



DOES BMI AFFECT LUNG FUNCTIONS?

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ABSTRACT

The objective of this study is to determine the correlation between pulmonary function tests by spirometry with body mass index in healthy obese and non obese adults. This study involves 100 medical students (50 males, 50 females) aged 18 to 25 yrs (mean age 21.28 ± 2.0 yrs). They were grouped according to BMI as normal weight (18.5–23.9 kg/m², n=35), overweight (24–29.9 kg/m², n=30) and obese (≥ 30 kg/m², n=35). Subjects underwent spirometry tests, Pulmonary function tests. Parameters were tidal volume (TV), vital capacity (VC), forced expiratory volume in the first second (FEV₁), forced vital capacity (FVC), FEV₁/FVC. We found no significant differences in TV (p value = 0.582), VC (p value = 0.886) FVC (p value = 0.614), FEV₁ (p value = 0.746), FEV₁/FVC Ratio (p value = 0.19) between the obese and non-obese subjects.

KEY WORDS: body mass index; lung volumes; obesity; pulmonary function test.



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INTRODUCTION

Obesity is the marked emerging condition during the past 20 years in all developed countries as well as developing world. (1) It also has been recognized as having significant effects on many systemic diseases, such as increased risk of coronary heart disease, type-2 diabetes, stroke, sleep apnea, and several other disorders (2,3,6). Several previous studies have reported that increased body weight is related with decrease lung volumes (7, 8), specifically, a decrease in vital capacity and total lung capacity (5, 7, 17). Also a positive association between obesity and asthma has been found in adults (10, 11, 17). A significant improvement in pulmonary function has been observed after dietary or surgical treatment of morbid obesity. (4) Obesity can be assessed by multiple techniques out of which BMI is the simplest one. Though BMI includes both fat and lean mass and it does not take into account the differences in fat distribution. Still it is currently used for identifying overweight or obesity. According to WHO (1), BMI between 18.5-24.9 kg/m² is considered as normal, BMI between 25-29.9 kg/m² is considered as overweight and BMI \geq 30 kg/m² is considered as obese. But increase in health related risk factors and co morbidities associated with obesity at a lower BMI has been observed in Asian populations (2,3). The purpose of this study was to elucidate the relationship between body mass index (BMI) and lung functions. This study is limited to spirometry part of PFT because spirometry tests are considered to be the initial screening tool for pulmonary diseases.

MATERIALS AND METHODS

Subject selection

The study was conducted at physiology department R D Gardi Medical College Ujjain (m.p.). After approval of Institutional ethical committee, hundred medical students (50 males, 50 females) between the ages of 18 to 25 yrs participated in the study. None of the

subjects had history of asthma, smoking, cardiopulmonary disease, previous history or clinical evidence of hypertension, diabetes mellitus, Tuberculosis.

Method

After taking informed written consent from each participant & explaining the purpose of study, a detailed history was recorded. They underwent a complete clinical examination. Weight was recorded without shoes on an Equinox mechanical scale (model: BR 9015). Standing height was recorded without shoes on a wall mounted measuring tape to the nearest of centimeters. These data were used to calculate BMI by formula $BMI = \text{weight (kg)}/\text{height}^2 \text{ (m}^2\text{)}$.

Categorization of BMI was done according to the WHO criteria (2)

The volunteers were divided into 3 groups

Group I : BMI = 18.5–24.9 normal weight;

Group II : BMI = 25-29.9 overweight;

Group III : BMI \geq 30, obese.

Pulmonary Function Tests

Pulmonary functions were recorded by using the "Cosmed PFT Suite calibration module version 7.49 2005 S.R.L." according to American Thoracic Society recommendations. Pulmonary function parameters selected were tidal volume (TV) vital capacity (VC) forced expiratory volume in the first second (FEV₁), forced vital capacity (FVC), FEV₁/FVC. The volunteers were given rehearsal before taking the actual reading. Three such readings were recorded, and best performed test was selected for interpretation.

Data and Statistical Analysis

The data was analyzed by using one way ANOVA with the help of SPSS version 13.0. Mean and standard deviation were calculated. One-Way ANOVA with post-hoc Tukey's HSD test was applied to compare the study groups. Probability value (P) of less than 0.05 was considered statistically significant.

RESULT

The study was conducted at physiology department R D Gardi Medical College Ujjain (m.p.) hundred medical students (50 males, 50

females) between the ages of 18 to 25 yrs participated in the study.

Table 1 shows correlation between gender & BMI. As it can be seen from the table that gender has no significant effect on BMI as BMI in both sexes was nearly equal.

