

PREVALENCE OF WORK RELATED MUSCULOSKELETAL DISORDERS IN FIRE FIGHTERS

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ABSTRACT

Introduction: Firefighters having high risk for occupational injuries ,perform many hazardous job tasks at the scene of fire. The objective of this cross sectional study is to find the prevalence of self reported musculoskeletal disorders in firefighters at various Fire brigade centres in Mumbai.

Method: Total number of 70 active duty firefighters ,both male and females ,were recruited in the study from various fire brigade centres in Mumbai. A validated questionnaire was administered to them consisting information about their demographics, their job profile and self reported measures of their health and co morbidities. The participants also completed a Body Diagram to indicate the location of pain for their musculoskeletal problems. Their working postures was analysed by using REBA after doing a pilot study .The three tasks were lifting the ladder up and down ,folding the hose and lifting the dummy .The data was collected and analysed.



Result: The study participants comprised both male and females active duty firefighters, 59 males, mean age (27-45 years),SD (3.5) and 11 females ,mean age (25-30 years), SD (1.6). The prevalence of neck, shoulder, elbow ,upper back and lower back complaints was 24%, 23%, 13%, 7% and 6 % respectively. 27% participants reported no complaints related to musculoskeletal problems. REBA (Rapid Entire Body Assessment) indicated that 40 out of 70 firefighters have medium risk of cumulative trauma disorders while 30 have high risk in the task of lifting the ladder up and down on shoulders. For folding the hose, all 70 participants had medium risk of injuries and for lifting the dummy, 29 out of 70 had high risk and 41 firefighters had very high risk of musculoskeletal injuries.

Conclusion: This study reveals that there is high prevalence of musculoskeletal injuries especially in neck and shoulder among firefighters at various fire brigade centres in Mumbai .REBA assessment for the risk analysis for cumulative trauma disorders shows medium to high risk in all three tasks of lifting the ladder, folding the hose and lifting the dummy which warrants immediate preventive measures and remedial treatment among the study population.

KEY WORDS: Firefighters, REBA (Rapid Entire Body Assessment), Musculoskeletal disorders, Cumulative trauma disorders , prevention.

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INTRODUCTION

Work related injuries impose a significant health and economic burden and contribute to loss of

productivity [1]. Firefighters have high rates of work related injuries because of the high physical demands of their job tasks [2,3].

Firefighters perform high risk physically demanding tasks and are simultaneously exposed to environmental factors that contribute to higher prevalence of injury and disease [3,4]. Tasks associated with firefighting such as heavy lifting, unsafe work postures [4,5] and body motion [6,7] have been associated with higher injury rates in firefighters.

The role of firefighters in providing community safety service requires intermittent periods of peak physical activity, which places them at increased risk for musculoskeletal disorders and cardiovascular injuries compared to other occupations. Fire fighters undergo extensive training to extinguish hazardous fires that threaten property and human or natural populations. For this purpose, fire fighters require both agility and strength in emergency situation, during the act of fire and hence they have regular drills.

The job profile of the active duty fire fighters at various fire brigade centres in Mumbai includes a shift of 12 hours which includes regular 4 hours of training including various drills followed by desk job and field visits and one hour of break time. The various drills that are performed on alternate days include: "Fire hydrant drill", "hose training" and "Stair climbing with weights". The fire hydrant drill is a group activity involving 5 members to perform mock fire act where the fighters perform activities like opening the hydrant, lifting the staircase to reach out places, arranging the hose and then extinguishing the fire. The hose training is an individual task in which the fighter unwraps and wraps the hose as fast as possible by laying down the hose on floor and then folding it. Stair climbing includes lifting a dummy of 60-70 kg or a co-fire fighter on their shoulders and the ascending and descending stairs. The drills includes repetitive tasks of material handling.

Manual material handling involves the use of the human body in carrying loads, where the load can be animate or inanimate. The five tasks included are lifting and lowering, pushing and pulling, twisting, holding and carrying. These activities can be dynamic, where one body part is holding on load and others moving or static where the person grasping the load constantly in static body posture. The activities can be

repetitive in the task or one time. High physical load associated with repetition in task predisposes these firefighters to musculoskeletal disorders.

Work-related musculoskeletal disorders (MSDs) are injuries in the human musculoskeletal system involving joints, ligaments, muscles, tendons. MSDs are extensive wear and tear on tendons, muscles and sensitive nerve tissue caused by continuous use over an extended period of time or any sudden exertion at work site [8]. The physical risk factors include, awkward postures- body postures determine which joints and muscles are stressed, forceful exertions, repetitions- motions repeated frequently lead to fatigue and muscle-tendon strain accumulation, vibrations- exposure to whole body or local vibrations, contact stresses – repeated or continuous contact with objects leads to fatigue and muscle-tendon strain accumulation [9]. Manual handling tasks can lead to musculoskeletal injuries and cumulative trauma disorders due to sustained and awkward body positions which can be assessed by various assessment tools like REBA(rapid entire body assessment), RULA(rapid upper limb assessment), NIOSH(National institute for occupational safety and health) weight lifting calculator.

