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Predictors of pulmonary function in fire-fighters

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Abstract

Introduction: Fire-fighters are at great risk of being exposed to intense smoke. This occupational hazard may have an effect on their pulmonary function, as observed in many studies. This study was done to identify various factors that predict pulmonary function among fire-fighters.

Methodology: All the fire-fighters of Puducherry region were recruited in our study after obtaining an informed consent. After enrolment, socio-demographic variables and anthropometric measurements were recorded in a pre-structured proforma, following which every participant underwent spirometry testing. The Spirometric parameters FVC, FEV1, FEV1/FVC ratio, PEF, FEF25-75 were recorded and the results were analysed.

Results: There was a statistically significant negative correlation between years of service and Spirometric values FVC, FEV1, PEF, and FEF 25-75 except FEV1/FVC (%). Out of a total of 115 fire-fighters, 87(75.7%) had a normal spirometry and 28(24.3%) showed evidence of obstructive airway disease (OAD). There was no statistically significant difference between fire-fighters with OAD and without OAD in terms of age, duration of service in the department, height, weight and body mass index (BMI). Among fire-fighters, the odds of having OAD was high for smokers, subjects with history of atopy and those who had recent history of wheeze and respiratory infection, compared to those without these risk factors. However the results were not statistically significant.

Conclusions: As the duration of service increases, there is a decline in the Spirometric parameters FVC, FEV1, PEF and FEF25-75, for all the fire-fighters. 28(24.3%) showed evidence of obstructive airway disease by spirometry. Age, duration of service in the fire department, height, weight and Body mass index may not be useful predictors that a fire-fighter would develop obstructive airway disease. However, longitudinal studies with large sample size are necessary for robust evidence.

Keywords: Fire-fighters; FVC –forced vital capacity, FEV1-Forced expiratory volume in one second; OAD–Obstructive airway disease

Introduction

Fire fighting involves exposure to frequent intense smoke, which contains high concentrations of many hazardous aerosols, toxic gases, chemicals and particulate matter [1, 2]. This poses a significant occupational hazard to the lung health of the fire-fighters.

The pioneering studies on lung function among fire-fighters were conducted in Boston in the 1970s [3]. Since then many studies have been conducted to assess the acute and chronic effects of smoke on lung function [4-10]. Acute effects on the lungs have well been documented in these studies. However, whether chronic exposure to smoke in fire-fighters results in greater loss in lung function compared to non-fire-fighters has always been a matter of debate, with varying results from different studies. Also, whether factors like the duration of service in the department, anthropometric variables like height, weight, smoking habits and history of atopy, have an adverse effect on the pulmonary function in the long term is also a matter of controversy. In this study, we have tried to analyse the various factors which may affect the pulmonary function among fire-fighters. Such studies on fire-fighters are very scarce in India.

Materials and Method

This cross sectional study was conducted by the Department of Respiratory medicine, Indira Gandhi Medical College and Research Institute (IGMC & RI) Puducherry. The study was conducted from April 2015 to May 2015. The study was initiated after obtaining permission from the Institute research committee, Institute ethics committee and the Fire service department, Puducherry.

After obtaining written consent, all the fire-fighters working in various fire stations in Puducherry were recruited for the study. Fire-fighters who were not willing to undergo spirometry were excluded from the study. The study was done in their workplace itself.

All the subjects were asked to fill up a questionnaire regarding their demographic variables, the nature of their job, the number of years of service in the department and the number of fire accidents handled every month. Also, a detailed questionnaire pertaining to their past and present medical history, personal habits (smoking, alcohol consumption, regular exercises) was also filled up. The anthropometric measurements, viz. height, weight was made using standard procedures. Body mass index (BMI) was calculated to identify overweight and obese patients; by using the formula BMI=weight in kg /height in metres^2. Then the subjects vitals viz., pulse rate, blood pressure were noted. Spirometry was done using MIR SPIROLAB III to assess their pulmonary function. Subjects blew into the Spirometer in a sitting and relaxed position and the values were recorded. The Spirometric values obtained (FEV1, FVC, FEV1/FVC

ratio, FEF 25-75, PEFR) were compared with predetermined predicted values for their respective age, sex, height, weight and South Asian race. The effect of various demographic and anthropometric variables on lung function was analysed.

Statistical Analysis: Data was entered using EpiData Version 3.1. Simple percentages, proportions, mean and standard deviation, odds ratio and 95%CI were used for describing the results of the study. Pearson Correlation, Chi-square test, Yates corrected Chi-square test, Fisher's Exact test and students t-test was used to find the association. Data was analysed using SPSS Version 20. p value <0.05 was taken as statistically significant.

