

Evaluation of Pulmonary Function Tests among Smokers and Non-Smokers in an urban area of Nepal

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Abstract

Background: Tobacco smoking is common in the world and the trend is more in developing countries. Smoking has a hazardous effect on respiratory functions. Smoking is the single most potent risk factor for the development of chronic obstructive airway diseases (COPD). PFT by a trained professional gives an indication of lung health by measuring airway ailments. Objectives were to study pulmonary function test (PFT) in smokers and non-smokers between 25-45 years.

Materials and Methods: Healthy male subjects, 120 smokers and 120 non-smokers, between 25-45 years without any symptoms were included as subjects. Patients with uncontrolled debilitating diseases were excluded. Collected data was analysed using Statistical Package for the Social Sciences (SPSS) software version 21.

Results: A total of 240 males, 120 smokers and 120 non-smokers matched for age, height, and weight were enrolled in this study. From the results, the FEV₁, FVC, FEF, FEV₁/FVC ratio were obtained and analysed. The mean difference in values for pulmonary function was highly significant ($P < 0.05$) between smokers and non-smokers. The mean FVC in smokers was 1.88 ± 0.61 L and in non-smokers was 2.83 ± 0.55 L. The decrease in FEV₁ in smokers (1.34 ± 0.47 L) as compared to non-smokers (2.52 ± 0.62 L) clearly indicates obstructive pulmonary disease.

Conclusions: Smoking is common in males between 25-45 years of age. Smoking is highly associated with an abnormal PFT. Avoiding of smoking in any form should be encouraged and PFTs from time to time in adults both smokers and non-smokers will be useful for early detection of the respiratory ailments.

Keywords: COPD, PFT, Smoking

Introduction

The World Health Organization proclaimed that tobacco smoking killed 100 million people worldwide in the 20th century and warned that it could kill more than one billion people across the world in the 21st century as well (1). Cigarette smoking is the principal preventable cause of mortality. Smokers who quit smoking are relatively safe from dying from smoking-related diseases (2). Tobacco smoke contains more than 4,000 chemicals and around 40 carcinogens (3). Smokers have decreased lung functions compared to non-smokers. Smoking is the most dangerous risk factor for the development of COPD. On an average, cigarette smokers have a high tendency of decrease in FEV1 of about 50 ml, which is nearly double the average value of 30 ml annually present in non-smokers (4). The classification criteria as suggested by WHO (5) (1998) is:

- **Smoker:** Someone who, at the time of the study, smoke tobacco products either daily or occasionally.
- **Non-smoker:** Someone who, at the time of the study, did not smoke at all.
- **Ex-smoker:** Someone who was formerly a daily or occasional smoker, but currently does not smoke at all

Tobacco smoke contains 60 known carcinogens which have the capability to develop lung carcinoma. The major known compositions of tobacco smoke include Acetone, Butane, Arsenic, Naphthalene, Cadmium, Carbon monoxide, Hydrogen Cyanide and Vinyl chloride. Cigarette smokers therefore, have a high rate of mortality due to lung carcinoma (6). Pulmonary function testing is a routine procedure for the assessment and monitoring of respiratory diseases. Tests are also useful because they cause minimum discomfort for the subjects. Pulmonary function tests vary according to age, height, sex, and body size (7, 8). Pulmonary function tests are economic, non-invasive and reproducible (9). PFT may play a role in convincing the patient to give up smoking of any form. The smoking trend is huge and proper effort is needed to launch effective campaigns to generate awareness regarding the consequences of smoking and pulmonary diseases. PFTs by a qualified health professional give an indication of lung health by measuring airway abnormality. An attempt has been made to study the pulmonary function tests among the healthy population including smokers who are asymptomatic.

Materials and Methods

A cross sectional study was conducted in the Department of Physiology, Kathmandu Medical College, Kathmandu, Nepal after obtaining clearance and approval from the Institutional Review Committee (IRC) of Kathmandu Medical College. The study was conducted from 15th January 2023 to 15th February 2024. The study population included 240 healthy male subjects aged between 25 to 45 years. They comprised 120 smokers and 120 non-smokers. Females were not included in this study, because of the low incidence of tobacco smoking among females in Nepal and also non-reporting tendency of the females in our society.