Rapid entire body assessment (REBA) is used for the study which helps to assess the mechanical load on the body, forces acting on the body including twisting forces due to weights, position attained during the task by the worker and helps in commenting on the stresses acting and risk of musculoskeletal injures and also helps in planning the ergonomic modifications and hazard preventions. REBA includes assessment of three components -legs, trunk and hand with additional assessment of load, twisting forces and grip.

The above population was chosen for the study as they perform repetitive tasks and adopt sustained postures with added weights at their workplace. Similar studies have been done abroad among firefighters to have context specific, targeted approaches in preventing work injuries in western population. The present study helps in assessing the risk of work related musculoskeletal injuries using REBA (Rapid body

assessment) among the active duty firefighters at various fire brigade centres in Mumbai. This group of population was selected as until now recently, there have been no studies or research done in Indian firefighters population. Therefore the primary objective of our study was to know the prevalence of self reported musculoskeletal disorders in active duty firefighters at various fire brigade centres and to assess the level of risk of the tasks using REBA while analyzing their working postures.

AIMS AND OBJECTIVES

AIMS

- To study the prevalence of risk of work related musculoskeletal injuries in fire fighters

OBJECTIVE

- To study the prevalence of musculoskeletal injuries due to adopted postures/activities performed at workplace.
- To know the common type of injuries or musculoskeletal injuries experienced by the workers.

METHODOLOGY

Materials used –REBA, Employee Assessment Worksheet, pen ,paper ,Body Diagram chart, Questionnaire.

Rapid Entire Body Assessment, (REBA) - It was designed for easy use without having advanced degree in ergonomics or expensive equipment. Using REBA worksheet, evaluator can assign a score for each of following body regions – wrist, forearms, elbows, shoulders, neck, trunk, back, legs and knees. After data for each region is collected and scored, tables on form are used to compile the risk factors variables, generating single score that represents the level of Musculoskeletal disorders risk [10].

SCORE	LEVEL OF MUSCULOSKELETAL DISORDERS RISK
1	Negligible risk ,no action required
2 - 3	Low risk, change may be needed
4 - 7	Medium risk, further investigation
8 - 10	High risk, investigate and implement change
11+	Very high risk, implement change .

Procedure- This is a cross sectional study conducted among the firefighters from various fire brigade stations at Mumbai. Total number of 70 , both male and female fire fighters, mean

age, males(27-45)years and females (25-30) years were recruited after taking their informed consent and the purpose of the study was explained to them .The study protocol was approved by the Principal of Terna Physiotherapy College, Nerul, Navi Mumbai and the authorities of various fire brigade centres of Mumbai. After doing literature research a validated questionnaire was formed including questions related to their demographics, a body diagram to denote the area of pain, the type of pain, self reported measures of health and their co morbidities. A pilot study was done among 20 participants to observe and analyse their working postures using the REBA. After doing pilot study, necessary changes were done in the questionnaire and it was administered among the fire fighters by an experienced physiotherapist. The inclusion criteria for the study was on duty active firefighters ,who are working for more than three years and who have work related health complaints .Those who were not evaluated were those who were not willing to participate and those who had injuries and musculoskeletal complaints not related to their job profile.

Assessment was done using REBA for three different tasks, lifting the stairs on the shoulders, lifting and lowering a dummy, folding the hose for all the seventy subjects. The total duration of data collection was for three months. After collecting the data, statistical analysis was done and result interpreted.

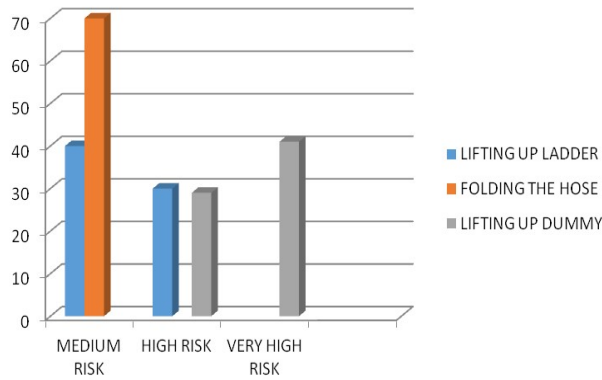
Statistical Analysis: The survey data was entered by the researcher and the data quality was cross checked by the study coordinator. Descriptive statistics was done to determine the mean age, gender distribution , and the area of pain .The level of risk associated with the three mentioned tasks - lifting up the ladder ,folding the hose and lifting up the dummy using REBA was also analysed.

