

# Fitness for Work Evaluation of Firefighters in Tehran

Ramin Mehrdad, Farid Movasatian, and Akram Sadat Momenzadeh

Department of Occupational Medicine, Center for Research on Occupational Medicine,  
Tehran University of Medical Sciences, Tehran, Iran

Received: 21 May. 2012; Received in revised form: 20 Dec. 2012; Accepted: 5 Jan. 2013

**Abstract-** Firefighting is extremely strenuous and physically demanding work and involves ability to cope with emergency life-or-death situations. Because of the high physical demands of firefighting, successful job performance and minimizing of morbidity and mortality depends on fitness for duty. The firefighting department of Tehran does not perform periodic medical assessment for firefighters. The aim of this study was to evaluate medical fitness among firefighters in Tehran. In this cross sectional study we examined 147 firefighters. Medical and occupational history obtained by interview, then we performed physical examination, blood tests, ECG, spirometry and audiometry. Then results compared with guidelines for firefighters in the USA, Australia and the United Kingdom. Seven percent of our participants had a kind of pulmonary dysfunction and 25% had some degrees of hearing loss. A considerable percent of them had modifiable coronary heart disease risk factors. Thirteen participants were unfit for this job that among them; ten firefighters were unfit based on vision capability, one case due to hypertension and two cases because of pulmonary dysfunction. Because of hazardous nature of firefighting; preplacement, periodic medical evaluations and assessment of fitness for firefighters in Iran is highly recommended. Establishment of fitness criteria for firefighters in Iran is necessary to perform assigned functions safely.

© 2013 Tehran University of Medical Sciences. All rights reserved.

*Acta Medica Iranica*, 2013; 51(4): 265-269.

**Keywords:** Health; Firefighter; Medical fitness

## Introduction

Firefighters perform tasks that are physically and psychologically very demanding. These tasks often are performed with maximum physical capacity under hazardous environmental conditions. Firefighters are potentially exposed to hazardous factors (physical, chemical and biological) as well as psychological hazards during their work (1,2).

Intrinsic (adrenergic response) and extrinsic factors (e.g. heavy personal protective equipment, heat) increase blood pressure, heart rate and body core temperature. Cardiovascular disease is the cause of almost half of on duty deaths among firefighters and most fatalities happen to firefighters with underlying coronary heart disease (2-4).

National Fire Protection Agency (NFPA) requires that the fire department shall establish and provide a health and fitness program to enable members to develop and maintain an appropriate level of fitness to safely perform their assigned functions (5). Occupational Safety and Health Administration (OSHA)

requires that every firefighter who performs fire suppression tasks has been determined to be fit to perform firefighting duties. This assessment is performed by a physician who is familiar with firefighting tasks (6).

In the US only one-fifths of fire departments had a program to maintain basic firefighter fitness and health (7). Of the 131 fire departments which NIOSH investigated in 2003, 71% performed medical evaluations and only 31% conducted periodic medical evaluations for all members participating in fire suppression (8,9).

In Iran medical surveillance has not been provided for firefighters regularly during their working life. At this time, the firefighting department of Tehran does not have any medical fitness program for firefighters and doesn't perform periodic medical examination. Entrance medical examination has been performed without considering occupational hazards and there is not any certain fitness criteria for this job.

The purpose of this study was to evaluate health condition among Tehran's firefighters and to assess their

**Corresponding Author:** Akram Momenzadeh

Department of Occupational Medicine, Center for Research on Occupational Medicine, Tehran University of Medical Sciences, Tehran, Iran  
Tel: +98 21 88994485, Fax: +98 21 88994487, E-mail: aksamova@yahoo.com

fitness for work based on guidelines in the USA; *NFPA* (National Fire Protection Agency 1582 Standard), Australia; *AFAC* (Australasian Fire Authorities Council medical guidelines for firefighters) and the United Kingdom; *UK FRS* (United Kingdom medical and occupational evidence for recruitment and retention in the Fire Rescue Service).

