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Submaximal Fitness Testing In Male Firefighters: An Observational Study

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ABSTRACT

Background: Cardiac death is the leading cause of on-duty deaths in Fire fighters and therefore by assessing the cardiopulmonary capacity can prevent or reduce cardiovascular events in this population. Very few studies are done in Indian population for assessing physical fitness in Firefighters.
Method: A total of 100 Firefighters performed in Sub maximal fitness testing using Chester Step Test to predict the aerobic capacity (VO_2max) in healthy men, ranging from age 25 - 45 years. The HRmax and the Rate of perceived exertion (RPE) was monitored using Fitbit Inspire HR and Borg scale respectively.
Results: The results were predicted with the help of 'Chester Step Test data collection and result sheet'. Out of 100 participants, 13% belonged to the Excellent category, 24% in Good category, 46% in Average, 16% in Below average and 1% in Poor was interpreted according to the norms of aerobic capacity.
Conclusion: The study concluded that, 37% of firefighters fit in Excellent and good category while the remaining 62% belonged to Average category, which suggests that the fitness level in firefighters is low.

Keywords: Sub maximal fitness testing, fire fighters.

INTRODUCTION

Fire fighters perform strenuous work in hostile, chaotic and unpredictable conditions. Thus, fire fighter is widely recognized as dangerous work. Every year approximately 80,000 fire fighters are injured and about 100 firefighters lose their lives in the line of duty. Firefighters face multiple dangers in the course of their work; they encounter toxic fumes, dangerous products of combustion, high radiant heat loads and a chaotic work environment. Despite the myriad dangers, the leading course of line- of- duty death among the fire fighters is sudden cardiac event, accounting for approximately 50% of duty deaths. [1] Firefighters require high levels of aerobic fitness, anaerobic capacity and muscular strength and endurance; however, data suggest that many fire fighters do not possess high aerobic and anaerobic capacity. Furthermore, many fire fighters are overweight and have one or more modifiable risk factors for cardiovascular disease. The safety of the public and the health and safety of firefighters would be enhanced if firefighters followed well designed fitness programs to improve overall health and fitness. [2] Fire fighters are ideal populations considering most of them are sedentary. Approximately 70% of firefighters are volunteers, and health and fitness screenings are often not required. [1] The statement from the International Association of the fire chiefs asserts that "A program of physical fitness, health and wellness should be an objective at every fire department" as a means to reduce fatalities

and injuries and it must enable firefighters to maintain appropriate levels of physical fitness. [3]

A full-time firefighter works an average of 56 hours per week, but the work hour is divided into 24 hours shifts. Some departments schedule firefighters to work 8 to 12-hour shifts. In India, however, firefighters work 8hrs a shift, either morning or night shifts. Becoming a fire fighter requires passing a physical ability test. The Candidate Physical Ability Test (CPAT) events are stair climb, hose drag, equipment carry, ladder raise and extension, forcible entry, search, rescue, ceiling breach and pull. [4] But after an individual join as a professional in this field, fitness training is not taken into consideration as a daily routine and hence musculoskeletal injuries are common in active duty firefighters. [5] Very few studies are done in Indian population on assessing fitness of fire fighters.

Purpose of study: During work, fire fighters are exposed to many stress inducing conditions. These include insufficient and irregular physical activity, unhealthy eating habits, sleep deprivation, chronic stress that influences quality of sleeping and health status, waiting in readiness, toxic fumes and hazardous combustion products. Fewer studies have addressed whether fire fighters are fitter than general population and possess sufficient level of aerobic capacity and muscle strength. [6] Few studies are done on evaluating physical fitness for this group. The leading cause of mortality in firefighters is sudden cardiac death. While the reason remains unclear, low cardio respiratory fitness has been associated with increased risk of cardiovascular disease-related events. [7]

For testing fitness in firefighters, tests like; cooper test, 400m run test, sit ups, push-ups, hand grip test, and strength tests have been used. [8] Direct measurements of aerobic capacity, however, are often complicated, time consuming, and expensive.

Aims and Objectives:

Aim: To assess Sub maximal Fitness Testing in male firefighters.

Objectives: To assess the fitness level in male firefighters using Submaximal test - Chester Step Test

MATERIALS AND METHODOLOGY

The study design was observational and was carried out in fire stations in Pune. The sampling method was Purposive and sample size was 100. The target population was 25 - 45 years old male Fire fighters. The study duration was for 6 months.

