

Original Research Article

A Study of Effect of Gender and BMI on Pulmonary Function Tests in Young Individuals of Gujarat

Dr. Harsida Gosai^{1*}, Dr. Anita Verma²

¹Ph.D Scholar, Gujarat University, Tutor, Department of Physiology, Narendra Modi Medical College, Ahmedabad

²Ph.D Guide, Gujarat University, Prof & Head of Department, Department of Physiology, Smt NHL Municipal Medical College, Ahmedabad

***Corresponding Author:** Dr. Harsida Gosai

Ph.D Scholar, Gujarat University, Tutor, Department of Physiology, Narendra Modi Medical College, Ahmedabad

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Abstract: *Introduction:* Pulmonary function tests (PFTs) are critical tools in evaluating respiratory health by measuring lung capacity, airflow, and overall pulmonary performance. These tests provide insights into various respiratory disorders and help assess the impact of different physiological and environmental factors on lung function. Among the numerous factors influencing pulmonary function, body mass index (BMI) has emerged as a significant determinant. *Methods:* A Cross-sectional study was done at Department of Physiology NMMC Ahmedabad. The selection of samples based on their body weight. The present study included 120 participants (60 males and 60 females). All participants aged 18-20 years who are apparently healthy. Male and female according to BMI categorized into two groups, i.e., BMI < 25 and BMI > 25. *Results:* Respiratory parameters such as FVC, FEV1, FEV1/FVC, and PEFR are found to be significantly lower in female participants in comparison to male participants as shown in Table 1. The correlation of different pulmonary function parameters with BMI of the male and female participants are presented in Tables 2 and 3. It is observed that respiratory parameters such as FVC, FEV1, FEV1/FVC, and PEFR of both male and female participants correlated positively with BMI < 25 but there were substantial lung function losses with increasing BMI > 25, i.e., PFTs were negatively correlated. *Conclusion:* Obesity influences the respiratory function enhancing dyspnoea and increasing both cardiac load and respiratory muscle fatigue of the thoracic wall and the diaphragm due to the higher pressure exerted by intraabdominal adipose accumulation. In our study the results showed that increase in BMI had an inverse relationship with FVC, FEV1 and PEFR in obese when compared to the normal weight subjects.

Keywords: Exercise, Pulmonary Function Test, Body Mass Index.

INTRODUCTION

Pulmonary function tests (PFTs) are critical tools in evaluating respiratory health by measuring lung capacity, airflow, and overall pulmonary performance. These tests provide insights into various respiratory disorders and help assess the impact of different physiological and environmental factors on lung function [1]. Among the numerous factors influencing pulmonary function, body mass index (BMI) has emerged as a significant determinant. BMI, a measure of body fat based on height and weight, is a widely used indicator to classify individuals as underweight, normal weight, overweight, or obese. An abnormal BMI, whether low or high, has been associated with alterations in lung mechanics, chest wall compliance, and respiratory muscle strength. Overweight and obesity, in particular, are linked to restrictive ventilatory patterns due to increased fat deposition on the chest wall and abdomen [2], which may limit diaphragmatic movement. Conversely, underweight individuals may experience compromised respiratory function due to reduced muscle mass and weakened respiratory muscles. Young individuals represent a crucial population for studying the effect of BMI on pulmonary function, as this age group is at a stage of optimal lung development and function. Understanding how BMI influences PFTs in this demographic is essential for early identification of potential respiratory risks, especially given the rising prevalence of obesity and sedentary lifestyles globally. The lungs, with their greater surface area, are directly open

