

## Spirometric evaluation of pulmonary function among fire fighters –A cross sectional study from Puducherry, India

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### Abstract

**Background:** To assess the pulmonary function among firefighters using Spirometry.

**Methodology:** A cross sectional study was conducted among firefighters in Puducherry, India. Spirometry was done to assess their lung function. The Spirometric values obtained viz., FEV1, FVC, FEV1/FVC ratio, FEF25-75% were compared with predetermined predicted values (expected values) for their respective age, sex, height, weight and South Asian race.

**Results:** In our study, a total of 115 firefighters working in 9 fire stations in Puducherry were subjected to Spirometry in their workplace itself. Eighty seven (75.7%) subjects had a normal Spirometry (FEV1/FVC ratio >80 %). Twenty eight (24.3%) subjects had FEV1/FVC ratio <80% and were diagnosed to have obstructive airway disease. Out of the 28 subjects, sixteen (57.1%) subjects had FEV1 >80% of predicted (Borderline obstruction). Ten (35.7%) subjects had FEV1 between 60-80% of predicted (Mild obstruction) and 2 (7.1%) subjects had FEV1 between 40-60% of predicted (Moderate obstruction). None of the patients had FEV1 <40% of predicted (Severe obstruction).

**Conclusions:** Out of 24.3% subjects who showed evidence of obstruction, 51.7% subjects showed borderline obstruction, 35.7% subjects showed mild obstruction and 7.1% subjects showed moderate obstruction. Follow-up Spirometry in the study group over a period of time could help us in establishing the association between smoke exposure and decline in pulmonary function.

**Keywords:** COPD-chronic obstructive pulmonary disease; Fire fighters; Spirometry

### Introduction

It is a well known fact that exposure to smoke can cause significant respiratory illnesses, both short term and long term [1]. Long term exposure to smoke can cause progressive decline in the pulmonary function and lead to obstructive airway diseases especially COPD (Chronic Obstructive Pulmonary Disease). Even before the onset of symptoms, COPD can be detected much earlier with the help of Spirometry [2,3].

Firefighters are in a high risk profession and they are frequently exposed to intense smoke. Not only they are more liable to get frequent respiratory illnesses but also their pulmonary function declines rapidly over the years they are continuously exposed to smoke. They have a high chance of developing COPD much earlier than the general population. In India, there is minimal data regarding the Spirometric evaluation of pulmonary function of firefighters. Hence the present study was undertaken.

### Materials and Methods

This cross sectional study was conducted by the Department of Respiratory medicine, IGMC & RI (Indira Gandhi Medical College and Research Institute, 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.

All the Firefighters working in various fire stations in Puducherry were recruited for the study after

obtaining written consent. Firefighters who were not willing to undergo Spirometry were excluded from the study. The study was done in their workplace itself. The subjects' height and weight were recorded. 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.

A FEV1/FVC ratio of less than 80% was taken as the cut off for diagnosis of obstructive airway disease. Results of investigations were shared with the participants.

**Statistical analysis:** Data was entered in MS Excel and analyzed using SPSS v20 software and EPI INFO. Continuous variables were expressed as Mean +/-S.D and categorical variables were expressed as proportion. Tests of significance like Student T test and Chi-square were used to compare mean and proportion respectively.

### Results

In our study, a total of 115 firefighters working in 9 fire stations in Puducherry were subjected to Spirometry in their workplace itself. Though the estimated sample size was 132, yet only 115 fire fighters could be tested because, either the subjects were on long leave on medical grounds or were not

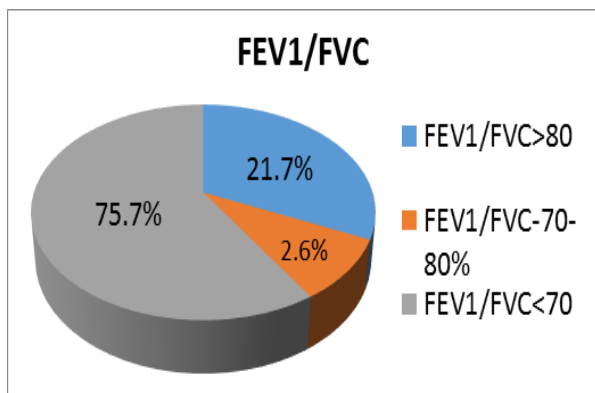
willing to undergo Spirometry. All the Spirometry results were acceptable and reproducible. The results were analyzed in the following manner.

