

PREVALENCE OF MUSCULOSKELETAL DISORDERS AND ERGONOMIC RISK FACTORS AMONG FIREFIGHTERS

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Abstract

Background: Musculoskeletal disorder is defined as damage to the musculoskeletal system, which includes the muscles, tendons, ligaments, nerves, discs, blood vessels, and other components that allow the human body to move. Firefighting is an unsafe and arduous physically. Firefighters work in emergencies to prevent and cease fire and respond to disaster. Therefore they are at increased risk for developing musculoskeletal disorder. **Objective:** To investigate the prevalence of musculoskeletal disorders and ergonomic risk factors among firefighters. **Methodology:** Nordic musculoskeletal questionnaire was used to report musculoskeletal disorders in 106 firefighters and quick exposure check (QEC) questionnaire was used in 20 firefighters for 3 different tasks to evaluate the ergonomic risk factors. **Results:** 37% of firefighters experienced low back pain as major pain in last 12 months. Followed by shoulder and neck pain. Low back pain (28%) along with knee pain (22%) caused trouble in working in last 12 months. Task of lifting ladders on shoulder was the major ergonomic risk factor for developing musculoskeletal disorders as compared to holding up hose and folding the hose task. **Conclusion:** High prevalence was shown in low back, knees, neck and shoulder. Lifting up ladders on shoulder task leads to ergonomic risk for development of musculoskeletal disorders.

Keywords: Firefighters, Musculoskeletal Disorders, Ergonomic Risk Factors, Qec (Quick Exposure Check), Nordic Musculoskeletal Questionnaire.

INTRODUCTION

The phrase "musculoskeletal disorders (MSDs)" describes inflammatory diseases or abnormalities that impact the bones, muscles, joints, ligaments, tendons, nerves, and supporting blood vessels of the body. Pain and functional impairment are caused by these disorders or deficits[1]. Firefighting is a physically hard and dangerous career that necessitates a certain degree of fitness to carry out essential work responsibilities[2]. Firefighters are government professionals who carry out emergency rescues, prevent and extinguish fires, and respond to disasters in a recovery capacity. Additionally, they are subjected to physical hazards including heat, noise, toxic gases, smoke, carbon monoxide, and diesel fumes[3]. Workers who deal with fireworks often have MSDs[4]. Thus Firefighting is one of the most dangerous and demanding professions there are[5]. The physical demands of rescue missions and sudden movements might strain a firefighter's musculoskeletal system[6]. Workplace accidents cause major financial and health costs, as well as missed productivity[7]. Moreover, the majority of disabilities and missed workdays are caused by occupational musculoskeletal problems[8]. There is widespread agreement that working as a firefighter is perilous by nature[9]. During firefighting operations, firefighters are subjected to physical dangers, injuries, and accidents. It is thought that mechanical elements have an impact on musculoskeletal discomfort[10]. Furthermore, firefighters engage in activities that include significant levels of physical strain, extreme temperatures, and negative health impacts from breathing poisonous gases. Many of

these risk factors are to blame for chronic respiratory, musculoskeletal, and psychological issues[11]. The intense physical demands of firefighters' jobs lead to high incidence of work-related injuries[12]. The type of job that firefighters do might subject them to a lot of speed, monotonous, repetitive duties, and occupational musculoskeletal diseases[13]. Thus Firefighters have a higher risk of musculoskeletal injuries than other occupations[14] [15] [16]. In addition, firefighters experience a lot of muscular discomfort at work[17]. Because they frequently confront circumstances demanding extreme activity, often in an unanticipated manner. Firefighters are frequently exposed to the dangers of low back pain (LBP)[18]. They do several dangerous work responsibilities at the scene of a fire, making them a profession at high risk for back injuries[19]. The majority of injuries sustained by firefighters while working on the fire ground are still musculoskeletal in nature[20].