Materials used: 1. Stepper (20cms) 2. Fit bit Inspire HR 3. Metronome 4. Stop watch 5. Borg Scale 6. Pen.

Inclusion criteria: 1. Age group 25-45 years 2. Male gender 3. Professional fire fighters.

Exclusion criteria: 1. Diagnosed case of any cardiac or respiratory disorder like hypertension, Asthma, COPD, Pneumonia etc. 2. Recent surgery 3. Recent neurological disorders 4. Recent fractures of upper and lower extremity.

PROCEDURE:

Ethical clearance was obtained from the institute. Firefighters fulfilling the inclusion criteria were selected. Chester Step Test (CST), a sub maximal fitness capacity has been used for predicting the aerobic capacity of the firefighters. The procedure of the test was explained to every individual prior to the testing.

Resting HR was recorded before conducting the test.

The applicant's age was recorded.

80% max HR (220-age*0.8) was recorded on paperwork.

Explain to the subject that the Chester Step Test measures the aerobic capacity, by stepping onto and off the step at a step rate. In every 2min the heart rate and exertion level was being checked and the stepping rate was increased slightly.

The subjects were allowed to change their lead leg if they wish. The test continued in

this progressive manner until their heart rate reached around 80% of it's maximum or until they felt that the intensity was moderately hard. In such case, they were asked to stop and recover. If at any time they felt over tiredness, breathless or dizzy then they were asked to stop and recover.

The applicants were demonstrated on how to perform the test by stepping up and down on the step keeping in time with the beat of Metronome.

- The applicant could lead with either foot and is able to change the leading leg during testing, but MUST stay in time with the metronome.

-The stepping must be UP/UP/DOWN/DOWN.

- The applicant must not be holding on to a railing/wall during the test.

The test was started at the same time as starting the stop watch. The uneven weight bearing between left/ right legs, use of hands on thigh for support, forward flexed posture, signs of fatigue, etc were being watched.

When the applicant gets deviated from the beat, they were instructed a few times but when they kept slowing down due to fatigue, we ceased the testing.

Metronome pace was increased every 2 minutes.

At the conclusion of each 2-minute stage we obtained the RPE and HR.

3 levels were required to be completed in order to determine an outcome.

Metronome Pacing:

- Stage 1 = 15 steps per minute = 60BPM
- Stage 2 = 20 steps per minute = 80BPM
- Stage 3 = 25 steps per minute = 100BPM
- Stage 4 = 30 steps per minute = 120BPM
- Stage 5 = 35 steps per minute = 140BPM

1. Step test was started.

Started audio file or metronome at 60 BPM.

After 2 minutes of stepping, the subjects heart rate and rating of perceived exertion (RPE) level was checked and recorded on Chester Step Test data sheet.

2. Provided subject's heart rate should be below 80% HRmax and RPE below 14, the subject should continue stepping at level 2- a slightly faster rate.

Started on level 2 = 80BPM

3. HR and RPE was checked and recorded at 4 minutes or the end of level 2.

4. Provided subject's heart rate should be below 80 % HRmax and RPE below 14, the subject should continue stepping at level 3 – a slightly faster rate.

Started on level 3 = 100BPM

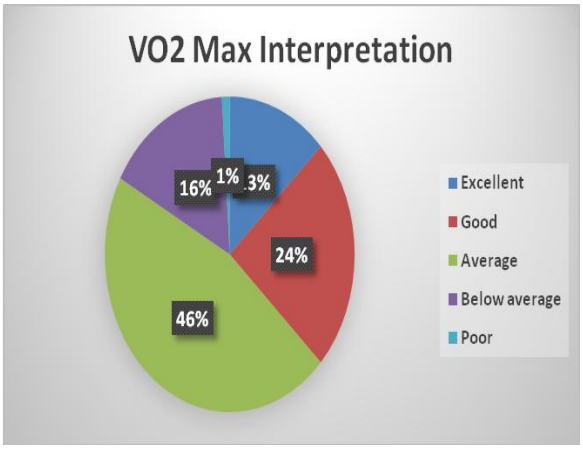
5. Again heart rate and RPE was recorded at 6 minutes or the end of level 3.

