ORIGINAL ARTICLE

Effect of Smoking and Obesity on Pulmonary Function Tests in Young Adults in Uttar Pradesh, India

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ABSTRACT

Introduction: Cigarette smoking is the leading known risk factor for the development of chronic obstructive pulmonary disease and also a major risk factor for cardiovascular disease. Obesity may have multiple effects on the pulmonary function that can be assessed by peak expiratory flow rate (PEFR) and vital capacity (VC). VC provides useful information about the strength of respiratory muscle and PEFR is a useful parameter to monitor airway obstruction. Both obstructions to the airflow and senile degenerative changes in the lungs together might play roles in decreased PEFR in smokers and obese.

Objectives: The objectives of the study were to correlate between smoking and obesity and VC and PEFR separately.

Materials and Methods: Data were collected from subjects of the age group 17–35 years of both smokers (n = 40) and nonsmokers (n = 40). Parameters measured were VC (using student's spirometer) and PEFR (using Wright's mini peak flow meter).

Result: There was a significant negative correlation between body mass index (BMI) and VC and BMI and PEFR. VC and PEFR were significantly higher in nonsmokers as compared to smokers.

Conclusion: Smoking and obesity adversely affect pulmonary function tests. This study data will help in the management of different types of obstructive pulmonary diseases.

Key words: Obesity, smoking, VC and PEFR

INTRODUCTION

Pulmonary functions are generally taken as the indices of respiratory muscle strength, compliance of the thoracic cavity, airway resistance, and elastic recoil of the lungs.

Out of the various lung function test parameters such as static (tidal volume, vital capacity (VC), reserve volumes, etc.) and dynamic (forced VC, forced expiratory volume in the first second, and peak expiratory flow rate [PEFR]), we have chosen VC and PEFR as they have been found to be reliable markers of lung function.

VC, the maximum amount of air a person can expire after deep inspiration, is higher in male than female due to the large chest wall and more respiratory muscle power in male. VC decreases in old age due to loss of elasticity of lungs, is higher in swimmers and divers, in standing position, and decreases during pregnancy. Pathologically, VC decreases in diseases of respiratory apparatus (i.e., poliomyelitis, pulmonary fibrosis, respiratory obstruction, pleural effusion, pulmonary edema, pneumothorax, ascites, etc.).[1]

PEFR is the maximum velocity (liters/min) with which air is forced out of the lungs in a single forced expiratory effort. It is clinically useful for the differentiation of obstructive and restrictive lung disease.

Both these tests are affected by factors such as sex, body surface area, obesity, physical activity, posture, and environmental and racial differences.[1]

Obesity is one of the most important parameters affecting pulmonary function tests (PFT). Weight may affect PFT as it is related to small airway dysfunction and expiratory flow limitation, alterations in respiratory mechanics, decreased chest wall and lung compliance, decreased respiratory muscle strength and endurance, decreased pulmonary gas exchange, lower control of breathing, and limitations in exercise capacity.[2-5]

Cigarette smoking is a well-known cause of the derangement of lung function and is the fourth most common cause of death worldwide.[6,7] Cigarette smokers have a number of structural abnormalities,

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ISSN 2320-138X

including mucus plugs, accumulation of pigment laden macrophages, goblet and squamous cells metaplasia, ulceration, inflammatory cell infiltrate, smooth muscle hypertrophy, fibrosis, and excessive pigments.[8] The lung functions of cigarette smokers showed an accelerated decline when compared to nonsmokers.[9] PEFR was significantly lower in smokers than nonsmokers[10-14] and some studies found a maximum reduction in PEFR was in *bidi* smokers than cigarette smokers.[13] If people stop smoking, PEFR improves with the passage of time.[8]

We aim to assess the effects of smoking and obesity in the respiratory system. For this, we have measured VC and PEFR, as they have been found to be reliable, quick, and easy tools for assessment of static as well as dynamic lung function tests.

MATERIALS AND METHODS

The present study was conducted among 80 adult male subjects who include 40 smokers and 40 nonsmokers from the Moradabad area, Uttar Pradesh, India. Smokers were the subjects that were engaged in fumes of burning tobacco in cigarettes of at least five sticks per day for at least 2 years (equivalent to a minimum of 0.5 pack-years). All smoker subjects were continuing to smoke at the time of the study. All the subjects were apparently healthy as per brief history and general clinical examination. Except for smoking, no other substance abuse was present in them. There was no history of documented familial respiratory disease (such as cystic fibrosis and alpha 1 antitrypsin deficiency).