**Materials and Methods**

In this cross sectional study we evaluated health condition and fitness for work of firefighters who work for fire department of Tehran. Using simple random sampling method, we selected 147 of around 2500 full time firefighters and asked them to participate in this study. All participants were male as the fire department in Iran doesn't employ femals.

The study procedures were explained to all participants, and they were asked to sign a written informed consent. The study protocol was reviewed and approved by ethics committee of Tehran University of Medical Sciences.

Each participant was evaluated during three steps:

1. At the first, we asked them to fill out some individual information such as age, total years of employment, smoking habit, past medical history (diabetes mellitus, cardiovascular diseases and hypertension, surgery, drug history), and familial history. Then their weight and height were measured and BMI (Body Mass Index) was calculated.
2. In this step a physician who was familiar with firefighting tasks performed a complete physical examination with special attention to cardiopulmonary system.
3. Paraclinc tests: After at least 14 hours fasting, we performed laboratory tests including complete blood cell (CBC), fasting blood sugar (FBS), triglyceride (TG), total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), blood urea nitrogen (BUN) and creatinin (Cr). Also we performed Eelectrocardiography (ECG), spirometry (using spirolab III according to American Thoracic Society criteria), audiometry (air and bone conduction) and optometric test (visual acuity, field and color vision) for all participants.

After gathering the data, we compared our results with guidelines for firefighters in the USA (*NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments*), Australia (*AFAC*) and the United Kingdom (*UK FRS*) to evaluate fitness or unfitness of participants. All participants who needed

more evaluation were referred for follow up.

**Results**

Mean (SD) of age and length of service for our participants were 32.8 (7.8) and 9.0 (3.5) years respectively. 27 firefighters (18%) had a second job. 35 participants (23.8%) did not performe enough physical activity (at least 30 minutes, three times a week). Mean (SD) of BMI was 25.6 (2.8). The mean of FBS was 97.8 mg/dl and the mean of triglyceride and total cholostrol were 146.8 mg/dl and 177 mg/dl respectively.

Table 1 shows prevalence of risk factors of coronary artery disease (CAD) among this group of firefighters. Physical inactivity (23.8%) and low level of HDL (19%) were the two most common risk factors. Pulmonary dysfunction was observed in 10 firefighters (6.8%) including seven cases (4.7%) with mild and one case (0.7%) with moderate restrictive pattern and two cases (1.3%) with mild obstructive pattern.

Approximately 25% of firefighters (37) had various degrees of hearing loss. Table 2 shows these abnormalities in detail.

Table 4 shows unfit participants for firefighting tasks on the basis of *NFPA-1582*, *AFAC* and *UKFRS* guidelines. Ten (6.8%), six (4%) and seven (4.8%) persons were disqualified according to the *UKFRS*, *NFPA-1582* and *AFAC* guideline respectively. Poor visual acuity was the most common cause of unfitness. Three participants had color vision impairment and were unfitted based on *AFAC* and *UKFRS* guidelines.

**Table 1.** Frequency of coronary artery disease risk factors among firefighters.

<b>Risk factor</b>	<b>Frequency (%)</b>
Age ≥ 45	17 (11.6%)
Familial history of MI <sup>1</sup>	9 (6.1%)
Hypertension (BP <sup>2</sup> ≥140/90 )	10 (6.8%)
FBS <sup>3</sup> ≥ 126	5 (3.4%)
HDL <sup>4</sup> < 40	28 (19%)
LDL <sup>5</sup> ≥ 160	6 (4.1%)
HDL ≥ 60 (Protective factor)	16 (10.9%)
BMI <sup>6</sup> ≥ 30	12 (8.2%)
Smoker	17 (11.6%)
<b>Physical inactivity</b>	<b>35 (23.8)</b>

1; MI: Myocardial Infarction      2; BP: Blood Pressure  
 3; FBS: Fasting Blood Sugar      4; HDL: High Density Lipoprotein  
 5; LDL: Low Density Lipoprotein  
 6; BMI: Body Mass Index