The Chester step test was concluded.

RESULTS

Table 1: VO_2max Interpretation:

VO2 Max interpretation	No. of subjects	Mean of VO2 Max	%
Excellent	13	60.46	13
Good	24	43.66	24
Average	46	37.46	46
Below average	16	31.37	16
Poor	1	1	1



Graph 1:

Interpretation:

Table 1 and Graph 1 shows that, out of 100 participants (Firefighters), 13% belonged to the Excellent category, 24% in Good category, 46% in Average, 16% in Below average and 1% in Poor interpreted according to the norms of aerobic capacity (mlsO_2/kg/min).

DISCUSSION

The purpose of the study was to find the Submaximal fitness in Firefighters using Chester step test and with the help of the data sheet, VO_2max interpretation was done

showing the fitness ratings of an individual. Total of 100 firefighters participated to achieve the criteria for maximal effort in submaximal test, to measure the aerobic fitness. The results from the Chester step test was predicted with the help the 'Chester step test data collection and result sheet'. In order to determine whether the subject is fit for the test, HRmax and RPE was analyzed using Karvonen's formula and Borg's scale. The Chester step test predicted the VO_2max in healthy men, ranging from age criteria 25 - 45years.

According to Table 1 and Graph 1, only 13% belong to the Excellent category, while 24% in good category, the rest population i.e. 63% of population was in Average, Below average and Poor category which suggests that the fitness levels in firefighters is low. The rationale for this result might be risk factors leading to future cardiovascular disease, body weight, race, lifestyle, alcohol and tobacco consumption, nutritional status, motivation and physiological parameters and sleep deprivation. [9,10]

Whilst many of the risks traditionally associated with firefighting involved responding to emergency situations are performed relatively infrequently. The normal day to day physical demands of the job appear to be insufficient to maintain role specific fitness levels. As firefighters must be physically prepared to respond at any time to these unique occupational demands, those that do not maintain appropriate level of physical fitness associated can put themselves at risk of over-excretion, which can lead to exertional heat illness and /or heart attack.

Another reason for reduced fitness level in firefighters maybe due to lack of everyday fitness training. This lack of personal training programme of firefighters is linked to higher rate of job-related injuries. Also, there are long periods of sedentary activities at times. Nutrition can be a challenge for an on-duty firefighter and 'busy' is unfortunately a routine excuse for fast food. The lack of good balanced diet might also be the reason for lack of fitness in firefighter. [11] The HR response to exercise can be influenced by many different factors in addition to the training status of the participant. These include, but are not limited to, caffeine usage, medications, and shift work. Because many of the subjects in the present study were shift workers, the latter may be especially important, as shift work has been shown to affect both blood pressure and HR dynamics. [12]

Limited attention has been given to describing factors that can contribute to firefighter's job performance and overall well-being, such as sleep problems, depression, substance use, social bonding, and quality of life. Sleep disturbance, fatigue and work-related accidents are common among shift workers who typically work 8- hour rotating shift. However, in many fire departments, extended rotating shift of 10hrs/14hrs night are common instead of standard three 8-hour shift rotating schedule. Evidence suggests that although extended rotating shift do not add any additional health hazards beyond that of the standard 8-hour shift. In fact, working time has found to be more predictive of impaired alertness and increased occupational accidents. [13]

In the current study I've observed that many firefighters do not possess high aerobic capacity because many firefighters were Overweight and obese, which have been identified as a determining risk factor in occupational health, cardio vascular disease and safety of firefighters. Low level of physical activity has a significant effect on increased fat. Firefighters are required to be ready to respond instantly to a call, that can lead to hostile and dangerous environment that require maximal physical effort. Therefore, a regular physical fitness should be emphasized in fire department across nation.

CONCLUSION

The study concluded that, 37% of firefighters fit in Excellent and Good

category while the remaining 62% belonged to Average category.

Limitations: 1. The study was conducted within short period of time.

The study setup was conducted in a limited area.

Future Scope of Study: 1. Long term Intervention protocol can be carried on the based of the results of Chester step test. 2. Other outcome measures like testing of strength, endurance and anaerobic fitness, along with stress anxiety issues and quality of life, can be taken. 3. The study can also be carried out in different emergency service population to check their fitness level.

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