The main objectives of the research were explained to the participants and consent was taken before recording the parameters. Five subjects were taken for recording per day from 11:00 am to 2:00 pm to avoid diurnal variations. The PFT recordings were taken in a comfortable standing position. Each was recorded at least 3 times, each 2 min apart, and the maximum value was taken. Recording of the episode of wheeze, coughing, or leakage was excluded from the study. The following parameters were measured.

VC

A student's spirometer was used for the recording of VC. The mouthpiece of a spirometer was placed firmly in the mouth of the subject, nostrils closed by nose-clip, and the subject was asked to inspire deeply followed by expire comfortably and fully till he was unable to expire anymore through the mouthpiece and note the recording.

PEFR

Wright's mini peak flow meter was used for the recording of PEFR. The subject was instructed to take a full deep breath, which was followed by the maximum forceful blow of expiration through the mouthpiece and note the recording.

Each individual's weight (by weighing machine) and height (by stadiometer) were taken to measure body mass index.

Statistical Analysis

Data analysis was done using independent student *t*-test to compare the mean values between smokers and nonsmokers.

RESULTS

Forty smokers and forty healthy controls were selected for the study. All subjects were males within the age of 17–35 years. All demographic and cardiorespiratory vital parameters (age, height, weight, pulse rate, mean arterial pressure, and respiratory rate) were comparable in the smoker and nonsmoker group.

Measured PFT parameters were averaged and compared in two groups [Table 1 and Figure 1]. VC ($t = 10.41$, $P < 0.01$) and PEFR ($t = 6.819$, $P < 0.01$) were significantly higher in nonsmokers as compare to smokers.

All data were found to be normally distributed, and so Pearson's correlation coefficient was used to correlate the obesity with VC and PEFR. Differences were considered significant at $P < 0.01$ level. We found a significant negative correlation between body mass index (BMI) and VC ($r = -0.383$, $P < 0.01$; Figure 2) and BMI and PEFR ($r = -0.514$, $P < 0.01$; Figure 3).

DISCUSSION

This study is a cross-sectional analysis of PFT in smokers compared to nonsmokers. It also correlates those parameters with the level of obesity.

Association of BMI and VC and PEFR in Smoker and Nonsmoker

In the present study, VC was significantly higher in nonsmoker as compared to a smoker ($t = 10.41$, $P < 0.01$; Table 1 and Figure 1), similarly, PEFR was significantly higher in nonsmokers as compare to smokers ($t = 6.819$, $P < 0.01$; Table 1 and Figure 1).

Table 1: Comparison of mean VC and PEFR in smokers and nonsmokers

	Smokers (mean±SD) (*n*=40)	Nonsmokers (mean±SD) (*n*=40)	*t* value	*P* value
VC	2495.83±187.22	3523.91±568.30	10.409	<0.01
PEFR	278.361±29.16	361.54±68.41	6.819	<0.01

PEFR: Peak expiratory flow rate, VC: Vital capacity

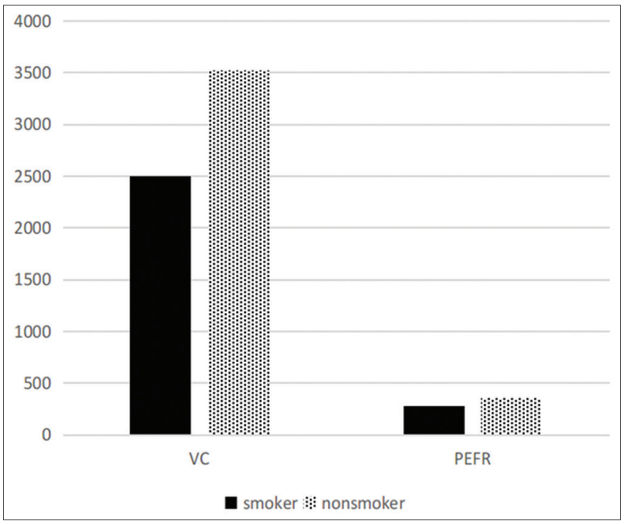

Figure 1: Comparison of mean vital capacity and peak expiratory flow rate in smokers and nonsmokers

