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RESEARCH ARTICLE

Correlation of gender and body mass index with pulmonary function tests in medical and paramedical students of Muzaffarnagar Medical College

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ABSTRACT

Background: Obesity is a newer chronic non-communicable disease, one of the today's most neglected public health problems according to WHO. While the complication of obesity such as diabetes, cardiovascular disease, and osteoarthritis are well established, but less emphasis is traditionally placed on the effects of obesity on the respiratory system. **Aims and Objective:** To study the effect of gender and correlation of body mass index (BMI) with pulmonary function tests (PFTs). **Materials and Methods:** This study was done on 115 first year Medical and Paramedical Students of Muzaffarnagar Medical College, Muzaffarnagar. Following the selection, the participants were divided into two groups based on BMI < 25 and BMI > 25. Anthropomeric parameters and spirometeric parameters were measured using a computerized spirometer. Statistical analysis was done by applying Student's *t*-test. Linear association was established using Pearson's correlation. **Results:** On comparing the female participants with male participants, PFTs (forced vital capacity [FVC], forced expired volume in 1 second [FEV1], FEV1/FVC, peak expiratory flow rate) were found to be significantly lower in female than male. On observing, the correlation of pulmonary function parameter with BMI correlated positively with BMI < 25. PFTs were negatively correlated with increasing BMI in both male and female participants but the correlation is not statistically significant. **Conclusion:** Our finding suggests that there is a significant impairment of lung functions in the overweight individuals.

KEY WORDS: Body Mass Index; Pulmonary Function Tests; Gender

INTRODUCTION

Obesity is a newer chronic non-communicable disease, one of the today's most neglected public health problem according to WHO.[1] While the complication of obesity such as diabetes, cardiovascular disease, and osteoarthritis are well established, but less emphasis is traditionally placed on the effects of obesity on the respiratory system.[2]

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Obesity is found to decrease the lung volume and capacities by decreasing both lung and chest wall compliance.[3] There is also an increase in resistance to outflow of air through the airways in the obesity.[4] The pattern of pulmonary function is found to worsen with the degree of obesity moving from a restrictive pattern in mild to moderate obesity with both forced expired volume in 1 second (FEV1) and forced vital capacity (FVC) reduced and FEV1/FVC ratio being normal to an obstructive pattern in severe and morbid obesity with significant decrease in FEV1 as against FVC and FEV1/FVC ratio being decreased.[5,6]

MATERIALS AND METHODS

This study was conducted in the Department of Physiology, Muzaffarnagar Medical College, Muzaffarnagar between

October 2016 and April 2017 data were obtained from the first year Medical and Paramedical Students of Muzaffarnagar Medical College, Muzaffarnagar.

Sample Selection Criteria

A total of 115 participants were selected by stratified random sampling technique. Participants were categorized two groups based on body mass index (BMI) classification for world's population.[7] Ethical clearance was obtained from the Institution Ethical Committee.

Inclusion Criteria

Participant aged 18-20 years having normal general health.

Exclusion Criteria

Participant with known respiratory, cardiovascular, and neuromuscular diseases, thoracic, skeletal deformities, thyroid dysfunction, diabetes mellitus, history of tobacco smoking/chewing, and alcohol consumption excluded from the study.

Parameters Recorded

Following the selection of participant anthropometric measurements and pulmonary function tests (PFTs) were performed on them.

Anthropometric Measurements

Height (in meters) - using a stadiometer, weight (in kg) - using a digital weighing scale were measured. BMI was calculated using the Quetlet index BMI = Weight (kg)/ Height 2 (meters).

PFTs

Following explaining and demonstrating the procedure to the participant, a trial run of the procedure of spirometery was done for each participant. Once, the procedure was satisfactorily performed, the final recording of PFT parameters was done on each participant.[3] Recording was obtained and the best of them selected for analysis. FEV1, FVC, and FEV1/FVC, peak expiratory flow rate (PEFR) were recording using a computerized spirometer: The predicted value for each parameter is calculated by the software automatically using the inbuilt normative database for the population under consideration. The pattern of pulmonary function was evaluated by the software by comparing with predicted value for each parameter and expressed as percentage of the predicted value. FEV1, FVC, and FEV1/FVC > 80% of predicted value was considered normal for this population.[8]

Statistical Analysis

All the values were presented as mean ± standard deviation. Level of significance was assessed using unpaired *t*-test. Linear association was established using Pearson's correlation. The mean statistical analysis was performed using software SPSS version 24.

