Section: Physiology

Original Research Article

EVALUATION OF PULMONARY FUNCTION TESTS IN FIRE SERVICE MEN TO ASSESS THE HAZARDS OF FIRE SMOKE IN RELATION TO PULMONARY FUNCTIONS

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ABSTRACT

Firefighters are exposed to a wide range of harmful substances during firefighting. Exposure to fire smoke has been associated with a decrease in the lung function. Objective of our study is to evaluate the impairment of pulmonary function in fire service men and to assess the lung function impairment with respect to duration of service in fire rescue operation. A cross sectional study was done with 67 Urban fire service men more than 3 yrs of service in fire rescue operation in the city fire station. The pulmonary function parameters like forced vital capacity [FVC], FEV1, FEV1/FVC and PEFR are recorded. The pulmonary function was analysed based on years of service (3-5 years, 6-10 years, and 11-15 years). Study associations between occupational exposure and use of protective respiratory equipment were done. No significant difference in FVC was observed ($p = 0.898$), but FEV1 significantly decreased with increasing service duration ($p = 0.004$). The FEV1/FVC ratio also showed a significant decline with longer service duration ($p = 0.0001$), suggesting obstructive lung disease. Participants who did not use Personal Protective Equipment (PPE) had a significantly lower FEV1/FVC ratio ($p = 0.0001$). In conclusion, this study highlights the hazards of fire and smoke in firefighters on prolonged exposure. The findings showed that longer service duration was significant contributor to declining pulmonary function, as evidenced by reduced FEV1/FVC ratio. The use of PPE demonstrated a protective effect on lung function, particularly in those with prolonged duration of exposure to fire and smoke.

INTRODUCTION

Firefighters are exposed to a wide range of harmful substances during firefighting. Exposure to fire smoke has been associated with a decrease in the lung function. Objective of our study is to evaluate the pulmonary function in fire service men and to assess the lung function impairment with respect to duration of service in fire rescue operation.

Aim and objective: Evaluation of pulmonary function tests in fire service men to assess the hazards of fire smoke in relation to pulmonary functions.

MATERIALS AND METHODS

This study was conducted in a tertiary care center. Study population was urban fire service men working in the city fire station with duration of service 3 years to 15 years. Duration of the study was 12 months. Sample size was 67. Age group between 25 to 55yrs and Body mass index between 18-25kg/m ^{2} were included in the study. The Pulmonary Function Test recording was done in the research laboratory in the Department of Physiology, tertiary care center, Chennai. The Medicaid Physiolab computerized spirometer instrument was used for the study. Written informed consent form was obtained from all the subjects, after explaining the procedure and its significance in their own language.

Inclusion Criteria: Urban fire service men 3 years to 15 years of service. Age group between 25 to 55yrs and Body mass index between 18-25kg/m ^{2} were included in the study.

Exclusion Criteria: Fire service men less than 3 years of service. Individuals with history of drug intake (Corticosteroids, Bronchodilators, NSAIDS, Anti -Tubercular drugs etc). Individuals with history of chronic illness, neurologic or psychiatric illness. Individuals with history of recent respiratory tract infection. Individuals with history of allergic

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respiratory diseases. Individuals with history of any drug abuse. Individuals with history of recent surgery. Individuals with musculoskeletal chest deformity

Statistical Analysis: The data was analysed using excel MS software and mean & standard deviation for the quantitative variables, and percentage for the categorical variables. T test and chi-square test was used for inferential statistics. P value of less than 0.05 was considered statistically significant. Statistical analysis was performed using SSPS software 22.0.

