Heat exposure effects among firefighters

Abstract

Background: Firefighting is a hazardous occupation. The firefighters (FF) in extinguishing fire are often exposed to extreme heat of 1200°C to 1400°C temperature. The heat exposure effects may occur from hot air, radiant heat, contact with hot surfaces, endogenous heat produced by the body during exercise, which cannot be cooled during fire. A significant morbidity and mortality from exposure to heat was reported in other countries but not from India. Aims: Present study focuses on prevalence of heat exposure effects i.e., heat exhaustion, heat syncope, heat pyrexia and heat cramps recorded among fire fighters of Ahmedabad fire brigade. Settings: Ahmedabad fire brigade (AFB) of Ahmedabad municipal corporation. Design: Cross sectional. Materials and Methods: Present study focuses on prevalence of heat exposure effects i.e., heat exhaustion, heat syncope, heat pyrexia and heat cramps recorded between 262 FF of AFB. This prevalence's were observed among firemen those directly exposed to heat in combating fire and others (load trucks, pump trucks etc.) that assist the firemen. These were seen in different age groups (<30; 31-45 and >45 yrs), duration of exposure (<10; 11-20 and >21 yrs). The number of accidents associated with heat exposure was analyzed. Statistical Analysis: Prevalence comparison by Chisquare test. Results: The results revealed that a total of 53 (20.0%) FF reported health exposure effects and were higher among firemen than other groups. Heat exhaustion 48 (18.3%); heat syncope 11(4.2%); heat pyrexia 11 (4.2%) and heat cramps 16(6.1%) were reported indicating significant occurrence of heat stress among firefighters. In majority of FF, the frequency of occurrence was observed at only one instance. There were no differences according to age or duration of exposure. Among 53 FF with heat exposure effects, accident were reported in 10 (18.9%) suggesting that heat stress may be responsible for this. Conclusion: Overall, Significant occurrence of heat exposure effect among FF and wearing cooling jackets/other heat proof materials may be precautionary cum preventive measure.

Key words: Accident duration, firefighters, heat exposure effects

INTRODUCTION

Fire is the manifestation of rapid combustion or combination

of materials with oxygen. Most typically, the word fire refers to the combination of brilliant glow and large amount of heat released during a rapid, self sustaining exothermic process of combustible gases ejected from fuel. The flames are a body of gas that releases heat and light. Whenever there is a fire, the firefighters rush to extinguish it. During this process heat exposure may either be hot dry or water moist type occurs.^[1] The heat exposure occurs from hot air, radiant heat, contact with hot surfaces and endogenous heat produced by the body during work.

Firefighters between 1990 and 1995, over 20,000 experienced heat exhaustion or frostbite. Heat turnout gear, SCBA and barrier clothing used for hazardous materials incidents can increase the work of firefighting and impede body temperature control mechanisms further contributing to thermal stress.⁽²⁾ The description of heat exposure effects are given in details i.e., heat syncope,^[3,4] heat exhaustion,^[5,6] heat cramps,^[5,7] l heat pyrexia^[8] and these have been reviewed.^[9]

Studies on thermal stress in the glass bangle industry,^[10] ceramic industry^[14] in India were on physiological strain among the workers. A report on physiological responses of firefighters while working in controlled hot environment were assessed using heat rate, body temperature, etc.^[12] There are two published reports on studies among firefighters in India^[13,14] but none of these above reports evaluated heat exposure effects. Hence in this present study among firefighters, heat exposure morbidity is assessed.

Original Article

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MATERIALS AND METHODS

A study on health effects among firefighters was conducted among 262 firefighters of Ahmedabad fire brigade (AFB) derived from 11 fire tenders located in different areas of Ahmedabad. This is a part of this study. The firefighters (FF) physical findings, occupational history and heat exposure effects i.e., heat syncope, heat pyrexia, heat cramps, heat exhaustion and heat stroke were recorded in a coded Proforma. The frequency of occurring these effects, their distribution in relation to age (<30; 31-45 and >46 years) and duration of exposure (<10, 11-20 and >21 years) were observed. The number of FF having history of accidents was recorded and among them those associated with heat exposure effects was determined. The relevant results are discussed.

RESULTS

The details of heat exposure effects i.e., heat cramps, heat exhaustion, heat syncope, heat stroke, heat pyrexia is given in Table 1.