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to the external environment and are heavily influenced by epidemiological, environmental and occupational factors. Pulmonary function testing has been a major step forward in assessing the functional status of the lungs. In conjunction with the clinical assessment and other investigations, they can be used for establishing diagnosis, indicating severity of the disease and also in assessing the prognosis [3]. Exercise represents a state of physical exertion of the body and it is associated with extensive alterations in the circulatory and respiratory systems. The cardiovascular and respiratory mechanisms operate in an integrated fashion to meet the oxygen demands of the tissues during exercise. Measurement of pulmonary functions after exercise could provide useful information about the functional reserve capacity of lungs both in healthy persons and in patients with respiratory diseases [4]. Exercise is used as a challenge test to make a diagnosis of exercise induced bronchoconstriction in asthmatic patients with a history of breathlessness during or after exertion. However it is essential to define the mode of response to exercise in a normal population before identifying the individuals with an abnormal response. The ventilatory capacity of a healthy individual often exceeds the demands even during strenuous exercise [5]. Despite this enormous reserve, the ventilatory response to exercise may become constrained in obese individuals with normal lungs [6]. So this study aims to evaluate the effect of BMI on pulmonary function parameters in young individuals by comparing the PFT results across BMI categories [7]. By analyzing gender differences and the correlation between BMI and pulmonary function, this study seeks to provide valuable insights into the relationship between body composition and respiratory health, contributing to preventive and therapeutic strategies for maintaining optimal lung function in the young population.

MATERIALS AND METHODS

A cross-sectional study was done at Department of Physiology, Narendra Modi Medical College Ahmedabad. A total of 120, normal, and obese participants aged between 18 to 25 years were included in the study using random sampling technique based on their body weight. All the participants included were non-smokers, without any known pulmonary, cardiac or chest deformities age between 18-25 years, males and females, written informed consent was taken from the participants. Before medical screening session five minutes rest was given to every participant.

Height was recorded in cm (with range of 70-190 cm), with bare feet. Weight was recorded in kg using a mechanical scale with a capacity of 160 kg Following formula was used for BMI calculation: i.e., weight in kg/height in meter² (cm is converted into m²) [8].

Spirometry was done on Spiroexcel used for measuring respiratory parameters. Normal tidal breathing was noted for one-minute duration [9]. For recording breathing, participants were instructed to breathe deep in maximally and then breathe out forcefully.

DATA ANALYSIS

SPSS was used for data analysis. Frequencies and percentage were calculated for categorical variables such as age groups, gender, body mass index groups. Means and standard deviations were calculated for continuous variables like age in years, weight, height, body mass index and spirometric parameters. P-value ≤ 0.05 was considered as statistically significant.

RESULTS

The present study included 120 participants (60 males and 60 females). All participants aged 18-25 years who are apparently healthy. Male and female according to BMI categorized into two groups, i.e., BMI < 25 and BMI > 25. Respiratory parameters such as FVC, FEV1, FEV1/FVC, and PEFR are found to be significantly lower in female participants in comparison to male participants as shown in Table 1. The correlation of different pulmonary function parameters with BMI of the male and female participants are presented in Tables 2. It is observed that respiratory parameters such as FVC, FEV1, FEV1/FVC, and PEFR of both male and female participants correlated positively with BMI < 25 but there were substantial lung function losses with increasing BMI > 25, i.e., PFTs were negatively correlated presents the effect of gender on pulmonary function test (PFT) parameters among the study participants. Male participants (n = 60) demonstrated higher values for FVC, FEV1, and PEFR compared to females (n = 60). BMI was also significantly higher in males. However, the FEV1/FVC ratio did not differ significantly between genders.

Table 1: Effect of Gender on Pulmonary Function Tests (PFTs) (n = 120)

Parameter	Male (n=60)	Female (n=60)	P-value
BMI	25.45 ± 3.39	23.43 ± 3.74	0.003*
FVC	3.62 ± 0.708	2.46 ± 0.52	0.000*
FEV1	3.17 ± 0.645	2.18 ± 0.53	0.000*
FEV1/FVC	87.6 ± 11.43	88 ± 8.4	0.830
PEFR	5.87 ± 1.76	3.65 ± 1.45	0.000*

Note: *Indicates significant difference (P < 0.01).