RESULTS

Table 1: Demographic data of the subjects with their age and Standard Deviation.

GENDER	AGE	NUMBER	Standard deviation
Male	27-45	59	3.5
female	25-30	11	1.6

Fig. 1: depicts the level of risk assessed by using REBA for the given above three tasks.



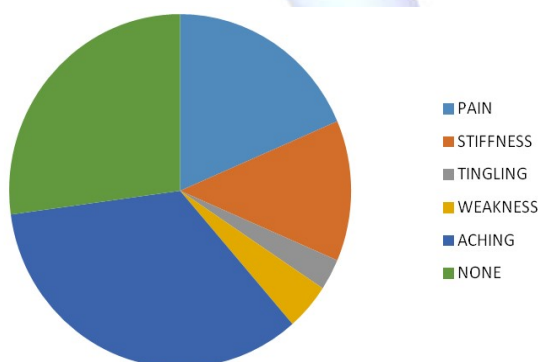
Inference: In the above graph, the X-axis shows the levels of risk associated with the three tasks i.e. lifting up ladder, folding the hose and lifting up the dummy respectively. The Y-axis shows the number of fire fighters.

The first task of lifting up ladder indicates that 40 out of 70 fire fighters have medium risk of musculoskeletal injuries on REBA scale and 30 have high risk.

The task of folding the hose denotes that all the 70 fire fighters have medium risk of musculoskeletal injuries for this task.

The third task of lifting the dummy denotes that 29 out of 70 have high risk of musculoskeletal injuries and rest 41 fire fighters have very high risk for the same task.

Fig. 2: Shows the type of discomfort experienced by the study participants while doing their daily tasks.



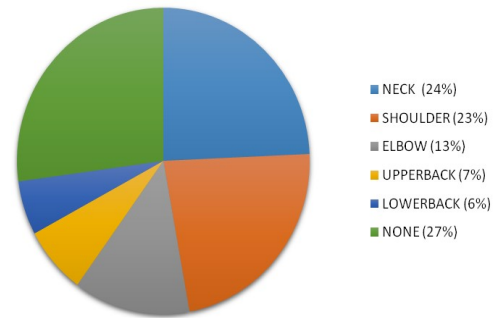
Inference: The pie chart denotes the type of discomfort experienced by the fire fighters.

The orange quadrant denotes the amount of workers experiencing no discomfort contributing to 27% of the total population.

The commonest type of discomfort was aching indicated by blue quadrant contributing to 34%,

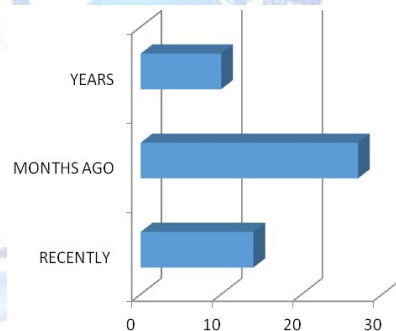
next was pain indicated by dark blue quadrant contributing to 19% and least common tingling type contributing to 3%.

Fig. 3: Explains the common areas where they experienced pain.



Inference: The pie chart denotes the common area of pain experienced by the workers. The commonest area was neck experienced denoted by blue quadrant contributing 24% of the total population followed by shoulder contributing to 23% (red quadrant) and the least common area was lower back 6% denoted by light blue.

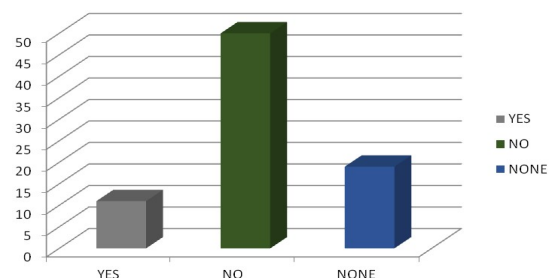
Fig. 4: Depicts the duration of the problems experienced by the workers.



Inference: In the above graph, the X axis shows the number of fire fighters and Y-axis show the time (since the problem caused).

Out of 70 fire fighters, 27 are suffering from musculoskeletal complaints since months, 10 since years and 14 have complaints recently.

Fig. 5: Depicts the number of study subjects receiving medical treatment for the musculoskeletal problems.



Inference: In the above graph, the X-axis shows the member's status for medical treatment and Y-axis the number of fire fighters.

