDs are among the most significant problems of working life [5]. MSDs involve muscles, tendons,

ligaments, joints, peripheral nerves and blood vessels, and could lead to inflammatory and degenerative conditions causing pain in the involved area [6]. MSDs-related risk factors are physical, social and personal [7]. Main complaint is pain in upper extremities, neck, shoulder, hand wrists and lower back [8]. In our study, tuberculosis laboratory workers were found to have upper extremity-related diseases than other extremity-related diseases.

MSDs could have potential adverse impacts on both individuals and institutions. Its relationship with physical and mental health of work force has been studied in various investigations. In a study conducted on 410 office workers, reported musculoskeletal impairment incidence in the upper extremities was 27.5%, followed by impairment in shoulder (18.1%), hand/hand wrist symptom (13.9%) and impairment in elbow (5.3%) [9]. A study carried out on nurses revealed that 69% of the nurses suffered from back pain, 46% from shoulder pain, 54% from neck pain and these complaints were shown to be related to working area [10]. In the present study, 62.5% of health personnel working in tuberculosis laboratory had shoulder pain, 25.0% had hand wrist pain and 18.75% had elbow pain.

Health workers have risk for MSDs. Especially nurses rank third after heavy industry workers and heavy vehicle drivers to suffer from back pain due to their occupation. Health workers other than nurses such as dentists, physiotherapists and caregivers also have high risk for back pain. Smith *et al.* [11] have reported that musculoskeletal system pains are most common in shoulder, waist, neck and lower back regions in Japanese nurses. It was determined in the present study that laboratory workers had higher rates of upper extremity diseases because of having to work with Class II, Type B Biosafety cabinets.

There are mechanical risks in tuberculosis laboratory because of use of machines, laboratory tools and pressure containers such as autoclave. Centrifuges are machines working by high-speed spinning and could cause problems due to chemicals and wearing of metal over time. Mounting centrifuges on uneven surfaces could lead to vibration and falling. Working in a narrow area could cause a hot and noisy working environment. Our literature survey showed that MSDs were studied among health workers, specifically in nurses; however, there was no report in literature on MSDs among tuberculosis laboratory workers to our best knowledge [9, 10]. Workers in tuberculosis laboratories were exposed to risks that

could lead to MSDs by working in Class II, Type B biosafety cabinets, in microscope studies, during separation of specimen on counters and working with monitors. We found that the risk of getting MSDs was high when working in the Type B biosafety cabinet. Works requiring repetitive motions are tiring for employees. Health workers cannot entirely relax during the short breaks between duties. Although repetitive motions demand minimum power, efforts needed to continue these motions over time increase regularly. When the activity is continued without break despite the accumulated fatigue [12]. Workers exposed to vibration may have complaints about weakness and pain in hands and arms. Muscle fatigue could lead to injuries in some people. Since the health problems due to vibration, an inevitable fact of working life, are not evident right after the start of exposure, vibration is not considered as a dangerous risk factor [13]. In our study, tuberculosis laboratory workers were found to have excessive fatigue, depression and loss of work power. Hand/hand wrist pain due to use of vortex machine has been frequent among the subjects of the present study. In addition, a positive association was found between smoking and hand/hand wrist pain.

There are some difficulties in recording occupational diseases in Turkey. Since background for the conditions of occupational diseases are difficult to determine, they may sometimes go unnoticed. An occupational disease can be apparent only after a long incubation period and lead to permanent damage. Despite their high incidence rates, MSDs are rarely reported as occupational diseases. Total number of reported cases of occupational diseases in Ankara Province was 6 in 2013, 9 in 2014 and 46 in 2015. According to 2016 hospital admission data of Gaziosmanpaşa University, Health, Research and Practice Hospital, 104 patients (44 male, 60 female; average age 56.6 ± 11.7) had frozen shoulder, rotator cuff tendon injury and shoulder lesion diagnoses, but no patient had these diagnoses as occupational disease. Similarly, despite the presence of MSD diagnoses among tuberculosis laboratory health personnel, they were not reported as occupational disease.

The most important aspect of occupational diseases is that they are 100% preventable. When checking methods are appropriately used and necessary risk management practices are implemented, occupational diseases could be eliminated in businesses.

The Limitations of the Study

Study population was small because only tuberculosis laboratory workers were included. Since this was a questionnaire study, MSD diagnoses were not supported by laboratory tests and physical examination other than major and minor findings. Therefore, other pathologies that could not be excluded only by anamnesis should also be considered.

Conclusions

In conclusion, it should be kept in mind that MSDs could appear as occupational diseases among tuberculosis laboratory workers. It is thought that improved physical working conditions, orderly implementation of periodic health checks and administering appropriate treatment to workers who had diagnosis for occupational diseases could lower the negative effects of MSDs due to occupational exposure. In addition, it could be useful to organize physical exercise programs to strengthen body muscles such as waist, shoulder and neck muscles for all health workers and to teach them working in appropriate posture to eliminate and prevent MSDs.

Authorship declaration

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors are in agreement with the manuscript.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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