

A Study Of Morbidity Profile And Occupational Injuries Among Firefighters In A Metropolitan City

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Abstract

Background: Firefighters work to reduce threats and minimize the potential harm from fire hazards. The nature of firefighters' work is demanding, often unpredictable and in stressful environments where they are routinely exposed to both mental and physical occupational hazards. This cross-sectional study was conducted to assess prevalence of occupational injuries and the morbidity profile of firefighters in a single metropolitan city.

Methods: In this study, 253 firefighters from the area under Municipal Corporation of Greater Mumbai (MCGM) were included using stratified random sampling method. All consenting firefighters were interviewed in office located in fire brigade using a pre-validated interview schedule and the data was analyzed using SPSS version 22.

Results: From the study, it was found out that abrasion was the most common occupational injury among firefighters. Pre-hypertension and Body Mass Index (BMI) in the overweight category were prevalent findings among firefighters. Association between cadre and years of service with occupational injuries was found out to be statistically significant. Also, the association between diabetes mellitus (DM) and hypertension (HTN) with occupational injuries was found out to be statistically significant. There was no clear association between ages of firefighters and BMI with occupational injuries.

Conclusion: There is a need to conduct more studies in Indian setup on occupational hazards and injuries amongst firefighters. Awareness about normal BMI, management of DM and HTN, healthy food practices, aerobic exercises, prevention and treatment of addictions, a drive for Hepatitis B vaccination, appropriate management of injuries and health insurance will serve a bigger role in diminishing morbidity in this occupation.

Keywords: Fire fighters, occupational injuries, hypertension, overweight

Introduction

According to the definition by International Labour Organization (ILO) and World Health Organization (WHO), labour health is the work carried out for keeping, continuing and developing body, mental and social well-being of individuals working in all occupations at

utmost level^[1]. The primary purpose of firefighters is to help ensure the safety of lives by preventing and extinguishing fires and offering medical care during emergencies. It's worth noting that in 2021 a firefighter is more likely to be involved in the latter as fire prevention efforts have been hugely successful over recent decades. Without firemen, fire disasters and consequent loss of lives could take place anywhere in our cities^[2] Inherent to the dangerous nature of the profession, firefighters are at an increased risk from a variety of physical and psychosocial workplace stressors, as well as increased potential for injury, illness, and fatality^[3]. Firefighters respond to various emergencies during each work shift that place them in harm's way, including emergency medical calls, fire suppression and hazardous material exposures^[4]. The most commonly reported injuries in them are strains and sprains, often related to lifting but limited prospective data is available that evaluates risk factors for these musculoskeletal (MS)injuries. Obesity has been associated with injury risk in comparable occupations^[5].

Fire fighters are exposed to a wide variety of potentially harmful substances or physical agents via multiple routes, including inhalation and skin contact, although advances in personal protection (e.g. clothing and breathing apparatus) have apparently served to reduce such exposures in recent years^[6]. On a regular basis Fire- fighters are exposed to carcinogenic agents including engine exhaust (diesel), ultraviolet (UV) radiation, asbestos, benzene and benzopyrene. These contaminants remain on gear and it's critical that firefighters protect themselves by properly and thoroughly cleaning their equipment. This should be done on a regular basis as well as after every call with a possibility of exposure^[7]. Occupational health and safety professionals are at the forefront of reducing injuries and accidents at work. They must be aware of the most common types of occupational injuries among them to develop and implement effective intervention programs^[8]. Although personal protective equipment (PPE) aims to protect firefighters from physical and chemical harm, they can become fatigued by impeded movement from its weight. Firefighters are often the first emergency workers to arrive at a fire or a medical emergency. They can then easily come into contact with blood that may have been contaminated with the hepatitis B and C viruses.^[9] They are often also exposed to extreme heat with temperatures reaching upto 1400 °C. The heat exposure effects may occur from hot air, radiant heat, contact with hot surfaces, endogenous heat produced by the body during exercise, etc. which cannot be cooled while managing the fire^[10].