**Table 2.** Hearing loss frequency in firefighters.

Hearing loss	Classification	Frequency(%)
Unilateral speech frequencies		0 (0%)
Bilateral speech frequencies	Mild	1 (0.7)
Unilateral high frequencies	Mild	8(5.5)
	Moderate	2 (1.4)
	Moderately severe	1 (0.7)
Bilateral high frequencies	Mild to moderate	9 (6)
Unilateral notching in 4 KHz	Mild	7 (4.7)
	Moderate	5 (3.4)
	Moderately severe	1 (0.7)
Bilateral notching in 4 KHz	Mild	2 (1.4)
Bilateral total frequencies	Mild	1 (0.7)
Total		37 (25.2)

In this study, we found that six participants had asymptomatic abnormal ECG findings (sinus bradycardia, T inversion, right bundle branch block,

premature ventricular complexes and ST elevation). We referred them to cardiologist to follow up.

**Table 3.** Unfit participants by study criteria.

Subject	Age (year)	Duration of employment (year)	Visual acuity	Color vision	Hearing	PFT <sup>1</sup>	Cardio-vascular	Reference
1	42	16	OK	OK	OK	FVC=68%	OK	NFPA
2	50	28	OK	OK	OK	FEV <sub>1</sub> /FVC= 72%, FEV <sub>1</sub> =77%	OK	NFPA
3	28	1	20/50	OK	OK	OK	OK	NFPA, AFAC, UK FRS
4	49	27	20/50	OK	OK	OK	OK	NFPA, AFAC, UK FRS
5	53	27	20/60	OK	OK	OK	OK	NFPA, AFAC, UK FRS
6	36	2	20/40	OK	OK	OK	OK	AFAC, UK FRS
7	38	15	20/100	OK	OK	OK	OK	UK FRS
8	40	19	20/200	OK	OK	OK	OK	UK FRS
9	51	28	20/100	OK	OK	OK	OK	UK FRS
10	28	2	OK	Strong deutan	OK	OK	OK	AFAC, UK FRS
11	49	28	OK	Strong deutan	OK	OK	OK	AFAC, UK FRS
12	34	4	OK	Strong deutan	OK	OK	OK	AFAC, UK FRS
13	53	28	OK	OK	OK	OK	BP= 170/ 105	NFPA

1; PFT: pulmonary function test

**Table 4.** Performance failure of total firefighters on study criteria.

Source	Visual acuity	Color vision	Hearing	PFT	Blood Pressure	Total
NFPA-1582	3 (2.0%)	0	0	2 (1.3%)	1 (0.7%)	6 (4.0%)
AFAC guideline	4 (2.7%)	3 (2.0%)	0	0	0	7 (4.8%)
UK FRS criteria	7 (4.8%)	3 (2.0%)	0	0	0	10 (6.8%)
Total failure	7 (4.8%)	3 (2.0%)	0	2 (1.3%)	1 (0.7%)	13 (8.8%)

## Discussion

Approximately 25% of participants had modifiable risk factors of coronary artery disease (CAD). A vast majority of them didn't know that they have CAD risk factors therefore they did not do anything to correct them. Seven percent had hypertension (blood pressure  $\geq$  140/90) and blood pressure of one person was 170/105 (Stage 2 HTN) without any treatment. Kales *et al.* described that frequency of hypertension was 20-23% in 1996 to 2000. They found that firefighters with stage II hypertension (BP>160/100) were consistently 2 or 3 times more likely to experience adverse outcome (death, on-duty injury, termination of duty, retirement or incident cardiovascular disease) compared with those with normal blood pressure (10). CDC/NIOSH propound that to reduce these risk factors, fire departments should consider mandating that all firefighters have medical examination and participate in a department-based fitness program (11). NFPA1582, *Standards on Comprehensive Occupational Medical Program for Fire Departments*, necessitates cardiac evaluation with maximum stress electrocardiography together with imaging techniques (e.g., echocardiography, TC99m sestamibi study and/or coronary angiography) for firefighters over the age of 45 (for men) and 55 (for women) with two or more CAD risk factors (5). In current study seven firefighters (4.7%) had these conditions and firefighting department didn't perform any diagnostic test for them.