Healthy smokers were selected from among patients coming to OPD of KMCTH, Nepal.

Inclusion criteria

- Healthy subjects, 120 smokers and 120 non-smokers between 25-45 years without any symptoms were included as subjects
- Smoker: Someone who, at the time of the study, smoked any tobacco products either daily or occasionally for the last five years.
- Non-smoker: someone who, at the time of the study, did not smoke at all.

Exclusion criteria

- Patients with uncontrolled debilitating diseases were excluded
- Ex-smokers were excluded from study

The pulmonary functions were done on a computerized spirometer in 240 male subjects comprising 120 smokers and 120 non-smokers. PFTs were recorded by a spirometer (RMS Medispiror, Recorders and Medicare system (P) Ltd. Model: RMS Helios) and FVC, FEF, PEFR, FEV, FEV/FVC ratio were recorded. For evaluating the pulmonary physiology, the subjects were asked to sit comfortably. The complete procedure was explained and informed written consent was taken. The subjects were told to breathe fully by deep inspiration and after that, with their nostrils closed, sealing their lips, were asked to forcefully expire air. The best three readings were recorded and analysed. FVC, FEF, PEFR, FEV1, FEV1/FVC ratio were recorded and noted. Collected data were analysed using Statistical Package for the Social Sciences (SPSS) software version 21.

Results

The physical variables of the smokers and the non-smokers are shown in Table 1. Age range of the subjects was 25 – 45 years with mean age of smokers 33 ± 6.86 and of non-smokers 36.45 ± 5.58 . Mean height of the smoker group was 1.68 ± 0.07 meters and of the non-smoker group was 1.65 ± 0.12 meters. Whereas, mean weight of smokers was 68 ± 9.27 Kg and non-smokers was 66 ± 7.85 Kg. A total of 240 males, 120 smokers and 120 non-smokers matched for age, height, and weight were enrolled in this study. From the result, the FEV₁, FVC, FEF, FEV₁/FVC ratio were obtained and analysed. The mean difference

in values for pulmonary function was highly significant ($P < 0.05$) between smokers and non-smokers. The mean FVC in smokers was 1.88 ± 0.61 L and in non-smokers was 2.83 ± 0.55 L (Table 2). The decrease in FEV₁ in smokers (1.34 ± 0.47 L) as compared to non-smokers (2.52 ± 0.62 L) clearly indicates the obstructive pulmonary disease (Figure 2 & 3).

Table 1: Anthropological details of study participants (n=240)

No	Variables	Frequency	Percentage
1	<i>Age in Years</i>		
	25-35	110	45.83
	36-45	130	54.17
2	<i>Height (centimetres)</i>		
	≤ 160	89	37.08
	161-175	102	42.50
	≥ 176	49	30.48
3	<i>Weight (KG)</i>		
	≤ 60	45	18.75
	61-75	124	51.67
	≥ 76	71	29.58

Table 2: Comparison of various pulmonary function tests between smokers and non-smokers

S. No	Pulmonary Function Test (PFT)	Non-smokers (120) (Mean ± SD)	Smokers (120) (Mean ± SD)	P Value
1	FVC (L)	2.83 ± 0.55	1.88 ± 0.61	$P < 0.05$
2	PEF ₂₅₋₇₅ (L/S)	2.72 ± 0.95	1.70 ± 0.49	$P < 0.05$
3	PEFR (L/S)	5.84 ± 1.82	3.78 ± 1.78	$P < 0.05$
4	FEV ₁ (L)	2.52 ± 0.62	1.34 ± 0.47	$P < 0.05$
5	FEV ₁ /FVC (%)	82.88 ± 8.85	72.56 ± 9.66	$P < 0.05$