The role of Fire Service in India broadly which was earlier confined to extinguishing fires and protecting life and property, has now changed dramatically in the last few years. The fire service now responds to hazardous material incidents, advanced emergency medical situations, high angle rescue and confined space rescue incidents, trench and collapse operations, underwater rescue and more. In the immediate aftermath of any disaster coordinated search and rescue efforts are critical to saving lives and property. Such duties demand strenuous muscular work; they must climb stairs and ladders, carry and use heavy tools, often above their head or in uncomfortable positions^[11]. To control hazards and minimize inevitable risks associated with line-of-duty operations to acceptable levels, fire-fighters must properly utilize and maintain needed personal protective equipment (PPE), follow established standard operating procedures and safe work practices and communicate and report identified safety concerns. This communication is essential so that hazardous situations can be abated or avoided and so that supervisors or fellow fire-fighters can take the necessary precautions to avoid uncontrollable hazardous exposures, environments and situations^[12].

Accidents, traumas and poisoning are the most frequent causes of health impairments among firemen^[13]. Mumbai fire brigade recorded a 40% rise in calls on major fires in 2018, though the total number of calls on all types of fires dropped^[14]. Compared to other emergency workers, fire fighters have highlighted the stressful nature of their job owing to the work's

physical nature and the increased physical burden when there are not enough fire-fighters on the fire ground ^[15]. The health effects of exposures related to fighting fires has long been a major interest of occupational health investigators. Extensive records are available on fire-fighters of the MCGM including their health and work history ^[16]. Not much published literature is available to give us an idea about magnitude of problem in India. Thus, this project was an endeavor to study health pattern, co-morbidities and prevalence of occupational injuries among fire fighters workers and suggest recommendations based on above study.

Materials and Methods

This was an observational cross-sectional type of study carried out among 253 firefighters in six fire departments of MCGM (Mumbai). Approval for this study was taken from the Institutional Ethics Committee and the Chief Fire Officer of the fire brigade headquarters at Byculla, Mumbai. Subjects were chosen using stratified random sampling method. Fire fighters of all cadres with job tenure of more than one year were included in the study after consenting to their participation. Office of fire station was considered convenient to conduct interview of firefighters and perform the clinical and anthropometric measurements. Written informed consent was obtained from study participants at the time of interview.

The case record form included the domains-socio-demographic profile, occupational injury profile, personal history (including diet/habits/physical activity), family history, medical history, physical and biochemical measurements. The Socio-demographic profile of firefighters took into account the pay scale, job position and duration of service. Blood pressure was measured using Omron HEM-7113 digital BP apparatus. Biochemical measurement included random blood sugar testing using ONETOUCH Select Simple blood glucose monitor. Weight was checked by analogue weighing machine model Eagle EMP4001A. Height was measured by stadiometer of standard quality. All the individual body measurements were taken at home keeping in mind participants' convenience. Calibration of all the instruments was done periodically. Morbidities were determined on the basis of self-reporting. If the blood pressure or blood sugar levels were found to be high, they were advised to see their family physician.

All responses were considered and tabulated. Graphical representations were made wherever needed. The data entry was done in Microsoft Excel and statistical analysis was done using SPSS version 22.0. Socio-demographic profile of the employees was depicted first. All continuous variables were expressed in terms of frequencies and percentages. Mean and standard deviation were calculated for continuous variables like age and blood pressure. Median was taken for BMI. Categorical outcome variables, hypertension and diabetes were expressed as proportions. Other categorical variables were expressed as percentage. Chi square test was used to study the association between dependent and independent variables. The exposure variables found to have significant association with the outcome variables were further analyzed. Since outcome variable was categorical and dichotomous, binary logistic regression method was applied.