The amount of ergonomic risk factor experienced by firefighters as a result of their profession is determined via an ergonomic assessment. Repetitive motion of joints, awkward posture of body, violent exertion, pressure points, and static postures while performing tasks are ergonomic risk factors for musculoskeletal condition. They had to roll the fire hose till done, bending forward with unnatural posture. Due to their prolonged uncomfortable body posture, this may result in back discomfort[21]. Firefighters work is distinguished by their high social responsibility and the variety of hazards they face while performing life-saving and fire-fighting tasks[22]. The fire department is one of the world's most demanding and dangerous professions[23]. Firefighters do a variety of hazardous activities that need their physical participation in warm environments. Therefore, firefighters are at a significant risk of getting musculoskeletal disorders when carrying out jobs, handling heavy equipment, and wearing personal protective equipment. Since there hasn't been any research on firefighters in Pakistan yet, the aim of this study was to evaluate the prevalence of musculoskeletal disorders and ergonomic risk factors among those who work as firemen in Faisalabad, Pakistan.

METHODOLOGY

Subject

This cross-sectional study was conducted on 106 Firefighters from different fire stations of Faisalabad, Pakistan participated in this study. The study included male firefighters aged between 20-60 years, who were regular on duty, and had work experience at least 1 year and had health complaints related to work. The study excluded those who had any systematic disorder as DM, HTN etc and had history of any accident or fracture. Nordic musculoskeletal questionnaire was used to evaluate the prevalence of musculoskeletal disorders among firefighters.[24] Quick exposure check (QEC) was used for ergonomic risk assessment. QEC have score system which represent the level of risk. It has score values for each body part. Scores are calculated on the basis of answers given in QEC.

Procedure

Cross sectional study was conducted in October, 2023 among firefighters of Faisalabad in, Pakistan. Firefighters from different stations of Faisalabad participated in this study. Data was collected through google forms. Google forms were sent to emergency officer at rescue 1122 Faisalabad. He further sent google form links to firefighters. An ergonomic risk assessment was done on 20 firefighters by analyzing

their working postures using Quick exposure check (QEC) for 3 tasks i.e. holding up hose, folding the hose and lifting ladders on shoulder. All these tasks were performed under supervision of a physiotherapist. Physiotherapist rated the posture during tasks and filled out in QEC observer's assessment section.

Statistical analysis was done using SPSS (version 29.0). Descriptive statistics were performed to for age, weight, job shifts, and job positions. It was also performed to get results about pain frequency in body parts and troubled faced by firefighters in doing their job due to pain in different parts of body. Score of ergonomic risks of three tasks were analyzed according to the QEC score chart.

Ethical Approval

The study was approved by the ethical research committee of Chulalongkorn University and the Rescue 1122 headquarters, Lahore, Pakistan provided us approval for data collection.

RESULTS

Characteristics of the Subject

There were total 106 firefighters, 84 were firefighters and 22 were lead firefighters. 42 of them working in morning shift, 34 in evening shift and 30 at night shift respectively. Average age was 35.90 ± 5.8 years. Height is divided in 2 categories. First who in the range of 5.0 ft-5.6 ft. were 15 firemen and who in the range of 5.7 ft-6.2 ft. were 91 firemen. Average weight was 78.2 ± 8.3 kg. Sixty-five of firefighters were doing job of the fire rescue from 1-10 years and 41 of them worked from 11-20 years. Ninety-five of them worked 40-50 hrs. per week and 11 of them worked 50-60 hrs. including overtime.

Prevalence of Musculoskeletal Disorders

Low back pain was most significant reported in 37% of firefighters in last 12 months. The percentage of pain at other body parts including neck, shoulder, elbows, wrist/hands, upper back, hips, knees and ankles/feet as showed in Table 1. The second question of Table 1 showed pain in body areas which refrained firefighters from doing their task in last 12 months. Low back pain was at the top for causing trouble in doing job with 28% of firefighters. Question 3 showed percentage of firefighters who experienced pain in last 7 days in the in neck, shoulder, wrist/hands, upper back, lower back, hips, knees and ankles/feet were about 12%, 12%, 1%, 13%, 22%, 4%, 15% and 7% respectively.