Results

In our study, a total of 115 fire-fighters underwent spirometry.

Table 1: Correlation between years of service and spirometry values of fire-fighters

S. No	Parameters	Pearson Correlation (r)	Sig. (2-tailed)	N
1	FVC (L)	-.341	<0.001**	115
2	FEV1 (L)	-.362	<0.001**	115
3	FEV1/FVC (%)	-.105	0.270	115
4	PEF (L/s)	-.324	<0.001**	115
5	FEF25-75 (L/s)	-.214	0.023**	115

**p value<0.05 is significant

There was a statistically significant negative correlation between years of service and spirometric values FVC, FEV1, PEF, and FEF 25-75 except FEV1/FVC (%).

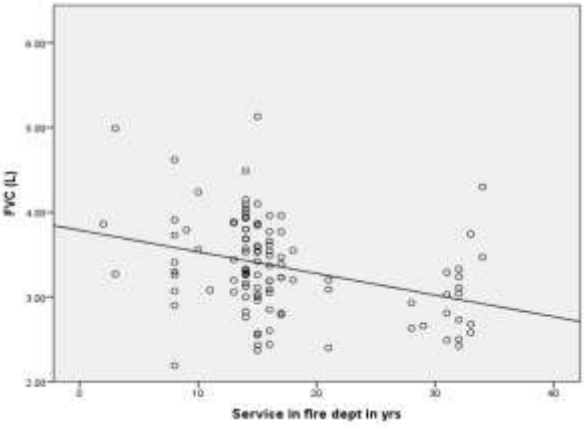

Fig. 1: Correlation between years of service and FVC values of all the fire-fighters

There is a statistically significant negative correlation between service in fire department and FVC.

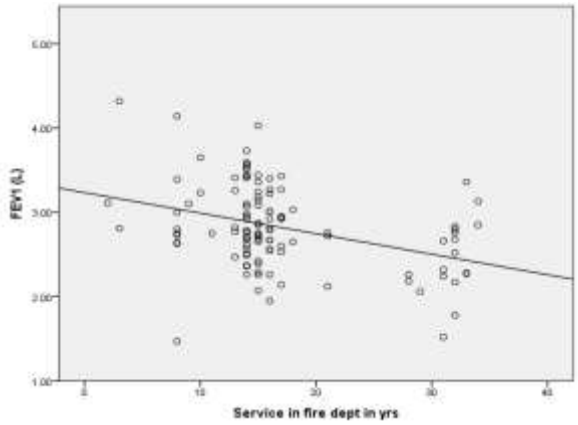

Fig. 2: Correlation between years of service and FEV1 values of all the fire-fighters

There is a statistically significant negative correlation between service in fire department and FEV1.

Out of the total 115 fire-fighters who underwent spirometry, 87(75.7%) subjects had a normal spirometry (FEV1/FVC ratio >80%). Considering the age group of the subjects screened being predominantly less than 50 years, an FEV1/FVC ratio of less than 80% was taken as evidence of airway obstruction in this study. Hence, a total of 28 subjects (24.3%) showed evidence of airway obstruction (FEV1/FVC ratio of <80%).

Table 2: Mean differences in demographic variables of fire-fighters

S. No	Variables	Obstructive Airway Disease (OAD)		p-value*
		Yes (n=28) (Mean±SD)	No(n=87) (Mean±SD)	
1	Age (yrs)	45.64±6.601	44.26±7.652	0.360
2	Service in fire dept (yrs)	17.11±8.029	16.83±7.236	0.874
3	Height (cm)	171.43±5.692	170.26±4.709	0.333
4	Weight (kg)	77.82±10.559	77.89±10.031	0.978
5	BMI (kg/m^2)	26.51±3.57422	26.87±3.32024	0.640

* Students 't' test;
**p <0.05 is significant

There was no statistically significant difference between fire-fighters with OAD and without OAD in terms of age, duration of service in the fire department, height, weight and BMI. Both the groups were comparable in the above mentioned parameters.