Results

The Socio-demographic profile of study participants (As shown in Table 1) reflected that out of 253 firefighters, majority belonged to age group 25-44 years, with a mean age 43.1 years. Minimum age was 25 years and maximum age was 57 years. Most of the study participants i.e. 233 (92.1%) were males and only 20 (7.9%) were females. It was observed that majority of the study participants were Hindus (94.1%), followed by Muslims (3.2%), Buddhists (2%) and Christians (0.8%). Maximum (n=161) firefighters belonged to the cadre of Firemen (63.64%), followed by Driver operator, leading firemen, Assistant station officer and Station officer. Majority of the firefighters were educated till HSC (35.6%) while 30.4% of them had completed graduation. Most of the participants had an experience of over 20 years, with a

Mean fire service 17.7. The study also reflected upon the BMI of the firefighters of which majority were found to be overweight 141 (55.7%), followed by 84 (33.2%) having a normal BMI and 28 (11.1%) being obese. None of the firefighters fell in the category of Extreme Obesity. Majority of the firefighters (46.2%) had a monthly income over 51,000 with most of them (92.5%) belonging to Upper Middle class of modified Kuppuswamy scale.

Out of the 253 firefighters under study, 116 (45.84%) firefighters experienced occupational injuries in their service period (As shown in Table 2). Of them, majority of firefighters 89(76.72%), experienced Occupational injuries only once and 26 (22.41%) firefighters experienced them twice in their service period. Most of the firefighters (n=86, 74.13%) experienced occupational injuries while attending a fire call while 20(17.24%) firefighters experiencing injuries while attending a non-fire call. 10(8.62%) of them experienced occupational injuries during routine Physical training. Abrasion (38.79%) was the most common type of injury sustained by firefighters followed by contused lacerated wounds or CLW (17.24%) and burns (12.06%). Other occupational injuries included irritation of eyes, sprains, contusions, fractures/dislocations and paraplegia. Upper limb (63.3%) was the most common body part injured during firefighting/non-fire call/physical training followed by lower limb (22.6%), head injuries (10.2%) and chest/abdominal injuries (3.1%). Out of the 116 firefighters who had occupational injuries (As shown in Table 3), 80(68.97%) firefighters received medical care and treatment while 36(31.03%) did not seek medical care. Most firefighters who got injured sought treatment from a government-run hospital 54(64.2%). Others were treated either by a General practitioner 17(20.2%) or from a private hospital 13(15.6%).

It was also found that out of the firefighters injured, only 64 (55.17%) firefighters took duty off while 52(44.83%) did not take duty off after the injury. Out of the 253 participants under study, 89(35.2%) of firefighters experienced breathing difficulty due to smoke during fire call while 164(64.8%) did not. Moreover, 25(9.9%) firefighters experienced heat exhaustion and 228(90.1%) of firefighters did not experience any similar symptoms (As shown in Table 4). Only 65.6% of the fire fighters had a health insurance.

From the study, it was observed that 138 (54.5%) firefighters were pre-hypertensive, 76(30%) of firefighters were having normal blood pressure, 20 (7.9%) firefighters were having stage 2 hypertension and 19(7.5%) firefighters were having hypertension stage 1. Out of the 39 hypertensive subjects (15.4%), undiagnosed hypertension accounted for 22 (56.4%) subjects while 17(43.56%) subjects were already diagnosed to be hypertensive. Amongst the diagnosed subjects, 3 (17.6%) were not receiving any treatment while 14(82.4%) were diagnosed and on treatment. Of them, the blood pressure of only 9 (64.3%) fire fighters was adequately controlled on the treatment plan. Prevalence of diabetes mellitus (DM) in the firefighters was 14.2% while prevalence of those with both DM and hypertension was 5.1%. There is significant association with the Occupational injury of firefighters with DM & HTN (As shown in Table 5). Only 17% of the firefighters were vaccinated for Hepatitis B. Addiction profile amongst firefighters showed that 18% firefighters had a smoking history, while tobacco chewing was present among 48.4% of them, alcohol addiction accounted to 20.3%, and both alcohol and tobacco addiction was present in 12.5% of the firefighters. Among 127 firefighters of age less than 45 years, 46.5% had Occupational injury and among 126 firefighters above 45 years of age, 54.8% had Occupational injury.

