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Original Research Article

Comparative Study on Pulmonary Function Tests in Smokers and Nonsmokers

Munna Kumar Saw[1], Vishwajit Kumar[2], Bijay Krishna Prasad

[1]JR-3, Department of Physiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar
[2]Tutor, Department of Physiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar
[3]Professor and Head of Department, Department of Physiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar

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Corresponding Author: Dr. Vishwajit Kumar
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Abstract:

Background: Compared to non-smokers, smokers have a higher risk of developing chronic obstructive pulmonary disease (COPD). The conditions known as chronic obstructive pulmonary diseases (COPD) include emphysema, bronchial asthma, and chronic bronchitis. A standard approach for evaluating and tracking illnesses is the pulmonary function test. The purpose of this is to estimate the pulmonary function tests, such as the Peak Expiratory Flow Rate (PEFR), Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), and the ratio of FEV1 to FVC in smokers and non-smokers. Additionally to investigate how these individuals' lung function is affected by their age and body mass index (BMI).

Methods: This cross-sectional study was carried out from July 2022 to December 2022 at ANMCH in Gaya, Bihar. A total of 121 participants were chosen, 60 of whom were smokers and 61 of whom were not. Tests for spirometry were used to evaluate lung function.

Result: It was discovered that smokers' mean FVC, FEV1, and PEFR were lower than those of non-smokers. The mean spirometric values of smokers and non-smokers differed significantly.

Conclusion: Spirometry is helpful in the early detection of abnormalities in persons who do not smoke or who smoke but are asymptomatic. PFTs should be carried out as soon as possible in smokers in order to identify reduced lung capacities and airflow restrictions.

Keywords: Smokers, Non-smokers, pulmonary function test, spirometry.

Introduction

According to the World Health Organization (WHO), smoking caused the deaths of 100 million people globally in the 20th century and warned that it may cause the deaths of one billion people in the 21st. [1] The number of tobacco-related deaths annually would rise to almost 10 million by the early 2030s. Smoking is a common practice in India, whether one smokes cigarettes, bidis, pipes, cigars, hookahs, or anything else. It is observed in both urban and rural areas.

One of the biggest risk factors for a wide range of cardiovascular and respiratory conditions is still tobacco use. [2] Lung cancer can result from the 400 compounds in tobacco smoke, 60 of which are recognized carcinogens. Pulmonary function tests rapidly diminish when a smoker (PFTs).

The single biggest risk factor that contributes to the development of COPD is smoking. One of the main causes of morbidity and death among long-term tobacco users is chronic obstructive pulmonary disease, or COPD. Small airways in COPD have a diameter of less than 2 mm. The indices of pulmonary function are inevitably impacted by these blockages in the airways. For instance, forced expiratory volume in the first second (FEV1) and forced vital capacity (FVC). Cigarette smokers often experience a significant annual rate of reduction in FEV1 of approximately 50 ml, which is nearly twice the average value of 30 ml observed in nonsmokers annually. [3]

Testing one's pulmonary function is a standard practice for diagnosing and tracking respiratory conditions. Additionally helpful are the tests' lower costs, noninvasive nature, reproducibility, and little uncomfortable effects on the participants. Spirometric measurements differ based on body size, sex, age, and height.

As a result, smoking cigarettes has a significant impact on respiratory function, which a pulmonary function test can identify. Comparing the lung

function of smokers versus non-smokers was the study's main objective.

Material and Method

From July 2022 to December 2022, a cross-sectional study was carried out in the physiology department of Anugrah Narayan Magadh Medical College in Gaya, Bihar. 121 people knowingly and freely consented in writing to take part in the study. Students and staff were chosen as subjects, and smokers and non-smokers were tested using a questionnaire. There were 61 nonsmokers and 60 smokers.

A structured questionnaire asked about smoking behaviors, including how many cigarettes a day, when it started, how long it lasted, and personal information about age, gender, and work. Measurements used in anthropometry as A conventional weighing machine was used to measure weight, a stadiometer was used to measure height, and the Quetelet index was used to compute body mass index (BMI).

The National Institutes of Health has guidelines that divide weight status into four categories: underweight (BMI 18.5), normal weight (BMI between 18.5 and 24.9), overweight (BMI between 25 and 29.9), and obese (BMI ≥ 30). [4]

The individuals' pulmonary function was evaluated using a series of spirometric tests, including forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV1/FVC, FVC%, and peak expiratory flow rate (PEFR), which were conducted using a digital computerized spirometer.

Prior to conducting the spirometry, the subjects were given an explanation and demonstration of the process. A stadiometer was used to measure each subject's standing height, and a conventional weighing machine was used to get their weight when they were wearing light clothing and were barefoot. The study was carried out between 10 and 11 a.m. in the physiology department of ANMMC, Gaya, Bihar, following a modest meal. To measure and estimate the pulmonary parameters, the individual inhaled as deeply as possible and exhaled as quickly and forcefully as feasible. Every person tried three times, and the highest value for every parameter was noted. [5]

Results

Table 1 presents the mean age of 34.85±12.84 years for 60 smokers and 36.21±9.40 years for non-smokers. The majority of them were men. Table 3 shows that the percentage of smokers (49.58%) and non-smokers (50.41%) as well as their mean height, weight, and BMI were, respectively, 159.68±6.87, 54.13±7.93, 21.25±2.82 & 163.52±7.50, 57.14±7.50, and 21.29±2.43. Additionally, for smokers and non-smokers, the mean spirometric values of FVC, FEV1, FEV1/FVC, and PEFR were 1.8±0.44, 1.66±0.46, 89.35±10.63, and 4.48±1.71 & 2.93±0.56, 2.60±0.48, 84.98±7.58, and 7.06±1.67, respectively. All data were analyzed statistically.