Table 1: Nordic Musculoskeletal Questionnaire

| | Neck | Shoulders | Elbow | Wrist / Hand | Upper Back | Lower back | Hips | Knees | Ankles / feet |
|--|----------|-----------|--------|--------------|------------|------------|--------|----------|---------------|
| Pain in last 12 months | 23% (24) | 25% (27) | 6% (6) | 9% (10) | 15% (16) | 37% (39) | 6% (6) | 22% (23) | 8% (8) |
| Refrain from work in last 12 months | 19% (20) | 14% (15) | 0% (0) | 8% (9) | 13% (14) | 28% (30) | 4% (4) | 22% (23) | 7% (7) |
| Pain in last 7 days | 12% (13) | 12% (13) | 0% | 1% (1) | 13% (14) | 22% (23) | 4% (4) | 15% (16) | 7% (7) |

Ergonomic Risk Assessment

For ergonomic risk assessment, 3 tasks were performed i.e. holding up hose, folding the hose and lifting ladders on shoulder. The QEC was used to evaluate the risk score. There was a separate scoring calculated for each body part for each task.

Holding up hose task was performed by 7 firefighters and scores was shown as in Figure 1. Back was at low risk in 71% of firemen and at moderate risk in 29% of firefighters. Shoulder/arm was at low risk in 43% firefighters and at moderate risk in 57% of firefighters. Wrist/hand was at low risk in 86% firemen and at moderate risk in 14% of firefighter. Neck was at moderate risk.in all of 7 firefighters.

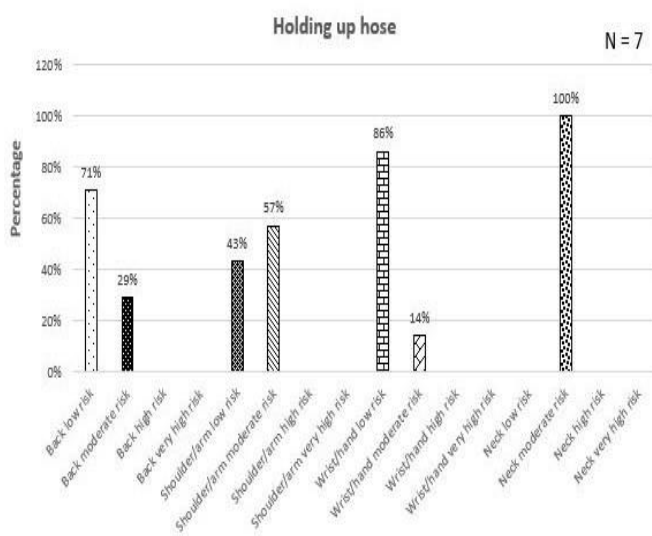


Figure 1: QEC Score for Holding Up Hose Task

Folding the hose task was performed by 7 of firefighters and score was shown in Figure 2. Back was at moderate risk in 7 firefighters. Shoulder/arm was at low risk in 71% firefighters and at moderate risk in 29% of firefighters. Wrist/hand was at low risk in 29% firemen and at moderate risk in 71% of firefighters. Neck was at moderate risk in 71% firefighters and at high risk in 29% firefighters.

