Original Research Article

Association of BMI and pulmonary function test among adults: A cross-sectional study

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Abstract

Background: Body mass index (BMI) is a common measure of overweight and obesity, and also indicators of body size, so they are associated with lung function parameters. The pulmonary function test is the most basic test method to diagnosis lung disease. **Objective:** To study the association of BMI and pulmonary function. **Material and Methods:** The present cross sectional prospective study conducted in Physiology Department among 100 volunteers in age group 18-22 years. Subjects with respiratory disorders like COPD, restrictive lung diseases, bronchial Asthma, cardiovascular Diseases and history of smoking were excluded from the study. The study was approved by the Ethical Committee of the Medical College. The data included demographic profile of subjects, anthropometry and PFT. The data thus obtained was tabulated and subjected to statistical analysis. **Results:** The lung function tests FEV1, FVC, PEF and FEF 25–75% was significantly less in females compared to males. ($P<0.05$) Obese subjects showed negative correlation of BMI with FEV1, FVC, PEF and FEF 25–75 with statistical significance. ($P<0.05$) **Conclusion:** BMI had an inverse relationship with FVC, FEV1 and PEF in obese subjects only.

Key Word: BMI, Pulmonary Function test, Cross sectional.

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INTRODUCTION

Obesity is a global threat and has been associated with numerous metabolic complications such as dyslipidemia, type 2 diabetes mellitus and cardiovascular disease.[1] The causes of childhood and adolescent obesity are many, including the lack of regular exercise, sedentary habits, excessive consumption of high-calorie foods and genetic factors of life, perinatal and early are included. [2] The effects of obesity on parameters of lung function are influenced by the quantity and distribution of body fat. [3,4] Body mass index (BMI) and waist circumference (WC) are common measures of overweight and obesity, and also indicators of body size, so they are associated with lung function parameters as a forced expiratory volume in a second (FEV1) and forced vital capacity (FVC).[5] However, it is an ignored fact that obese people have an increased risk of respiratory symptoms. They often feel short of breath, especially during physical activity, even if they have no lung disease. [6,7] To study the effect of obesity in the respiratory system, many researchers use pulmonary function test (PFT) values. Obesity has a clear potential to have a direct effect on respiratory well-being because it increases the consumption of oxygen and carbon dioxide production, while at the same time it hardens the respiratory system and increases the mechanical work necessary for breathing.[3,4] Considering this background we did this study to study association of BMI with pulmonary function in young adults.

OBJECTIVES

- To study the association of BMI and pulmonary function
- To study and compare the association of pulmonary function with the normal and obese adolescent.

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MATERIALS AND METHODS

The present study was a cross sectional prospective study undertaken to study the association of BMI and pulmonary function. The study was conducted from September 2018 to February 2019 in Physiology Department**,** Great Eastern Medical School and Hospital, Srikakulam. The study population was volunteers in age group 18-22 years. A total of 100 subjects in age group 18 to 22 years selected with Simple Random Sampling and who had given written consent were included into study. Subjects with respiratory disorders like COPD, restrictive lung diseases, bronchial Asthma, cardiovascular Diseases and history of smoking were excluded from the study. The study was approved by the Ethical Committee of the Medical College. The data included demographic profile of subjects, anthropometry and PFT. The pulmonary function tests were carried out by the team of technicians according to the recommended standard. Force expiratory volume in first second (FEV1), force vital capacity (FVC), FEV1/FVC, peak expiratory flow (PEF), and forced expiratory flow at 25–75% (FEF25–75) were measured by portable computerized Spirometer. Depending on the BMI values, the subjects were classified into obese (BMI >25 kg/m^2) and non obese (BMI ≤25 kg/m^2) according to WHO classification system.[1]The selected subjects were explained about the procedure of the test and its importance. After the subjects had attained near perfection in performing the procedure the pulmonary function test data was recorded by using computerized spirometer, following a standard protocol. The subjects were instructed on the previous day of the test, to have a light breakfast on the morning of the test. The test was performed after 1-2 hours following breakfast that was between 10:00-11:00 AM. The data thus obtained was tabulated and subjected to statistical analysis. There are no risk factors for the subjects involved in the study. Descriptive data were presented as Mean, Standard Deviation and Range values. Pearson's correlation coefficient was used to measure the relationship between the measurements. Ap-value of 0.05 or less was considered for statistical significance.

RESULTS

Table 1: Showing basic characteristics of subjects

Characteristics		Mean(±SD) / percentage
Mean Age (Years)		18.45 ±0.56
Gender (n=100)	Male	41
	Female	59
Height (Cms)		161.94 ±8.76
Weight (Kg)		63.32 ±12.99
BMI (Kg/m^2)		24.03± 3.91

The mean age of subjects in the study was 18.45 ±0.56 with slight female majority with 59%. The mean height, weight and BMI among subject was 161.94 ±8.76 cm, 63.32 ±12.99 kg and 24.03± 3.91 (Kg/m^2) respectively. (Table 1)

Table 2: Comparison of lung function test between male and female

Variables	Male	Female	P value
FEV1	2.59 ± 0.47	2.04 ± 0.35	<0.001*
FVC	3.01 ± 0.58	2.35 ± 0.42	<0.001*
FEV1/FVC	0.86 ± 0.09	0.88 ± 0.19	0.53
PEF	4.22 ± 1.61	3.12 ± 0.69	<0.001*
FEF$_{(25–75)}$	2.96 ± 0.83	2.02 ± 0.67	<0.001*