Table 1: Characters of study subjects (121) (Mean values ± SD)

Variable		No. of subjects	Percentage
Age (years)	<20	12	9.91%
	20-29	27	22.31%
	30-39	29	23.96%
	40-60	53	43.8%
Smokers		60	49.58%
Non-smokers		61	50.41%

BMI for underweight, normal weight, and overweight is displayed in Table 2, along with their respective percentages, numbers, and spirometric characteristics for the smokers and non-smokers groups.

Table 2: BMI Concerning

				FVC	FEV_1	FEV_1/FVC	PEFR
BMI	Underweight<18.5	22	18.18%	2.37±0.72	2.37±0.64	94.35±6.06	6.00±1.86
	Normal – 18.5-24.9	90	74.38%	2.39±0.76	2.07±0.68	88.63±9.10	5.58±2.11
	Overweight – 25-29.9	9	7.43%	2.11±0.16	2.36±0.44	88.72±6.24	6.40±2.44
	Obesity ≥30	0					

Table 3 demonstrates that there is a statistically significant difference in the mean spirometric values of FVC, FEV1, FEV1/FVC, and PEFR between smokers and non-smokers, and those non-smokers have higher mean spirometric parameters like FVC, FEV1, and PEFR than smokers. Spirometric analysis yielded a significant result ($P<0.05$).

Table 3: Statistical difference between mean spirometric values FVC, FEV1, FEV1/FVC and PEFR between smokers and non-smokers

Variables	Smokers (Mean±SD)	Non-Smokers (Mean±SD)	P-value
FVC(L)	1.8±0.44	2.93±0.56	<0.05
FEV1(L)	1.66±0.46	2.60±0.48	<0.05
FEV1/FVC%	84.98±7.58	89.35±10.63	<0.05
PEFR(L)	4.48±1.71	7.06±1.67	<0.05
BMI	21.25±2.82	21.29±2.43	
Height	159.68±6.87	163.52±7.50	
Weight	54.13±7.93	57.14±7.50	
Age	34.85±12.84	36.21±9.40	

Discussion

The number of smokers is continuously rising around the world despite widespread media coverage of the negative effects of tobacco, laws and policies designed to discourage smoking, and copious amounts of research highlighting the health risks associated with second-hand smoke (SHS) exposure among adults who do not smoke. [6,7,8] Smoking cigarettes causes inflammatory alterations in the small airways, particularly the respiratory bronchioles. Emphysema is the resultant dilation and destruction of small airways. [9] Smoking-related lung damage develops gradually and may not cause symptoms until lung functions are impaired.[10]
Adolescent smokers and those exposed to second-hand smoke have lower lung function measures, and both groups are more likely to experience respiratory issues such coughing, phlegm, asthma, and wheezing. [11,12]

As a component of PFTs, spirometry is a crucial technique for examining and tracking overall respiratory health. Spirometric tests are helpful in determining the degree of airway obstruction as well as in determining how well the pulmonary system is functioning and analyzing the effects of different treatment plans. As the highest level of lung function attained in early adulthood, FEV1 is determined at any given time in adulthood by three factors: smoking, the rate at which lung function declines, and the beginning of the decline in lung function. Cigarette smoking has an impact on all three of these factors. When a person ages and accumulates more pack years of smoking, the effects of smoking on lung function become more noticeable. The greatest FEV1 reduction is observed in current smokers. It is lowest in nonsmokers and moderate in ex-smokers. [13]

In Abhishek Biswas study, smokers' FVC and FEV1 levels were lower than those of non-smokers'. [14] In a research between smokers and nonsmokers in a rural region, Rubeena et al. found that smokers with low to moderate nicotine dependency had lower PFT levels. [15] Similar results were observed in this investigation. According to Vaidya et al. [16], ex-smokers had PFT values that were lower than those of non-smokers but still better than those of smokers, indicating a lower pulmonary function parameter in smokers compared to nonsmokers. Compared to non-smokers, cigarette smokers had a higher annual rate of decline in FEV1, a higher incidence of respiratory symptoms and anomalies in lung function, and a higher death rate from COPD. [17]

Quitting smoking decreases the forced expiratory volume fall in a single second, suggesting a favorable impact on significant inflammatory and/or re-modelling processes. [18] In order to keep smokers' pulmonary function from further declining, quitting should be promoted.

Conclusion

Significant harm is done to the pulmonary functioning by cigarette smoking. Smokers have negative effects on almost all lung function indices long before COPD and other smoking-related problems manifest. In order to promote quitting smoking and reduce morbidity, adult smokers should have specific pulmonary functions performed on them.

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