TABLE I
Age & anthropometric parameters of the total subjects.

parameter	male (n=50)	female (n=50)	Total(n=100)	p
Age (years)	20.96±2.10	22.99±1.73	21.28±2.00	
Height (mt)	1.69±.14	1.63±.04	1.66±0.12	
Weight (Kg)	72.75±3.55	58.44±4.42	67.88±5.01	
BMI (kg/m ²)	23.32	22.65	22.97	.756

Anthropometric parameters of study group as per mean ± SD

Table 2 shows the Age & anthropometric parameters of the total subjects. In the present study, the mean age of the volunteers was 21.28±2.0 years. The mean height of these volunteers' was 1.66±0.12mt and weight was

67.88±5.01 kg. The data from male & female was combined because there is no significant difference between males and females for the effects of BMI on the Spirometric values (p value = 0.756).

TABLE 2
Age & anthropometric parameters of the study groups.

parameter	Group1(n=35)	Group2(n=30)	Group3(n=35)	F	df	p
age	21.15±2.1	19.56±1.88	21.16±2.43 **	5.71	2	.004
height (mt)	1.66±.14	1.67±0.12	1.67±0.12	.07	2	.932
Weight(kg)	59.75±3.55	72.76±5.01**	82.75±3.55 ***	267.50	2	0.00
BMI (kg/m ²)	20.56	25.90**	30.2 ***	259.67	2	0.00

*Data presented as mean±SD. **P<0.01, ***P<0.001, ****P<0.001.*

There was a positive correlation between Weight and BMI in all the three groups ((Table 2). Analysis of data in Table 3 was done by one-way ANOVA with post-hoc Tukey's HSD test. Table III shows the effects of BMI on vital capacity (VC), forced expiratory volume in 1 sec (FEV₁) and forced vital capacity (FVC). The BMI in group1 (normal weight) was not

significantly different from the BMI of group2 (overweight) for any of these measurements. However, in all cases, the group1 had significantly higher lung volumes than those of group 3 (obese). The Group1 had a higher tidal volume than group 3, but was not statistically significant. FEV₁/FVC ratio was significantly decreased in group 3.

TABLE III
Imonary function tests parameters of the study groups.

parameter	Group1(n=35)	Group2(n=30)	Group3(n=35)	F	df	p
T.V(ml)	481.71±46.87	474.3±40.11	471.4 ±41.17	.543	2	.582
V.C(lit)	3.67±.61	3.52 ±.68	3.51±.56*	.738	2	.886
FEV1(lit)	3.14±.24	3.11±.52	3.05±.65	.294	2	.746
FVC(lit)	3.48 ±.39	3.43±.46	3.38±.42	.49	2	.614
FEV1/FVC (%)	84.04±2.8	82.87±2.1	82.44±1.9*	4.15	2	.019

*Data presented as mean±SD. * = P<0.05, significant*

DISCUSSION

In the present study as our findings shows that even with increased BMI the pulmonary functions were normal & did not show any significant decrease. Many studies conducted earlier have shown heterogeneous results. The effects of obesity on spirometric values are not consistent across all studies with some studies showing no effects (9,11,14,18) and some other studies showing positive effects(7,8,12,13). This discrepancy between studies could be explained by the wide variations in ethnicity of different population in PFT values or this may be a result of methodological differences in these studies. In present study we found that with increase in BMI there was a fall in TV (group 1- 481.71±46.87, group 2- 474.3±40.11 group 3 - 471.4 ±41.17) & VC values (group 1- 3.67±.61, group 2- 3.52 ±.68 group 3 - 3.51±.56) But the results were statistically not significant. Similar findings were also observed in the studies conducted by Collins, LC, Hoberty (14) & Mohammed Al Ghobain (18). In this study we found the highest decrease in FEV₁ was in obese group as compared to normal or overweight group, although it was not statically significant. Previous studies have shown similar findings (11, 15,16,19). It means that expiratory flow decrease with increasing weight, but not with increase in BMI. This finding is difficult to explain & requires further study correlating the site of fat deposition with

that of pulmonary function. As BMI is the measure of body mass that includes both fat and lean mass and takes no account of differences in fat distribution. The deposition of fat on the chest wall may decrease the expansion and excursion of the rib cage, through a direct loading effect or by altering the inter-costal muscle function. Abdominal and thoracic fat are likely to have direct effects on the downward movement of the diaphragm and on chest wall properties, while fat on the hips and thighs would be less likely to have any direct mechanical effect on the lungs. Thus measures which specify the area specific fat deposition, such as waist, hip ratio, will show significant and specific changes with lung volume.

CONCLUSION

Thus we conclude that body mass index does not directly affect the pulmonary functions. To find out specific relation other measures should be opted.

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