Table 3: Factors influencing the risk of developing obstructive airway disease (OAD)

Variables	OR	95%CI	p value	Obstructive Airway Disease		Total n (%)
				Yes- n (%)	No- n (%)	
Smoking	2.364	0.759-7.362	0.193#	6 (21.4)	9 (10.3)	15 (13.0)
Alcohol consumption	0.976	0.346-2.751	0.963	6 (21.4)	19 (21.8)	25 (21.7)
Regular Exercise	0.813	0.338-1.957	0.644	17 (60.7)	57 (65.5)	74 (64.3)
H/O cough with expectoration in the last 1 month	1.646	0.456-5.945	0.482#	4 (14.3)	8 (9.2)	12 (10.4)
H/O nose block in the last 1 month	1.123	0.394-3.199	0.828	6 (21.4)	17 (19.5)	23 (20.0)
H/O wheeze in the last 1 month	2.935	0.821-10.492	0.133#	5 (17.9)	6 (6.9)	11 (9.6)
K/c/o Diabetes	0.285	0.035-2.333	0.290#	1 (3.6)	10 (11.5)	11 (9.6)
K/c/o Hypertension	0.321	0.039-2.652	0.447#	1 (3.6)	9 (10.3)	10 (8.7)
Past H/O TB	-	-	0.243$	1 (3.6)	0 (0)	1 (0.9)
H/O Atopy	3.269	0.439-24.365	0.249$	2 (7.1)	2 (2.3)	4 (3.5)

#Yates corrected Chi-square test
$Fisher's Exact test

Among fire-fighters, the odds that they would demonstrate obstructive airway disease is high for smokers, subjects with history of atopy and those who had recent history of wheeze and respiratory infection, compared to those without these risk factors. However the results are not statistically significant.

Discussion

This study has revealed a statistically significant negative correlation between years of service and the spirometry values FVC, FEV1, PEF, FEF 25-75 except FEV1/FVC (%). It implies that as the years of service increases, the lung function parameters decreases proportionately. Our finding is similar to other previously published studies which have also shown a decline in lung function as duration of service increases [4, 5, 9, 10] . Unger et al., demonstrated a trend towards an increased rate of volume loss in the FVC and FEV1 as years progressed, among the fire fighters [11]. They suggested that the decrement in function is related to frequent, repeated insults over time rather than sudden decreases associated with specific exposures. In our study, whether it is a normal ageing process related decrease in FEV1 or whether it is a decline in lung function due to fire smoke as is reported in previous studies is difficult to establish, since our study was only a cross sectional study.

Our study did not find any significant difference between fire-fighters with Obstructive airway disease (OAD) and without OAD in terms of age, duration of service in the fire department, height, weight and body mass index (BMI). Both the groups were comparable in the above mentioned parameters, which makes us to infer that these factors do not play a role in determining whether fire-fighters would develop Obstructive airway disease OAD or not ,because of exposure to smoke. As age and the duration of service increases, fire-fighters developing OAD is also expected to increase [3-7]. Maybe because of the small sample size, we are unable to demonstrate any statistically significant difference.

In our study, the risk for developing OAD is relatively higher for smokers, subjects who had a history of atopy and who had recent h/o respiratory infection and wheeze, although the results were not statistically significant.

Cigarette Smoking is a well-known cause for decline in lung function and development of chronic obstructive pulmonary disease (COPD). Fire-fighters are not immune to smoking related COPD. It is quite natural to expect that smoking would have a compounding effect on development of Obstructive airway disease (OAD) in fire-fighters who are frequently exposed to intense smoke [12-14]. Loke et al., established that smoking fire-fighters had a decreased FEV1, FEV1/FVC % and a greater degree of small airway disease as compared to non-smoking fire-fighters [14]. Fire-fighters who smoked also had a greater degree of respiratory impairment compared to non –smoking fire-fighters.

Atopy, the hereditary predisposition to allergy, is by far the most important condition which renders fire-

fighters more susceptible to the effects of fire smoke [15]. In the study by Greven et al. in 2011, it was concluded that due to the airway hyper reactivity present in atopic individuals, fire-fighters experience a greater decline in lung function compared to non-atopic individuals after every episode of fire fighting [15] .

Subjects with recent h/o respiratory infection and wheeze, may have airway obstruction due to inflamed and hyper reactive airways [15]. Whether this is a reversible airway obstruction or not, can be proved only by a repeat spirometry after few months. But since this was a cross sectional study, repeat spirometry after few months was not done.

We need to have a larger sample size to identify if smokers, atopic individuals and subjects with a recent history of respiratory infection and wheeze are predisposed to develop obstructive airway disease (OAD) in the long run because of frequent smoke exposure.

Smaller sample size is a limitation of the study. However we had done the study in all the fire-fighters of region of Puducherry, who were in service, with the exception of few who were on leave and who were not willing to participate in the study.

Conclusions

As the duration of service increases, there is a decline in the Spirometric parameters FEV1, FVC, PEF and FEF25-75%, for the fire-fighters. 28(24.3%) showed evidence of obstructive airway disease by spirometry. Age, duration of service in the fire department, height, weight and Body mass index may not be useful predictors that a fire-fighter would develop obstructive airway disease. Large scale, follow up studies are required for in-depth understanding of factors predicting lung function among fire-fighters.

Conflict of interests: None

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