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Original Research Article

Evaluation of pulmonary function tests among smokers and non-smokers

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Abstract: Cigarettes kill an estimated 5 million people annually worldwide. The World Health Organization reported that tobacco smoking killed 100 million people worldwide in the 20th century and warned that it could kill one billion people around the world in the 21st century. Cigarette smoking is the leading preventable cause of mortality .By the early 2030, tobacco related death would increase to about 10 million a year. After inhalation of cigarette smoke, nicotine is quickly distributed to the brain, and it can affect the central nervous system instantaneously. Tobacco smoke contains 4000 chemicals, out of which 60 are known carcinogens, which can lead to lung cancer. Spirometry is the most common and widely used for the quantitative analysis of ventilatory dysfunction and is the classic pulmonary function test that measures the volume of air inspired and expired as a function of time. It is the simplest of all respiratory function tests.
Keywords: Smoking, Tobacco, Nicotine, Spirometry Chronic Obstructive Pulmonary Diseases (COPD)

INTRODUCTION

Cigarette smoking is the leading preventable cause of mortality. Smokers who quit smoking reduce their risk of developing and dying from tobacco-related diseases [1, 2]. Approximately 70 percent of smokers say that they want to quit, and over 50 percent of smokers report that they tried to quit in the past year [3, 4].

In India smoking is a common habit prevalent in both urban and rural areas irrespective of mode of smoking i.e. cigarettes, bidis, pipes, cigar, hookah etc. In India, tobacco is consumed mainly in the form of bidis (54%), followed by smokeless tobacco (27%) and cigarettes (9%) [5]. Bidi smoke may be more injurious because bidi contains unrefined form of tobacco as compared to cigarettes [6]. A bidi is also required to be puffed more frequently per minute to keep it burning. Smoking leads to rapid decline in pulmonary function tests (PFTs) [7]. Chronic Obstructive Pulmonary Diseases (COPD) has been recognized as one of the most important causes of morbidity and mortality in chronic tobacco smokers worldwide [8]. In COPD, small airways are less than 2mm in diameter. These obstructions in airways invariably affect the parameters of pulmonary function. E.g. Forced vital capacity (FVC) and Forced Expiratory Volume in the First Second (FEV1) [9]. Pulmonary function testing is a routine procedure for the assessment and monitoring of respiratory diseases [10]. Tests are also useful because they are less expensive, non-invasive, reproducible, and cause minimum discomfort for the subjects. Spirometric values vary according to age, height, sex, and body size [11, 12].

The pulmonary damage induced by smoking acts slowly and may show no symptoms until pulmonary functions are lost [13]. Smoking was one of the major risk factors for higher prevalence of bronchial asthma and allergic rhinitis[14]. Evaluation of pulmonary function is important in many clinical situations, both when the patient has a history or symptoms suggestive of lung disease and when risk factors for lung disease are present, such as occupational exposure to agents with known lung toxicity. The European Respiratory Society and the American Thoracic Society have published guidelines for the measurement and interpretation of pulmonary function tests (PFTs). The major types of pulmonary function tests (PFTs) are spirometry, spirometry before and after a bronchodilator, lung volumes, and quantitation of diffusing capacity for carbon monoxide.

EXPERIMENTAL SECTION/MATERIAL AND METHODS:

This is an observational prospective study done in the department of Chest and Tuberculosis, Government Medical College, Amritsar. This study was conducted after approval from the institutions ethical committee before the start of study. The present study was carried out on 100 smoker and 100 non-smoker subjects. The study group was amongst from general public including staff members, students and healthy attendant of the patients. The approval of institutional thesis and ethics committee was taken before the start of study. Participants who meet the inclusion criteria were recruited after giving information regarding the study in their vernacular language and written informed consent was obtained.

Inclusion Criteria:

1. Non-smoker: According to definition non-smoker is a person who does not smoke tobacco.
2. Smoker: They are persons who are engaged in the inhalation and exhalation of fumes of burning tobacco from cigarette, bidis, hookah etc. Every smoker must have been smoking at least five cigarettes a day.
3. Age 18-60 years.

Exclusion Criteria:

1. Females will be not included in the study.
2. Known case of bronchial asthma.
3. The person who are ill
4. The person with occupational history of working in textile mills and cement factory, Coalmines or other places where lungs are affected by dust or fumes.

Detailed clinical history was taken with special reference to smoking, habits, drug addiction occupation. In general physical examination the patient's height (cm), pulse rate (/min), B.P. (mmHg), SpO2 (%) and weight (kg) will be measured and recorded along with detailed clinical examination as per proforma attached. Spirometry recording was done between 9:00 am to 4:00 pm to avoid possible diurnal variation.