Table 2: Comparison of various pulmonary function tests between smokers and non-smokers

PFT outcomes	Smokers	Non-smokers	Total
Obstructive	36 (15%)	5 (2.08%)	41(17.08%)
Restrictive	8(3.33%)	1(0.41%)	9(3.75%)
Mixed	4 (1.67%)	1(0.41%)	5(2.08%)
Normal	72 (30%)	113 (47.08%)	185 (77.08%)
Total	120 (50%)	120 (50%)	240 (100%)

Figure 1: Physical characteristics of smokers and non-smokers

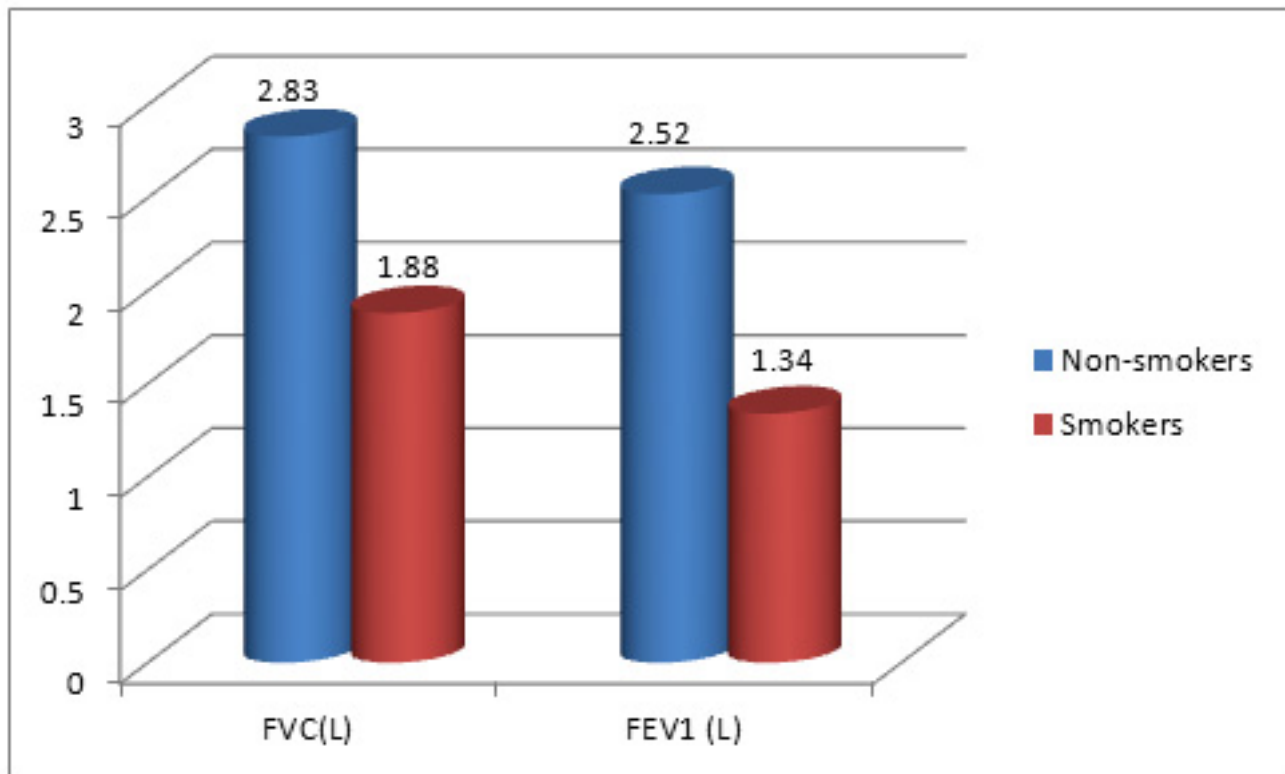


Figure 2: Comparison of variations in pulmonary function test (PFT) among smokers and non-smokers