The anthropometric findings of FF that are having heat exposure effects is presented in Table 2. A total of 53 (20.3%) reported heat exposure effects. Their mean height, weight and BMI is high and deviated much that observed in general

Effects	Details
Heat cramps	This occurs due to salt depletion due to excessive sweating. These are the first signs that body is having difficulty with increased townerature.
Heat exhaustion	It is more serious than heat cramps. It is due to salt and water depletion occurring due to excessive sweating. This occurs when a person is exposed to high temperature for a longer period or the body may become dehydrated and temperature regulation system may begin to fail. The symptoms include headache, nausea, exhaustion, weakness, dizziness, faintness, mental confusion etc.
Heat syncope	Due to vasodilatation and excessive sweating, there is circulatory and vasomotor instability
Heat stroke	Under the most extreme conditions, the body temperature regulate may begin to fail. Subject may become mentally confused and aggressive, feel paint. There is very little perspiration. Need emergency medical attention. Without care, will die in a matter of hours
 Heat pyrexia 	When the body temperature exceeds 105°C. It is considered heat pyrexia

Table 2: Anthropometric findings of fire fighters

Heat exposure n=53 (20.3)
39.6 ± 8.6
171.5 ± 5.4
72.9 ± 10.1
24.78 ± 3.27
11.74 ± 7.79

Figures in parentheses indicate percentage, N=number of fighters

population. In Table 3, the distribution of heat exposure effects among 53 FF indicated that majority 48 (90.6%) had heat exhaustion, followed by heat cramps 16 (30.2%), heat pyrexia 11 (20.7%) and heat syncope 5 (9.4%). This is highly reported among firemen that are directly exposed to fire than the others such as pump trucks, load trucks, etc. The frequency of heat exposure effects showed in Table 4 revealed that majority had one instance.

The association of accidents with that exposure effects presented in Table 5 indicated that out of the total 39 accidents reported by FF, 10 (25.6%) had an association with heat effects. The age distribution of heat exposure effects given in Table 6 and duration distribution showed in Table 7 did not reveal any significant differences. However, there is a slight increase in prevalence in 31-45 years age compared to < 30 years age FF.

Table 3: Heat exposure effects among firefighters

Effect	N = 53 (20.3)
Heat exhaustion	48 (90.6)
Heat syncope	05 (9.4)
Heat pyrexia	11 (20.7)
Heat cramps	16 (30.2)
Fire men	40 (75.5)
Others	13 (24.5)

Figures in parenthesis indicate percentage, N=number of fighters

Table 4: Frequency of heat exposure effects

Frequency	Heat exhaustion N=48	Heat syncope N=5	Heat pyrexia N=11	Heat cramps N=16
1 time	39 (81.2)	03 (60.0)	10 (90.9)	15 (93.8)
2 time	06 (12.5)	Nil	Nil	Nil
3 time	01 (2.1)	01 (20.0)	Nil	Nil
≥4 times	02 (4.2)	01 (20.0)	01 (9.1)	01 (6.2)

Figures in parentheses indicate percentage, N=number of fighters

Table 5: Association of accident with heat exposure effects

Information	N = 39
Accidents with heat exposure symptoms	10 (25.6)

Figures in parentheses indicate percentage, N=number of fighters

Table 6: Age distribution of heat exposure morbidity fire fighters

Group	Age groups (Yrs)		
	<30 N=52	31-45 N=114	46 + N = 06
Heat exposure FF N=53	10 (19.2)	24 (29.8)	19 (19.8)

 Table 7: Duration of exposure and heat exposure morbidity

 among firefighters

Morbidity	Duration of exposure (Yrs)		
	<10 N=150	11-20 N=53	21 N=59
Heat exposure effects	29 (19.3)	11 (20.8)	13 (22.0)

DISCUSSION

Most fatalities from fires are not due to burns, but are a result of inhalation of toxic gas, produced during combustion. Fire produces a complex toxic environment involving flame, heat, oxygen depletion, smoke and toxic gases.^[15] The present findings on heat exposure effects produced significant morbidity predominantly heat exhaustion, followed by heat cramps, heat pyrexia etc. The firemen that directly deal with fire reported higher prevalence indicating occupational thermal stress among this group. These effects are irrespective of age and duration. An interesting finding is the occurrence of accidents 10 (25.6%) of the total accidents associated with heat exposure suggest that the psychological effects associated with heat exposure may be responsible for this. The author knows an example of this in a case of accident due to severe heat exposure went into coma stage and was in hospital for a duration of 19 years and later succumbed to death.

To guard against heat stress and other medical emergencies at the fire scene, provide cool water supplies, rest areas and other access to emergency medical personnel.^[16] Wearing cooling Jackets/other heatproof materials may be precautionary cum preventive measure to protect from heat exposure effects.

More studies are needed on health evaluation among firefighters in India.

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