RESULTS

Table 1: Pulmonary Function Test Results of the study population

Parameter	Number of subjects	Mean	Standard Deviation
FVC (L)	67	2.52	0.59
FEV1 (L)	67	1.73	0.45
FEV1/FVC (%)	67	76.24	11.84
FEF 25-75% (L/s)	67	2.13	1.01
PEF (L/s)	67	4.07	1.09

The FEV1/FVC ratio showed a significant decline < 80%

Table 2: Comparison of Pulmonary Function by Service Duration in the study population

Duration of exposure	3-5 years (N=29)	6 - 10 years (N=27)	11 to 15 years (11)	P
FVC [L]	2.55 ±572	2.52± .580	2.45 ±0.68	0.898
FEV1 [L]	1.93 ±.257	1.55 ± .50637	1.63 ± .50	0.004
FEVI/FVC%	84.64 ±3.94	69.20 ±12.86	71.36 ± 9.34	0.0001
FEF 25-75% [L/s]	2.10 ±1.08	2.07 ± 1.071	2.36 ± .67	0.716
PEF [L/s]	4.06 ±1.09	3.96 ± 1.12	4.36 ± 1.02	0.597

The pulmonary function was analysed based on years of service (3-5 years, 6-10 years, and 11-15 years). No significant difference in FVC was observed (p = 0.898), but FEV1 significantly decreased with increasing service duration (p = 0.004). The FEV1/FVC ratio also showed a significant decline with longer service duration (p = 0.0001), suggesting obstructive pulmonary impairments.

Table 3: Pulmonary Function Based on PPE Usage

	Non usage of PPE (28)	Usage of PPE (39)	P
FVC [L]	2.50 ± 0.50	2.54 ± 0.643	0.794
FEV1 [L]	1.64 ± 0.48	1.79 ± 0.40	0.171
FEVI/FVC%	70.34 ± 12.8	80.47 ± 9.04	0.0001
FEF 25-75% [L/s]	2.2 ±1.04	2.05 ± 0.99	0.433
PEF [L/s]	4.28 ± .76	3.9 ± 1.26	0.182

Participants who did not use Personal Protective Equipment (PPE) had a significantly lower FEV1/FVC ratio (p = 0.0001). No significant differences were observed in FVC (p = 0.794) or FEV1 (p = 0.171), but the use of PPE appeared to protect lung function.

DISCUSSION

Our study was designed to assess the pulmonary function among urban firefighters, who face chronic exposure to hazardous smoky environment on a regular basis. This study examined lung function tests (FVC, FEV1, FEV1/FVC ratio, FEF 25-75%, and PEF) in order to determine the degree of the effects of pulmonary function degradation that firefighters are known to endure over time as a result of extended exposure to fire and smoke.

The study involved 67 participants from selected fire stations in the Chennai, and the primary objective was to assess lung function using pulmonary function tests (PFTs) and to explore the impact of factors such as Personal Protective Equipment (PPE) usage, and duration of exposure to fire and smoke.

In general, the study indicated that firefighters who had served for longer periods of time had deteriorating lung function, especially when it came to FEV1 and FEV1/FVC ratio, which point to Obstructive Lung Disease. Additionally, we found that using PPE helped to protect and improve the lung function, especially when it came to maintaining FEV1/FVC ratios.

This study showed that the subjects lung function was below the normal value especially for those who had been exposed to fire and smoke for longer periods of time. The FEV1/FVC ratio was 76.24% on average, which is suggestive of Obstructive Lung Disease.

This research confirms the widely held hypothesis that firemen are more likely to acquire chronic obstructive lung disorders (COPD), including bronchitis and emphysema, as a result of their frequent exposure to smoke and hazardous chemicals.

PPE acts as a barrier against dangerous airborne materials that firefighters are frequently exposed to while doing their tasks, such as smoke, particulate matter, and toxic fumes. We noted that the lung function was much better for those who routinely utilized PPE than for those who did not, especially

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when it came to their FEV1/FVC ratios. Use of PPE help in reducing the likelihood of developing chronic obstructive pulmonary disease (COPD), which is characterized by reduced airflow due to airway inflammation and narrowing.

This shows that although understanding PPE is vital, constant and appropriate use in real-world situations is ultimately what makes it successful. These results highlight the necessity of ongoing PPE procedure training and reinforcement to guarantee that knowledge and adherence result in protective health effects.

CONCLUSION

In conclusion, this study highlights the hazards of fire and smoke in firefighters on prolonged exposure. The findings showed that longer service duration was significant contributor to declining pulmonary function, as evidenced by reduced FEV1/FVC ratio. The use of PPE demonstrated a protective effect on lung function, particularly in those with prolonged duration of exposure to fire and smoke.

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