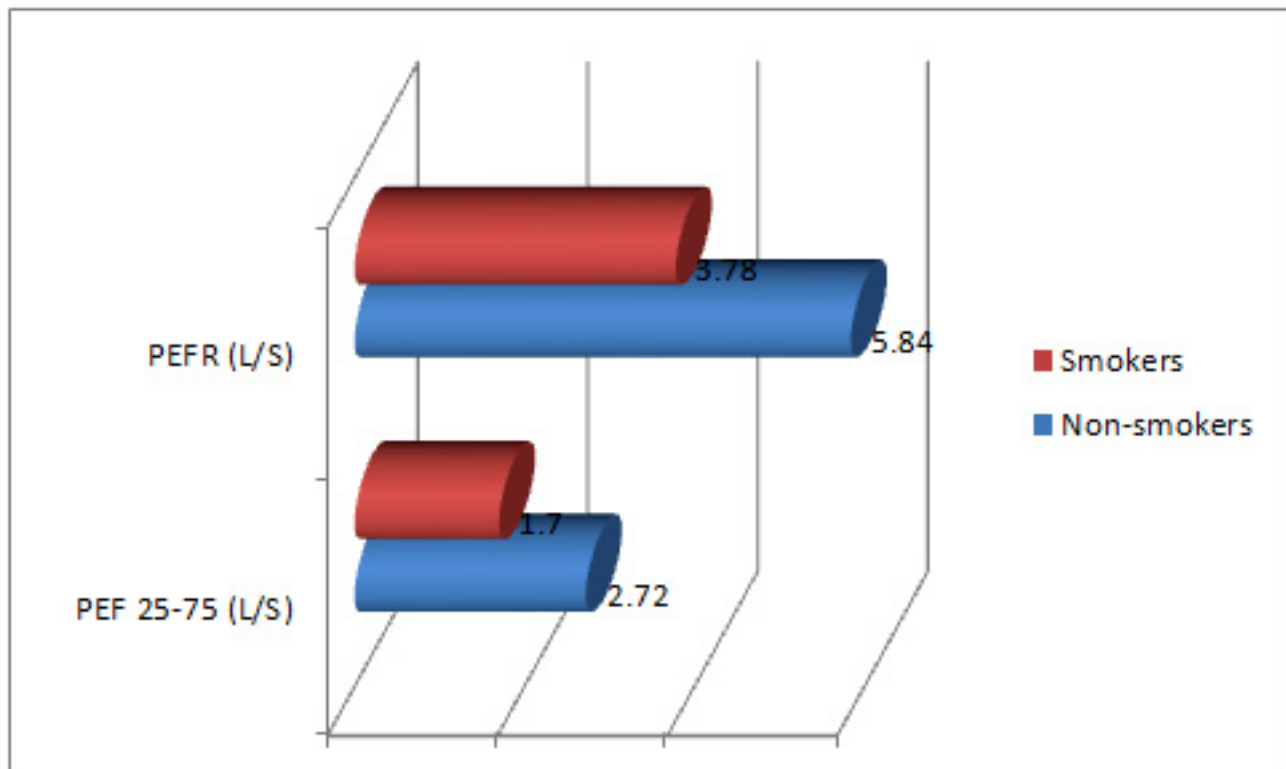
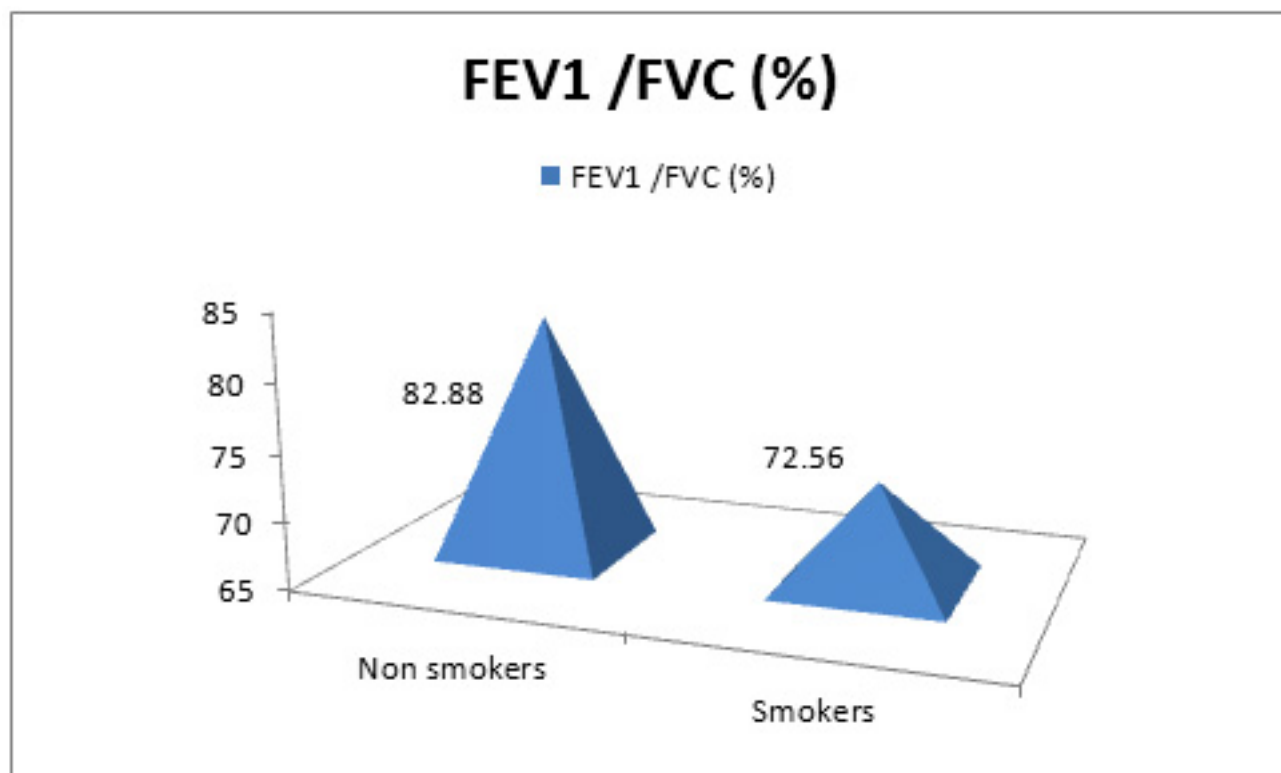