In the studies of Holder, Byczek and Kales, the most common cause of death among firefighters was coronary artery disease. Firefighters with more CAD risk factors had higher mortality and morbidity (3,12,13). We couldn't find any data exploring causes of on duty death among Tehran's firefighters so we highly recommend conducting of these studies.

Based on NFPA 1582, UK FRS and AFAC guidelines, 4%, 6.8% and 4.8% of firefighters respectively were determined unfit for this duty and 2% of them were unfit by each of above guidelines. Based on tables 3 and 4 thirteen persons were unfit. Seven participants had poor vision and failed criteria for visual acuity that all of them were determined unfit by UK FRS guideline because of the more strict criteria for visual acuity but three and four cases failed these criteria on NFPA 1582 and AFAC guidelines respectively. Three participants had strong deutan colour vision impairment and were unfit by AFAC and UK FRS guidelines, but there was not any case of monochromatic vision impairment and so all of them were fit by NFPA

1582 standard. In this study we examined visual field by confrontation test that all participants determined fit by three guidelines.

Although 37 subjects (25%) had affected by various degrees of hearing loss in one or both ears, according to tables 3 and 4, nobody of them were unfit for duty by three guidelines. Also fifteen participants had audiogram with 4 KHz notching which in thirteen of them this problem was unilateral. This finding is in agreement with other studies that show noise-induced hearing loss may be unilateral in firefighters (14,15).

In our study 10 firefighters had pulmonary dysfunction. However only two cases were unfit according to NFPA 1582 criteria for pulmonary function and none of them were unfit based on the other two guidelines. Tubbs *et al.* performed screening study among firefighters and found that 16 cases of 453 firefighters (3.5%) had restrictive and 26 cases (5.7%) had obstructive pulmonary dysfunction. Also 64% of them had various degrees of hearing loss (16).

Kales *et al.* analyzed results from the medical examinations of 340 firefighters and applied various objective standards in fitness for duty determinations. Ten percent had elevated blood pressures, 13% had far visual acuity worse than 20/30 in one or both eyes, and 38% had abnormal audiogram. Based on NFPA 1582 criteria, medical workshop criteria and other criteria of their study, 28 (8.2%), 17 (5%) and 7 (2%) firefighters were determined unfit respectively and total failures were 33 subjects (9.7%) (12).

The mean BMI was 25.6, fifty two percent were overweight ( $25 \leq \text{BMI} < 29.9$ ) and obesity ( $\text{BMI} \geq 30$ ) was seen in 8.2% (12 of 14) with no evidence of extreme obesity. Maximum BMI in our participants was 33.6 and most of them (60%) had  $\text{BMI} \geq 25$ . Mean BMI was shown 27.4-29.8 by the NVFC screening study in 2005 (17). Among Massachusetts firefighters mean BMI was 28.9 and 51% of subjects were overweight, 34% obese and 2% morbid obese (18). Clark *et al.* observed that 80% of firefighters had  $\text{BMI} \geq 25$  that among them 30% were obese and 2.3% were morbidly obese (19). Soteriades *et al.* found that obesity and morbidly obesity frequency were 40% and 2.4% respectively with a mean BMI of 30 and they found that firefighters with extreme obesity had an average of 2.1 cardiovascular disease risk factors (excluding obesity) in contrast to 1.5 cardiovascular disease risk factors for normal firefighters (20). In Marsh study 75% of subjects had  $\text{BMI} \geq 25$  and they observed that every one unit increase in BMI associated with 5% increase in risk of job disability (21). In conclusion, we recommend

firefighting department of Tehran to perform preplacement and periodic medical evaluations for all members to safely carry out their hazardous work and to provide a medical fitness program for firefighters. A medical evaluation should be performed following occupational injury, illness, or protracted absence from the job.