PROCEDURE OF SPIROMETRY:

Each participant was allowed to rest for about 5 minutes before the procedure. The details of procedure was explained and demonstrated to each participant. Following activities was avoided prior to procedure, as approved by American Thoracic Society.

- Smoking within 1 hour of procedure.
- Consuming alcohol within 4 hour of procedure.
- Performing vigorous exercise within 30 minutes of procedure.
- Wearing clothing that substantially restricts full chest and abdominal expansion.
- Eating a large meal within 2 hour of procedure.
- To obtain an accurate recording the participant will be told to :
- Sit up straight
- Wear nose clip
- Get a good seal around the mouth

The participant was asked to take deep inspiration while bearing the nose clip and then to exhale as forcefully and as fast as he can into the mouth piece of the device. All parameters were recorded. Manoeuvres will be repeated until at least three technically acceptable recordings (i.e. no coughs, air leaks, and false starts) are obtained. The results thus obtained were analyzed.

RESULTS AND DISCUSSION:

The present study was mainly constituted by old age subjects 51-60 years of age. The study included only male subjects.

Table-1: Comparison of mean spirometric values among smokers and non-smokers

Variables	Smokers (Mean±SD)	Non Smokers (Mean±SD)	T value	P value
FVC (L)	2.94±0.28	3.91±0.9	t=10.2912	The two-tailed P value is less than 0.0001
FEV1 (L)	1.86±0.5	3.37±0.54	t = 20.5181	The two-tailed P value is less than 0.0001
FEV1/FVC%	74.05±15.7	77.06±13.7	t=1.4445	The two-tailed P value equals 0.1502 (not statistically significant)
PEFR	366.25±94.8	613.5±32.7	t=24.6557	The two-tailed P value is less than 0.0001
$FEF_{25-75\%}$	61.7±11.61	203.5±36.5	t=37.0216	The two-tailed P value is less than 0.0001

Table 1 shows that there is statistical difference between mean Spirometric values FVC (L), FEV1 (L), PEFR, $FEF_{25-75\%}$) among smokers and non-smokers. The results have been calculated by applying unpaired T-square test.

Table-2:Comparison of spirometric outcomes among smokers and non-smokers (n=200)

Spirometric outcomes	Smokers (%)	Non-smokers (%)	Total no.
Obstructive	18(9%)	3(1.5%)	21(10.5%)
Restrictive	3(1.5%)	0	3(1.5%)
Mixed	1(0.5%)	0	1(0.5%)
Normal	78(39%)	97(48.5%)	175(87.5%)
Total	100(50%)	100(50%)	200(100%)

The table -2 shows that the spirometric results have been found to be more Obstructive in Smokers as compared to non-smokers. After applying the Sample T-square test, the t value is 6.78 and the p value is <0.01, hence it is highly significant. The interpretation of lung function relies on the comparison to reference values derived from a healthy population. The results of the current study have highlighted the importance of obtaining reference values and to develop prediction equations for these variables in our population. The mean values of FVC, FEV1, FEV1 / FVC %, PEFR and $FEF_{25-75\%}$ in sample population were 3.52, 2.56, 72.42, 461.63 and 126.47 respectively, comparable to those of other local studies.

The mean values of the spirometry variables were found with the difference in FVC were significantly higher in the younger age groups (less than 30 years). It was also observed that this difference in the mean values of FVC declined with subsequent increase in the age groups. This finding was in line with other international studies. These changes were in affirmation with the observations made in other studies and can be associated to normal. There was no significant difference in the mean physical parameters like age, height, weight, body mass index and body surface area, on calculating the mean and the standard deviation in the smokers and nonsmokers.

In our study, all the pulmonary function parameters like FVC, FEV1, PEFR, FEF2575% and MVV showed a highly significant association between the smokers and the nonsmokers ($p<0.001$) and this was similar to the observations on the impairment of the lung function in smokers, as was reported by Dhand *et al.;* Gosaviet aland Pandya *et al.;* Malo, Angelo and Indian workers like Mahajan *et al.;* [15].