*P<0.05 statistically significant

The tale no 2 shows comparison of lung function tests between male and female subjects. It was observed that FEV1, FVC, PEF and FEF $_{25–75}$ was significantly less in females compared to males. (P<0.05)

Table 3: Correlation of lung function test with BMI in non-obese and obese subjects

Variables		Pearson correlation (r)	P value
Non-obese	FEV1	-0.074	0.55
	FVC	-0.086	0.49
	FEV1/FVC	0.051	0.68
	PEF	0.105	0.40
	FEF$_{(25–75)}$	0.048	0.71
Obese	FEV1	-0.565	<0.001*
	FVC	-0.506	<0.001*
	FEV1/FVC	0.198	0.26
	PEF	-0.381	0.02*
	FEF$_{(25–75)}$	-0.351	0.03*

*P<0.05 statistically significant

There was no correlation of lung function test with BMI in non-obese subjects. In obese subjects correlation of BMI with FEV1, FVC, PEF and FEF 25–75 showed negative correlation with statistical significance. (P<0.05)

Table 4: Correlation of lung function test with BMI in obese male and female subjects

Variables (%)		Pearson correlation (r)	P value
Male	FEV1	-0.492	<0.001*
	FVC	-0.471	<0.001*
	FEV1/FVC	0.203	0.31
	PEF	-0.403	0.03*
	$FEF_{(25-75)}$	-0.321	0.04*
Female	FEV1	-0.518	<0.001*
	FVC	-0.516	<0.001*
	FEV1/FVC	0.211	0.37
	PEF	-0.379	0.03*
	$FEF_{(25-75)}$	-0.343	0.04*

(*P<0.05 statistically significant)

In obese male and female subjects correlation of BMI with FEV1, FVC, PEF and $FEF_{25-75\%}$ showed negative correlation with statistical significance. (P<0.05) But no significant correlation was found related to FEV1/FVC among male and female subjects.

DISCUSSION

The present study was a cross sectional prospective study undertaken to study the association of BMI and pulmonary function. A total of 100 subjects in age group 18 to 22 years who gave written consent were included into study. The mean age of subjects in the study was 18.45 ±0.56 years. The majority of subjects were females (59%). Out of 100 subjects 34% were obese. The comparison of lung function tests between male and female subjects. It was observed that FEV1, FVC, PEF and $FEF_{25-75\%}$ was significantly less in females compared to males. (P<0.05) Similar findings were observed in study done by Shengyu Wang *et al*[8] were FEV1, FVC, PEF, and FEF25–75 was significantly higher in males than in females. However, FEV1/FVC was significantly lower in males than in females. The findings were in contrast with study by Joyashree Banerjee *et al*[9] where females had higher FEV1, FVC, PEF, and FEF25–75 compared to males. In the present study, there was no correlation of lung function test with BMI in non-obese subjects. However among obese subjects correlation of BMI with FEV1, FVC, PEF and $FEF_{25-75\%}$ showed negative correlation with statistical significance. (P<0.05) Similar findings were seen in various studies by Sin DD *et al*[10], Biring MS *et al*[11] and Joyashree Banerjee *et al*[9]where BMI showed negative correlation with FEV1, FVC, PEF and $FEF_{25-75\%}$ with statistical significance. But Andrew J *et al*[12]did not find any association between BMI and FEV1. In obese male and female subjects correlation of BMI with FEV1, FVC, PEF and $FEF_{25-75\%}$ showed negative correlation with statistical significance. (P<0.05) But no significant correlation was found related to FEV1/FVC among male and female subjects. (P>0.05) In study done by McLachlan CR *et al*[13]female subjects showed negative correlation of BMI with FEV1/FVC ratio, while males showed no significant correlation. Obesity could alter lung function through different mechanisms. Obese people have a greater demand for ventilation and respiratory workload, respiratory muscular inefficiency, reduced functional reserve capacity and expiratory reserve volume, and closure of peripheral lung units. [14] This often results in a mismatch of ventilation -fusion (V / Q), especially in the supine position. Obesity is a classic cause of alveolar hypoventilation. Obesity also affects the reflexes of the upper respiratory tract, pulmonary mechanics and can influence central respiratory control. It negatively affects the mechanics of the chest wall, reduces CRF and ERV and causes a decrease in total respiratory capacity due to the deposition of subcutaneous adipose tissue. There is also a decrease in pulmonary compliance due to increased pulmonary blood volume. Respiratory muscle function can also be influenced by obesity due to the mechanical disadvantage induced by changes in the configuration of the chest wall, fat deposition and increased energy expenditure to expand the lungs and an increase in intra-abdominal fat tissue interferes with the mechanical properties of the chest. The wall causes a decrease in compliance and prevents the complete excursion of the diaphragm. There are also effects of obesity on the tone of the upper airways and, therefore, on resistance, which adds a mechanical load that increases respiratory work. The pathological obesity can also induce a restrictive alteration of the respiratory function, correlated to the reduced compliance of the chest wall and the lung parenchyma.[14] In conclusion, the results of present study showed that increase in BMI had an inverse relationship with FVC, FEV1 and PEF in obese subjects only. Thus it

is evident from the present study that obesity significantly affects the pulmonary functions which may give rise to long term complications.

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