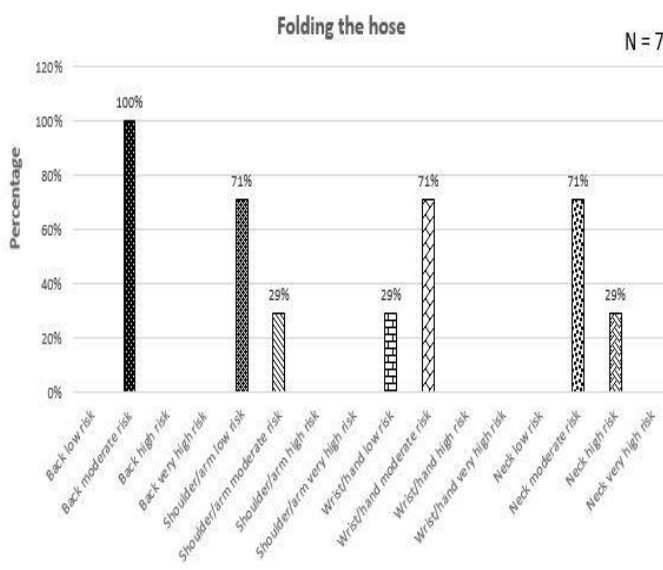


Figure 2: QEC Sore of Folding the Hose Task

Lifting ladders on shoulder was performed by 6 firefighters and score was shown in Figure 3. Back was at moderate risk in 67% firefighters and at high risk in 33% firefighters. Shoulder/arm was at moderate risk in 67% firefighters, at high risk in 17% and at very high risk in 17% firefighter. Wrist/hand was at moderate risk in 67% firefighters and at high risk in 33% firefighters. Neck was at moderate risk in 67% firefighters and at high risk 33% of firefighters.

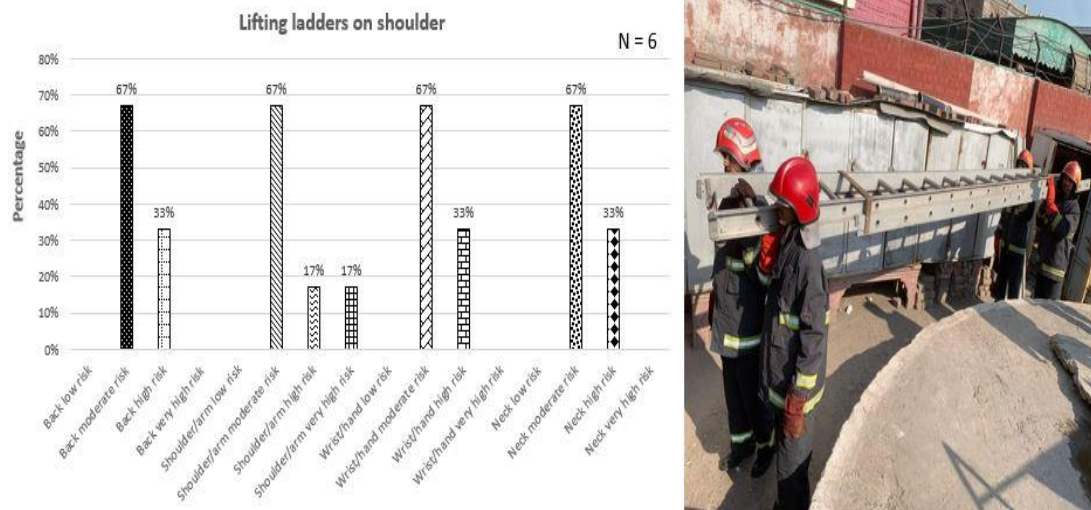


Figure 3: QEC Score of Lifting Ladders on Shoulders Task

DISCUSSION

This study was done to investigate the prevalence of musculoskeletal disorders and evaluate the ergonomic risk factors in firefighters of Faisalabad, Pakistan. As firefighters have to deal with such emergencies which includes exposure to heat and involves repetitive movements, abnormal postures while carrying out their job tasks. They also experienced some stress due to their job nature which also can cause body discomfort which lead to musculoskeletal disorders development.