Table 1: Socio-demographic data of the study participants

Socio-demographic data				
Parameters		Injured	Not Injured	
No. (%)	Total [n=253]	116(45.84)	137(54.15)	P value
Age (in years)				
25-44	127(50.2)	53(45.7)	74(54.0)	0.4212
45-60	126(49.8)	63(54.3)	63(46.0)	
Sex				
Male	233(92.1)	116(49.8)	117(50.2)	
Female	20(7.9)	0	20(100)	
Education Level				
SSC (10th)	67(26.5)	24(35.8)	43(64.2)	
HSC (12)	90(35.6)	42(46.7)	48(53.3)	
Diploma	5(2.0)	4(80.0)	1(20)	
Graduation	77(30.4)	35(45.5)	42(54.5)	
Post-graduation	14(5.5)	10(71.4)	4(28.6)	
Cadre				
Station officer	6(2.4)	3(50.0)	3(50.0)	0.01074
Assistant station officer	10(4.0)	4(40.0)	6(60.0)	
Leading firemen	18(7.1)	5(27.8)	13(72.2)	
Driver operator	58(22.9)	38(65.5)	20(34.5)	
Firemen	161(63.6)	66(40.9)	95(59.1)	
Experience in service				
<10 yrs.	53(20.9)	10(18.9)	43(81.9)	0.00004834
10-20 yrs.	80(31.6)	44(55.0)	36(45.0)	
>20 yrs.	120(47.4)	62(51.7)	58(48.3)	
BMI grade				
Normal	84(33.2)	40(47.6)	44(52.4)	0.7786
Overweight	141(55.7)	62(43.9)	79(56.1)	
Obese	28(11.1)	14(50.0)	14(50.0)	

Table 2: Distribution of fire fighters according to their injury profile

Frequency of injury [n=116]	Cause of injury (%)			
	Fire call	Non fire call	Physical training	Total
Once	67(75.2)	15(16.9)	7(7.9)	89
Twice	19(73.1)	5(19.2)	2(7.6)	26
Thrice	0	0	1(100.0)	1
Classification on type of Injury [n=116]				
Abrasion	24(53.3)	10(22.2)	11(24.4)	45
CLW	18(90.0)	1(5.0)	1(5.0)	20
Sprain	5(62.5)	1(12.5)	2(25.0)	8
Fractures/Dislocations	6(85.7)	0(0.0)	1(14.3)	7
Contusion	6(75.0)	1(12.5)	1(12.5)	8
Irritation of eyes	13(100.0)	0(0.0)	0(0.0)	13
Burns	14(100.0)	0(0.0)	0(0.0)	14
Paraplegia	0(0.0)	0(0.0)	1(100.0)	1

Table 3: Distribution of health seeking behavior and sickness absenteeism post injury

Treatment history [n=116]	Fire call	Non fire call	Physical training	Total
Treatment taken after injury	62(77.5)	11(13.75)	7(8.75)	80
Treatment not taken after injury	24(66.7)	9(25.0)	3(8.3)	36

Leave after injury [n=116]				
Leave taken after injury	53(82.8)	7(10.9)	4(6.3)	64
Leave not taken after injury	33(63.5)	13(25.0)	6(11.5)	52

Table 4: Distribution of Fire fighters according to Non musculoskeletal injury

Non-Musculoskeletal injury	Percentage	
	Yes	No
Breathing difficulty	89(35.2)	164(64.8)
Heat exhaustion	25(9.9)	228(90.1)
Hepatitis B infection	2(0.7)	251(99.2)

Table 5: Distribution of Fire fighters according Diabetes Mellitus, Hypertension and Occupational Injury

Co-morbidities	Occupational Injury (%)		P value
	Yes	No	
Diabetic	25(21.6)	14(10.2)	P=0.01287
Non Diabetic	91(78.4)	123(89.8)	
Hypertensive	26(22.4)	13(9.5)	P=0.004556
Non Hypertensive	90(77.6)	124(90.5)	