**Spirometry Results**

**Table 1: FEV1/FVC ratio**

	No. of subjects	Percentage (%)
FEV1/FVC >80%	87	75.7%
FEV1/FVC -70-80%	25	21.7%
FEV1/FVC<70%	3	2.6%

**FEV1**-Forced expiratory volume in 1 second; **FVC** – Forced vital capacity



**Figure 1: FEV1/FVC ratio**

**Table 2: FEV1/FVC ratio**

	No. of subjects	Percentage (%)
FEV1/FVC >80%	87	75.7
FEV1/FVC<80%	28	24.3

**Table 3: FEV1 (Forced Expiratory Volume in 1 second)**

Percentage of predicted (%)	No. of subjects (n=28)	Percentage (%)
FEV1>80 ( <b>Borderline obstruction</b> )	16	51.7
FEV1 60-80 ( <b>Mild obstruction</b> )	10	35.7
FEV1 -40-60 ( <b>Moderate obstruction</b> ).	2	7.1
FEV1<40 ( <b>Severe obstruction</b> )	0	0

**Table 4: FVC (Forced Vital Capacity)**

Percentage of predicted (%)	No. of subjects (n=28)	Percentage (%)
FVC>80	22	78.6
FVC60-80	4	14.3
FVC 40-60	2	7.1

FVC<40	0	0
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**Table 5: FEF 25-75% (Forced Expiratory Flow 25-75%)**

Percentage of predicted	No. of subjects (n=28)	Percentage (%)
FEF25-75 >80	1	3.6
FEF25-75 <80	27	96.4

96.4% subjects had a reduced FEF 25-75%

**Discussion**

Analyzing Spirometric results, 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 obstruction in this study. In our study, 28 subjects (24.3%) showed evidence of obstruction (FEV1/FVC ratio of <80%).

Three subjects (2.6%) showed FEV1/FVC ratio of <70%, suggestive of significant obstruction.

Hence a total of 28 subjects whose FEV1/FVC ratio were less than 80%, were diagnosed to have obstructive airway disease and taken up for further analysis. The values of FEV1, FVC, FEF 25-75% was compared with the predicted value for the subjects’ age, sex, height, weight and race and were analyzed.

Once obstructive airway disease is diagnosed, the FEV1 (Forced Expiratory Volume in 1 second) is usually used to grade the severity of obstruction. In our study, out of the 28 cases diagnosed to have obstruction, 16(51.7%) subjects had FEV1 >80% of predicted-**borderline obstruction**. 10(35.7%) subjects had FEV1 between 60-80% of predicted-**mild obstruction**. 2(7.1%) subjects had FEV1 between 40-60% of predicted-**moderate obstruction**.

Analyzing FVC (Forced Vital Capacity), out of the 28 cases diagnosed to have obstruction, 22 (78.6%) had a normal FVC. The rest 6 subjects had a reduced FVC either because of severe obstruction or concomitant restrictive defect.

Analyzing FEF 25-75% (Forced Expiratory Flow) 27 subjects had a reduced FEF 25-75%. However, the normal range of FEF 25-75% is too wide and hence this parameter is not being recommended by American Thoracic Society for diagnosis of small airway obstruction.

It has been demonstrated by various studies [4-15], that firefighters have an incremental decrease in FEV1 and FVC, compared to the matched population controls. This decrease also depends upon the number of years and amount of exposure to smoke. However, this can be demonstrated only if the firefighters are followed up over a period of time with repeated Spirometry.

In our study, a total of 28(24.3%) subjects demonstrated obstruction, of which 16(51.7%) subjects showed borderline obstruction and the rest 12(48.3%) showed mild to moderate obstruction. Of the 28

subjects who demonstrated obstruction, five were smokers and two were known asthmatics.

Whether the findings in our study are significant and if they could be really attributed to smoke exposure can be confirmed only after follow-up Spirometry results. Further longitudinal studies conducted in the same study group over a period of time and with matched controls, can tell us whether the firefighters have an incremental decrease in FEV1 and FVC due to smoke exposure.

### Conclusions

Out of the 115 firefighters evaluated in our study, a total of 28(24.3%) subjects demonstrated obstruction, of which 16(51.7%) subjects showed borderline obstruction and 10(35.7%) subjects showed mild obstruction, and 2 (7.1%) subjects showed moderate obstruction. Of the 28 subjects who demonstrated obstruction, 5 were smokers and 2 were known asthmatics. Serial Spirometry measurements in the study group over a period of time could help us in arriving at the conclusion that the findings in our study are significant and could be attributed to smoke exposure.

**Conflicts of interest:** None declared

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