Our study showed that in smokers 18 % were obstructive changes which were the most common, followed by the restrictive (3.0%) and the mixed (1%) changes. 98.0 % nonsmokers had normal PFT resultswhich was similar to the observations on the Pulmonary Function Test among Smokers and non-smokers reported by Sunita Nighute [16] and Abhijit Awari [17]. In our study most of the smokers were in the age group of 51-60years (55%). Majority of light smokers (7%) were in the age group 41-50 years, moderate smokers (57.69%) in 41-50 years and heavy smokers (55.22%) in 51-60 years. Similarly, Burrows *et al.;* [18] reported that there is quantitative significant relationship between impaired ventilatory function and duration and frequency of smoking.

In the present study out of total 200 study subjects 175 (87.5%) had normal lung functions, whereas 25 (12.5%) had impaired lung functions, out of which 21(91.3 %) were having obstructive features, 3 restrictive & 1 mixed. There results were similar to the observations Rubeena Bano, Mahagaonkar AM *et al.;* [19]. The association between smoking and impaired PFT was statistically highly significant. The smokers had 17.3 times more risk of having impaired pulmonary functions as compared to non-smokers.

The irritants present in the smoke cause release of elastase from alveolar macrophages that degrades structural elements of the lung which leads to loss of elastic recoil causing decrease in FVC%, FEV1%, PEFR in our present study. Cigarette smoking has varied and an extensive effect on respiratory function and it is one of the important etiologies for the number of respiratory diseases particularly chronic bronchitis, emphysema, COPD and bronchial carcinoma.

Studies have found that measures of body weight and fat were inversely related to the spirometric variables. Adiposity, especially of chest and abdomen was considered to restrict the normal movements of chest and diaphragm). Age was found to be necessary independent variable for all spirometric parameters. Spirometry is a frequently performed lung function test, and is an important tool in medical surveillance examinations of pulmonary diseases. The interpretation of lung function relies on the comparison to reference values derived from a healthy population. In the present study, there is a significant reduction in FEV1 value among the smokers compared to non-smokers. There was no statistically significant difference in the FVC and FEV1/FVC ratio among smokers and non-smokers.

In the present study, FEV1 was found to be significantly reduced in smokers. Cigarette smoking has extensive effect on respiratory functions and it has been clearly implicated in the aetiology of a number of respiratory diseases. Smoking may directly induce increased platelet consumption and may reflect the adherence or the deposition of these cells, to the damaged site as was suggested by Hind CR.

From the result, the FEV1, FVC and FEV1/ FVC ratio were noted. The mean difference in values for pulmonary function test for FEV1 was highly significant, while for the other parameters, viz. FVC and FEV1/ FVC ratio, the differences were not found to be statistically significant between smokers and non-smokers group on applying independent sample t test.

FEV1/FVC ratio was not found to be significantly different in this study as majority of smokers where in the old age group i.e. 50-60 years. This is not in accordance with studies done by Nwafleh HA *et al.;* [20]. These authors have found obstructive lung dysfunction to be a common finding in smokers.

SUMMARY AND CONCLUSION

A case study was conducted in the department of chest and tuberculosis, Govt. Medical College, Amritsar, where 200 subjects in which 100 smokers and 100 non-smokers were included and then comparative study between smokers and non-smokers on the basis of pulmonary function tests was performed.

We conclude that mean FVC, FEV1 and PEFR were higher in nonsmoker in each age group. Lung function changes from adolescence to old age. BMI was not significantly associated with the most of spirometric values. In order to generalize these reference values, a larger study following the ATS criteria is needed. As the demographic and anthropometric characters change with the passage of time, a larger study following the criteria set by ATS is required for this purpose.

Support for youths in this country is urgently needed. The smoking epidemic is so huge that every effort is needed to launch an effective campaign to protector people and maintain a good quality health life.

1. Majority of the cases 89 were in the age group of 51-60 years and minimum number of subjects i.e.10 in the age group of <20 .In the age group of 20-29 years, 40 subjects were present.
2. Only male subjects were included in our study because of predominance of smoking behaviour in male community in India.
3. Majority of subjects in our study have BMI in the normal range (18.5 kg/m^2 -22.9 kg/m^2). Only 4 subjects were obese having their BMI values above 25 kg/m^2.
4. Majority of the non-smokers subjects (97) in our study were normal spirometric values and only 3 non-smokers subjects were obstructive features.
5. In our study majority of the smoker subjects (78) were found to have normal spirometric values and among the rest there were 18(obstructive), 3(restrictive), 1(mixed).
6. Out of 100 smokers we studied 67 subjects were found to be heavy smokers, 26 subjects were moderate smokers and 7 were light smokers which was calculated on the basis of Smoking Index.
7. Smokers were found to be maximum in the age group 50-60 years as observed in our study (55/100).

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