## Acknowledgements

The authors wish to thank the firefighters-members of Tehran firefighting department, and the chief of this department, Mr. Hajibeigi; and deputy chief, Mr. Teimori. The authors also wish to thank chief of Baharloo hospital, Dr. Sadeghniat, and occupational medicine clinic personnel.

## References

- wilkins w. Fire fighters health and health effects of the world trade center collaps In: N.Rom W, editor. Environmental and occupational medicine: Lippincott-Raven; 2007.
- Sandy Bogucki PMR. Occupational health of police and firefighters. In: Rosenstock L, editor. Textbook of Clinical Occupational and Environmental Medicine. second ed: Elsevier Saunders; 2005. p. 272-81.
- Holder JD, Stallings LA, Peeples L, Burrell JW, Kales SN. Firefighter heart presumption retirements in Massachusetts 1997-2004. *J Occup Environ Med* 2006;48(10):1047-53.
- Kales SN, Soteriades ES, Christoudias SG, Christiani DC. Firefighters and on-duty deaths from coronary heart disease: a case control study. *Environ Health* 2003;2(1):14.
- NFPA. Standard on Comprehensive Occupational Medical Program for Fire Departments. In: department F, editor. 2007.
- OSHA. standard 1910.156. firebrigades. In: labor USdo, editor.
- USFA-NFPA. A needs Assessment of the U.S. fire service. FA-240Dec 2002.
- Syamlal G, Doney B, Bang KM, Greskevitch M, Groce D, Ganocy S, Hoffman W. Medical fitness evaluation for respirator users: results of a national survey of private sector employers. *J Occup Environ Med* 2007;49(6):691-9.
- OSHA. standard 1910-134 Respiratory protection. In: 29 USdoI, editor.
- Kales SN, Soteriades ES, Christoudias SG, Tucker SA, Nicolaou M, Christiani DC. Firefighters' blood pressure and employment status on hazardous materials teams in Massachusetts: a prospective study. *J Occup Environ Med* 2002;44(7):669-76.
- CDC. Fatalities among volunteer and career firefighters, United States 1994-2004. In: CDC, editor. United state: CDC; 2006. p. 453-5.
- Kales SN, Aldrich JM, Polyhronopoulos GN, Leitao EO, Artzerounian D, Gassert TH, Hu H, Kelsey KT, Sweet C, Christiani DC. Correlates of fitness for duty in hazardous materials firefighters. *Am J Ind Med* 1999;36(6):618-29.
- Byczek L, Walton SM, Conrad KM, Reichelt PA, Samo DG. Cardiovascular risks in firefighters: implications for occupational health nurse practice. *AAOHN J* 2004;52(2):66-76.
- Tubbs RL. Noise and hearing loss in firefighting. *Occup Med* 1995;10(4):843-56.
- Kales SN, Freyman RL, Hill JM, Polyhronopoulos GN, Aldrich JM, Christiani DC. Firefighters' hearing: a comparison with population databases from the International Standards Organization. *J Occup Environ Med* 2001;43(7):650-6.
- Tubbs RL, Melius J, Anderson KE. Health hazard evaluation report no. HETA 84-454-1890. In: NIOSH/CDC, editor. Cincinnati, Ohio 1988.
- NVFC. Heart healthy firefighter program, 2004 and 2005 summary of screening results. [www.healthyfirefighter.org](http://www.healthyfirefighter.org) [Internet].
- Kales SN, Polyhronopoulos GN, Aldrich JM, Leitao EO, Christiani DC. Correlates of body mass index in hazardous materials firefighters. *J Occup Environ Med* 1999;41(7):589-95.
- Clark S, Rene A, Theurer WM, Marshall M. Association of body mass index and health status in firefighters. *J Occup Environ Med*. 2002;44(10):940-6.
- Soteriades ES, Hauser R, Kawachi I, Liarokapis D, Christiani DC, Kales SN. Obesity and cardiovascular disease risk factors in firefighters: a prospective cohort study. *Obes Res*. 2005;13(10):1756-63.
- Marsh A. New medical /physical standards for Frederick county Firefighters. 1997.