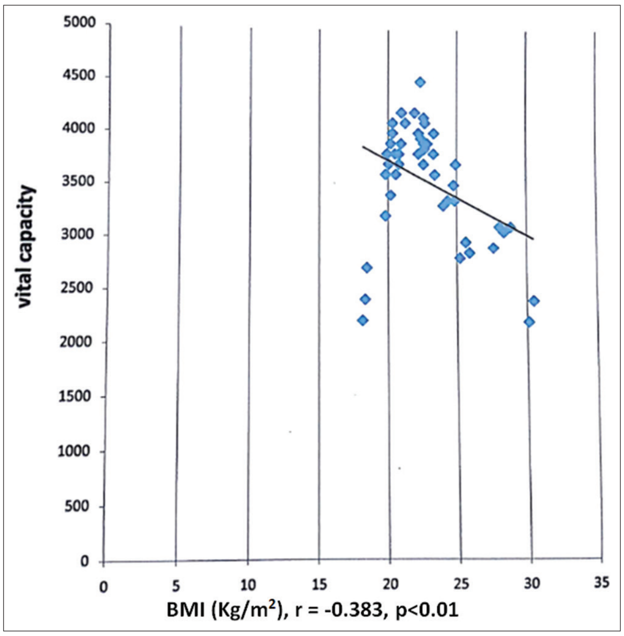

Figure 2: Correlation coefficient between body mass index and vital capacity

In the previous study, it was found that PEFR and VC decreased significantly in the smoker and similar findings are in agreement with the finding of others.[10-14] One possible reason for the decrease in PEFR could be inflammation which is common and constant pathological findings in cigarette smokers.[15] Earlier studies have reported that airway flow limitation occurs due to bronchial constriction caused by mediators of inflammation.[16] A study conducted in Japan showed that PEFR and VC were lower in smokers than in nonsmokers, suggesting that the lung function was significantly reduced in smokers.[17,18] Similar findings were observed in other studies also.[13,19,20]

Correlation between BMI and VC and PEFR

This cross-sectional descriptive study was conducted among 80 subjects (40 smokers and 40 nonsmokers)

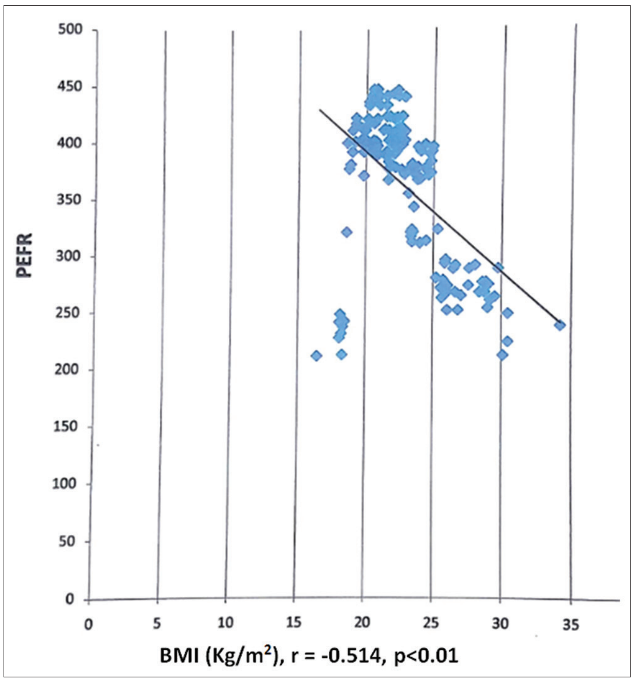

Figure 3: Correlation coefficient between body mass index and peak expiratory flow rate

age group 17–35 years from the Moradabad area, Uttar Pradesh, India. A significant negative correlation between BMI and PFT parameters were found, such as VC ($r = -0.383$, $P < 0.01$; Figure 2) and PEFR ($r = -0.514$, $P < 0.01$; Figure3). This shows that as obesity increases, the pulmonary function gets compromised.

In the previous study conducted in Riyadh, Saudi Arabia found a similar result. The obese subjects had lower VC and PEFR value than non-obese subjects; total respiratory resistance and airway resistance increases with obesity.[21] Similarly, Jones and Nzekwu studied PFT had found a significant inverse relationship between BMI and the value of VC and PEFR.[17]

Thus, smoking and obesity adversely affect lung function tests such as VC and PEFR. Hence, the management of conditions such as chronic obstructive pulmonary disease should also encompass lifestyle modifications such as cessation of smoking and weight reduction.

CONCLUSION

Smoking and obesity adversely affect lung function tests such as VC and PEFR. Hence, the management of conditions such as chronic obstructive pulmonary disease should also encompass lifestyle modifications such as cessation of smoking and weight reduction.

ACKNOWLEDGMENTS

We wish to express gratefulness to all the subjects for giving the valuable time for data collection. We also like to extend our gratitude to Teerthanker Mahaveer Medical College and Research Center (Moradabad, UP, India) for allowing us to conduct this research.

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