Table 2: Correlation of BMI with Pulmonary Function Parameters in Male & Female Participants (n = 120)

Parameter	BMI < 25	BMI > 25 P value
FVC	3.03 ±0.77	2.28 ± 0.29 0.0002
FEV1	3.06 ±0.39	2.15 ±0.23 0.0001
FEV1/FVC	95.13 ±5.3	87.40 ±6.32 0.0001
PEFR	5.01± 1.2	4.29± 1.26 0.0720

Note: $P < 0.05$ is considered significant with increasing BMI in both male and female participants, the correlation is statistically significant

DISCUSSION

Obesity is one of the major health hazards across the world. It can lead to various clinical complications such as diabetes, vascular diseases, osteoarthritis, etc. But less emphasis has been given on the effect of obesity on respiratory system [10]. In this study an attempt was made to find out whether there is an increased risk of respiratory problems in overweight and obese individuals. Pulmonary function tests are generally related to body size and age, where height is a proxy for chest size, and age reflects maturity [11]. Because of this reason every individual has different range of normal values. This study was formulated to see any increase in the BMI will lead to decrease in pulmonary functions [12].

Results of this study were similar with the study done in Andhra Pradesh, where a positive correlation of BMI with FVC and FEV1 was observed [13]. It may be because of fat accumulation around ribs, abdomen and diaphragm which causes restricted movements of ribs, reducing lung volume and decreasing respiratory compliance [14]. Our study revealed significant decrease in pulmonary function tests in obese Subjects who do not have any known obstructive airway disease. All the parameters of pulmonary function tests were negatively correlated with Body mass index (BMI). The present findings were not supported by the study done by Piyali *et al.*, [15]. The possible cause of the difference between two studies may be age factor and mild COPD for both sexes in their study. Therefore, it can be said that obesity has significant impact on respiratory problems. Excess of abdominal fat may restrict the diaphragmatic movement which leads to a decrease in pulmonary function [16]. This study suggested significant impairment of pulmonary functions in obese population due to limited expansion of thoracic cavity which leads to possibility of small airway diseases. The lung functions might be improved by weight loss [17].

This study investigated the effect of body mass index (BMI) on pulmonary function tests (PFTs) in young individuals, with a specific focus on the correlation between BMI and various lung function parameters. The findings provide critical insights into how BMI impacts respiratory health in this demographic, highlighting both gender-specific differences and the implications of being underweight or overweight [18].

The study revealed significant gender differences in pulmonary function parameters. Male participants demonstrated higher values for forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow rate (PEFR) compared to females. These findings align with existing literature that attributes these differences to physiological factors such as greater lung volume, higher muscle strength, and larger thoracic dimensions in males [19]. However, the FEV1/FVC ratio, a key indicator of airflow obstruction, did not significantly differ between genders, suggesting that airway function relative to lung capacity remains comparable [20].

One of the strengths of this study is the focus on a young population, which provides valuable insights into how BMI affects lung function during a critical period of physical development. However, the study has certain limitations. The cross-sectional design precludes establishing causality between BMI and pulmonary function. Additionally, factors such as physical activity levels, smoking status, and dietary habits, which could influence PFT parameters, were not assessed.

CONCLUSION

Obesity influences the respiratory function enhancing dyspnoea and increasing both cardiac load and respiratory muscle fatigue of the thoracic wall and the diaphragm due to the higher pressure exerted by intraabdominal adipose accumulation. In our study the results showed that increase in BMI had an inverse relationship with FVC, FEV1 and PEFR in obese when compared to the normal weight subjects. Thus, it is evident from the present study that obesity significantly affects the pulmonary functions which may give rise to long term complications and may lead to early morbidity and mortality.

This study highlights the significant impact of BMI on pulmonary function in young individuals. While a healthy BMI range appears to support optimal lung function, being overweight or obese is associated with impaired respiratory performance, particularly in females. These findings emphasize the importance of maintaining a healthy BMI for preserving lung health and preventing respiratory complications in young individuals.

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