Figure 3: Comparison of FEV1/FVC (%) among smokers and non-smokers

Discussion

In recent days pulmonary function tests have become useful tools for respiratory physiology and evaluation of respiratory condition of the patient. They are also a part of routine health examination in respiratory medicine, exercise physiology and public health monitoring. FVC, PEFR, FEV1, FEV1/FVC ratio were the pulmonary function tests selected for the present study. In our study, all the Pulmonary Function Tests like FVC, FEV1, FEV/FVC, PEFR, FEF2575% showed a highly significant association between the smokers and the nonsmokers ($P < 0.05$). The number of cigarettes smoked per day among 120 smokers is 7 cigarettes per day. Duration of smoking among smokers was more than 5 years. In a similar study done by Gold and Rees it has been well stated that the acute effect of smoking on the airways was the decrease of air-way conductance (10, 11). In our study the tendency was the reduction in the values of PFT in smokers which showed similar trends to the study done by Wihelmensen and Tibblin (12). Smoking may directly induce an arterial endothelial injury and an increased platelet consumption may reflect the adherence or the deposition of these cells, to damage site, was suggested by Hind C.R. (13). Hani A et al conclude in their study of pulmonary function test among smokers and non-smokers that mean FVC, FEV1 and PEFR were higher in non-smokers in each age group and BMI was not significantly associated with most of the PFT values (14).

Conclusions

The results of the present study demonstrated the significant effect of smoking on PFTs especially those indicating large airways. There were also elevated respiratory ailments among smokers.

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