Nordic musculoskeletal questionnaire (NMQ) was provided through google form for musculoskeletal disorders reporting. For ergonomic risk assessment, quick exposure check questionnaire (QEC) was used to evaluate the tasks. A physiotherapist in his presence made sure that the tasks performed by firefighters were done perfectly. Photos of tasks were taken by physiotherapist for reader's better understanding of tasks nature. Results from all responses showed that low back pain was most significant followed by neck and shoulder in firefighters during last 12 months. Low back pain, knees pain and neck pain caused trouble in firefighters from performing their job duties or work in previous last 12 months. For the pain in last 7 days experienced or reported by firefighters, low back along with knee pain was highly mentioned.

Sheetal et.al. [12] studied on firefighters of Mumbai, India to evaluate the prevalence of musculoskeletal. They used the rapid entire body assessment (REBA) for ergonomic tasks in firefighters and tasks were lifting the dummy and ladders on one side of trunk. However, our study is different from that study since we evaluated the prevalence of MSDs in last 12 months and in last 7 days along with frequency of firefighters who experienced trouble in their work from MSDs. We also choose different tasks of holding up hose, folding the hose and lifting ladders on shoulder and used the

QEC tool for ergonomic risk assessment in our study. In previous study, Bulduk et al. [25] used (QEC) on cab drivers' to evaluate the ergonomic risk factors for developing WMSDs. The Quick Exposure Check (QEC) observational instrument, which enables practitioners and employees to evaluate four important regions of the body, was used to observe 382 cab drivers in total. The QEC score results were found to be very high for the shoulder/arm, wrist/hand, and neck, but the scores for the back were found to be high for static usage and moderate for movement. The findings also indicated that limited postures, repetitive motions, vibration, and work-related stress were occupational risk factors for WMSDs. To reduce the risk of exposure to WMSDs in cab drivers, essential ergonomic actions are required.

There were 3 tasks performed in our study for ergonomic risk assessment analysis. These 3 tasks were holding up hose, folding the hose and lifting ladders on shoulder. These tasks were selected on the basis of their nature. As these tasks required repetitive motion, long time standing and carrying heavy loaded objects as well in emergency conditions and any disaster.

The first task was holding up hose in standing position. Which involve movements at repetitive motion according to emergency situations or need. This involve wrist movements in term of radial deviation and ulnar deviation, isometric movements. Neck movements also involved as a result of seeing the spots or areas which need to be encountered. Long time standing may also put pressure on back with carrying load and fighting the situation. For this task, we found wrist/hands and neck at moderate risk in many of firefighters.

The second task was folding the hose. This task involved bending or flexion of back while folding the hose. Bending of neck and wrist/hand movement is also involved with same repetitive pattern. Concentric wrist radial deviators contract as well as the elbow flexors and extensors contract isometrically[26]. Back was major at moderate risk followed by neck and wrist/hand, shoulder/arm in firefighters while performing this task.

The third task was lifting ladders on shoulder. As it clearly shows lifting heavy objects on shoulder will always put pressure on your shoulders. In this task, all body parts involved as back needed to bend for lifting ladder and wrist/hand was also involved along with shoulder/arm and neck movement. So, we found all back, neck, shoulder/arm, wrist/hand at moderate to very high risk for this task.

Our results showed that low back pain was highest reported in firefighters, all of three tasks low back were at moderate to very high risk for musculoskeletal disorders on the basis of task nature, duration and repetitive movements. Specially in task of lifting ladders on shoulder, all of body areas were at moderate to very high risk as ergonomic risk. These risks can be reduced by adapting proper ergonomic techniques, guidance about posture patterns and using modified tool with low weight.

Study Limitations

This study only reported about pain prevalence but not about severity of pain. Further study can be done by investigating the severity of pain. Moreover, this study was limited to only 1 city with small sample size. More cites can included more subjects for better results in future studies.

CONCLUSION

The major pain reported by firefighters was the low back pain and the task of lifting ladders on shoulder was at moderate to very high risk in back, neck, shoulder and wrist/hands. Holding up hose and folding hose were at moderate to high risk in ergonomic assessment.

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