RESULTS

The present study included 115 participants (70 males and 45 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. 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

Table 1: Effect of gender on PFTs

Parameters	(Mean±SD)		*P* value
	Male (*n*=70)	Female (*n*=45)	
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*

*Indicate significant difference (*P*<0.01). BMI: Body mass index, FVC: Forced vital capacity, FEV1: Forced expiratory volume at the end of 1 second, FEV1/FVC ratio of forced expiratory volume at the end of 1 second and forced vital capacity, PEFR: Peak expiratory flow rate

Table 2: Correlation of BMI with pulmonary function parameters in male participants

Parameters	Male			
	BMI<25		BMI>25	
	R	*P*	*R*	*P*
FVC	0.338	0.098	−0.178	0.247
FEV1	0.391	0.053	−0.125	0.418
FEV1/FVC	−0.059	0.779	−0.078	0.614
PEFR	0.184	0.376	−0.009	0.953

P<0.05 taken as significant. BMI: Body mass index, FVC: Forced vital capacity, FEV1: Forced expiratory volume at the end of 1 second, FEV1/FVC ratio of Forced expiratory volume at the end of 1 second and Forced vital capacity, PEFR: Peak expiratory flow rate, *R*: Pearson correlation coefficient

Table 3: Correlation of BMI with pulmonary function parameters in female participants

Parameters	Female			
	BMI<25		BMI>25	
	R	*P*	*R*	*P*
FVC	0.029	0.877	−0.366	0.179
FEV1	0.081	0.67	−0.462	0.082
FEV1/FVC	0.195	0.301	−0.284	0.304
PEFR	0.323	0.08	−0.523	0.045

P<0.05 taken as significant. BMI: Body mass index, FVC: Forced vital capacity, FEV1: Forced expiratory volume at the end of 1 second, FEV1/FVC ratio of forced expiratory volume at the end of 1 second and forced vital capacity, PEFR: Peak expiratory flow rate, *R*: Pearson correlation coefficient

with increasing BMI in both male and female participants, but the correlation is not statistically significant.

DISCUSSION

The aim of the study was to see the correlation of different lung functions parameters with gender and BMI in both male and female participants. While comparing the lung function parameters in male and female participants, it has been observed that lung function values are more in male than female. In our study, we have observed a positive correlation among all the lung function parameters with BMI when BMI of participants is within the normal range for their age and sex but there was negative correlation with increasing BMI, i.e., >25 but correlation was statistically insignificant.

These results were comparable with the study done by Rajkapoor et al. in which they found that mean lung function test was higher in boys than in girls. Budhiraj et al.[9] also reported lower pulmonary function values in female than male participants in similar age groups. This can be attributed to the fact that the men have bigger lungs for the same height as compared to females. Another contributing factor could be the greater strength of respiratory muscles in males.[10] The sex difference in lung function may be attributed to various factors including of sex hormone, sex hormone receptor, or intracellular signaling pathways in addition to physiological and anatomical differences in respiratory system of male and female.[11] Measurement of lung volume is important components of pulmonary assessment in children and adolescents with lung disease. Many physical factors that are correlated with pulmonary function are height, weight, sex, and BMI.[12] BMI is considered to be the best variable for anthropometric evaluation in nutritional and the general health screening.[13] In our study, we have observed a positive correlation among all the lung function parameters with BMI, when BMI of participants is within the normal range for their age and sex but there were negative correlation with increasing BMI, i.e., >25. These observations are in agreement with several cross-sectional studies that found association of FVC and FEV1 with BMI.[14,15] Proposed mechanism for link between obesity and deceased PFTs explained by the restrictive effect on lung and chest wall as accumulation of excess fat could interfere with the movement of chest wall and descent of diaphragm. Increased adiposity has been associated with increased levels of cytokines such as interleukin 6 and tumor necrosis alpha and decreased level of adiponectin thereby increase the level of systemic inflammation which in turn negatively affect the lung function.[16,17]

The limitation in the present study was in its design. This was a cross-sectional study which was carried out in a small group in a single institute. A longitudinal multi-centric study in a larger population is needed.

CONCLUSION

Our finding suggests that here is a significant impairment of lung functions in the overweight individuals and that the possibility of small airway diseases is higher in the overweight group. Larger epidemiological studies in future may help further elucidate these relationships for formulating public health policy and action.

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