Discussion

Oisaeng Hong *et al.* ^[17] conducted study in U.S. observed that mean age of firefighters was 44.9 ± 8.1 . Steven A. Kahn *et al.* ^[18] conducted study in UK observed that mean age of firefighters was 38.9 ± 8.81 . The present study reflects comparable findings. Gender distribution of the firefighters tilted heavily in towards males, similar to the study conducted by Oisaeng Hong *et al.* ^[17] According to study findings of Stephanie M. Phelps *et al.* ^[19] those in the firemen cadre accounted for 12.9% of the total subjects, Driver operators for 19.3%, Leading firemen for 31.7% and Station officers for 1.2%. The findings of present study were different from the one conducted by Stephanie M. Phelps *et al.*; this was probably due to geographic variations in the two areas where the study was conducted. The Study by Oisaeng Hong *et al.* ^[17] showed mean years of fire service to be 17.4 years. According to study conducted by Oisaeng Hong *et al.* ^[17] 66% of firefighters experienced occupational injuries during their service period. The difference in prevalence of occupational injuries is due to different geographic area and incidence of number of calls. The prevalence of the frequency of injuries falls in line with the study conducted by Stephanie M. Phelps *et al.* ^[19] where majority of firefighters (82.0%) experienced Occupational injuries only once, (11.9%) experienced Occupational injuries only twice, (4.4%) of firefighters who had occupational injury experienced injury more than equal to three times. In the same study, it was found out that occupational injuries during fire call were (26.3%), during non-fire call were (31.3%) and physical training were (6.3%). The difference in findings is due to difference in geographic locations of study and use of PPE. According to study conducted by Stephanie M. Phelps *et al.* ^[19] sprain was most common musculoskeletal injury (78.8%), followed by fractures (8.8%). These findings are different from those observed in our study due to the routine usage

of protective equipment's and variations in geographic locations of the study. This study also concluded that the most common body part injured amongst firefighters was the back (31.2%)

followed by lower limbs (26.25%), upper limbs (12.5) and head (1.25%) with the above similar reasons accounting for the difference. Also, all the Firefighters (25) who had experienced heat exhaustion recovered well on drinking plenty of water and none of them needed IV infusion.

According to study conducted by F. Munir *et al.*,^[20] 65% of the firefighters were either overweight (54%) or obese (11%). In 2011, slightly fewer firefighters were overweight (53%), but the proportion classified as obese increased significantly to 13%. Those classified as normal weight in 2008 were more likely to have gained weight by 2011 in comparison with those categorized as obese at baseline. The findings of present study are similar to study conducted by F. Munir *et al.*^[20].

According to study conducted by Elpidoforos S. Soteriades *et al.*,^[21] it was found that only 42% of hypertensive were receiving treatment with medications, including only 22% of firefighters with hypertensive readings. Overall, the blood pressure of 74% of the hypertensive subjects was not adequately controlled. The finding is almost similar to that in the present study.

Possible reasons for low treatment rates may be the inadequate recognition among primary care physicians that mild hypertension is a significant risk factor for cardiovascular disease. Both Oisaeng Chin *et al.*^[17] and Stephanie M. Phelps *et al.*^[22] in their study found association between injury status and age of firefighters to be statistically significant. This finding differs from the one concluded from this study. According to study, Stephanie M. Phelps^[22] also found association between years of service of firefighters with Occupational injury.

Conclusion

There is paucity of Indian research material on occupational injuries and their association with various conditions in firefighters. This study helped to find out significant association between co-morbidities like Diabetes and Hypertension and occupational injuries among firefighters. Also, firefighters who have spent more years in service are less susceptible to injuries. Study showed that majority of the firefighters are overweight, so they should be encouraged about aerobic exercises and educated about importance of healthy diet and normal BMI. They should be made aware about the ill effects of over-normal BMI and their implications. They should be counseled about harmful effects of addictions. All firefighters should be adequately vaccinated for Hepatitis B, because they lift dead bodies and those injured so their hands may get soiled with blood. There is a need for improvement in PPE kit and robust training practices to help fulfill the duty while preventing personal injuries at the same time. In case of injuries, all firefighters should be encouraged to take treatment from healthcare facility and not advised to take self-treatment. They should be provided with special leave after occupational injury. All firefighters should be provided with health insurance since they are risking their lives for rescue of people in danger and it should include occupational injuries in panel ailments.

Limitations

The number of fire calls and rescue operations conducted was not included in this study, so its relationship with the Occupational injury was not calculated. The percentage of firefighters who remove PPE in between the fire call extinguishing and rescue operations was not calculated. The prevalence of diabetes was calculated by history of diabetes treatment and RBS. Ideally HBA1C should be done to know prevalence of DM.

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