Out of the total fire fighters, currently 11 are taking medical treatment for their complaints, 50 are not undergoing any medical treatment but are suffering from musculoskeletal problems and 19 out of 70 fighters have no musculoskeletal complaints.

DISCUSSION

The study was conducted as an attempt to investigate the prevalence of work related musculoskeletal injuries in fire fighters. As stated earlier, the job profile requires high levels of intense training with repetitive tasks involving drills.

The subjects selected in the study were on duty fire fighters both male and female of age group (25-45) years who have work experience of more than three years. All the fire fighters were screened as per inclusion and exclusion criteria.

The subjects were then provided with a validated questionnaire involving questions regarding their musculoskeletal complaints at workplace. The screening of all the 70 subjects suggested that the commonest complaints experienced were shoulder pain, neck pain followed by back pain in 73% subjects and rest 27% of the population experiencing no pain. Out of the entire population only 15% have taken medical treatment for their condition. With five subjects opting for job modifications or duty changes and none of the subjects have taken any leaves from work due to their complaints.

The three tasks that were analyzed using the Rapid entire body assessment (REBA) tool were lifting the ladder to the side, folding the hose and lifting the dummy on the shoulders. These tasks were selected based on their repetitive nature in emergency situations as well as the regular drill practices.

The first task was lifting the ladder to the side on the trunk, in this task as the subject lifts the ladder from the ground there occurs shoulder flexion and trunk flexion to grasp the ladder, there is load throughout the trunk, leading to maximum stress to trunk flexors followed by activation of hip extensors followed by back extensors. There is increased torque on the lower back and smaller moment arm is seen, as the load is carried close to the lumbar spine [11].

The mentioned task demonstrated medium to high risks of musculoskeletal injuries.

The second task analyzed was folding the hose, where there is sustained elbow flexion with repeated wrist radial deviation with wrist placed in extension in standing position. There is isometric contraction of elbow flexors and extensors, along with concentric contraction of radial deviators of wrist. There is sliding of nerve roots leading to stretching force on them. As the task performed requires smaller duration and the joints are exposed to lesser loads, the structures have time to recover from the fatigue and strains and hence, the task demonstrated low to medium risk of musculoskeletal injuries in the population [12].

The third task assessed was lifting the dummy from the floor on to the shoulders. In this task, there are stresses on the acromio clavicular and scapula thoracic joints due to the overhead position. The scapular stabilizers and neck extensors have to more isometrically to give stability to the load carried. At the spine, the compressive loads are distributed through the spine along the discs in all the directions, leading to reduced nutrition to disc. Due to sustained posture, the connective tissue and ligaments are maximally taut while reaching the creep [13]. The load can lead to cartilages becoming thinner and leading to permanent deformation. The mentioned task demonstrated high to very high risks of injuries and also maximum subjects had shoulder and neck complaints.

All the joints and supporting structures subjected to repetitive stresses or sudden loading may be injured because they do not have enough time to recover from the microscopic or macroscopic traumas before they are subjected to the next loading cycle, caused due to fatigue and collagen deformation, also there is reduced threshold to the loading induced adaption which can cause overuse injury or repetitive motion disorder or cumulative trauma disorders [14]. Also, in emergency situations, where safety is the priority despite of all the training and drills inability to maintained the correct ergonomic postures or perform proper techniques can lead to high risk of musculoskeletal injuries. There can be static loading demands as well as ambulation, ascending descending stairs with

the weights, which can lead to altering stress and strains on the structures as per the situation.

Hence, the above results suggest that there are medium to very high risk of injuries depending on the duration, repetitive nature and loads in the performed tasks. The risks can be reduced by ergonomic techniques of manual material handling and job site modifications along with more use of tools can be given.

Study Limitations: Sample size was small. Larger population can be assessed for better and accurate results.

Future scope: Different age groups can be studied differently.

CLINICAL IMPLICATIONS

The above study involved assessment of sustained and repetitive awkward body postures at workplace and concluded risk of musculoskeletal injuries in fire fighters which can be used for:

- Job site modifications ; involving interchanging task within workers, alterations in schedule for performing tasks.
- Suggest alterations in manual material handling techniques
- Workplace hazard prevention

CONCLUSION

- The results demonstrated that the commonest complaints experienced by the entire population were neck and shoulder pain.
- The study revealed that the task of lifting the ladder demonstrated medium to high risks, folding the hose were low to medium risks and lifting up the dummy were high to very high risks of musculoskeletal injuries.

ABBREVIATIONS

CTD s - Cumulative Trauma Disorders

MSD – Musculoskeletal disorders

REBA - Rapid Entire Body Assessment

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Conflicts of interest: None

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