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Original Research Article

The Effect of Body Mass Index on Dynamic Lung Volumes

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ABSTRACT

Introduction: Obesity is important risk factor for pathophysiologic changes contributing for altered lung functions. **Method:** A total of 30 non obese and 30 obese medical students in age group of 18-25 years who have satisfied inclusion and exclusion criteria and have consented to participate in study were enrolled. Each enrolled subjects' height, weight and baseline blood pressure (BP) was recorded and evaluation of dynamic lung function was done using electronic spirometry. **Result:** There was significant decline in lung functions in obese normotensive as compare to non obese students. In long term we can conclude that obesity adversely affects lung functions and which is controlled adequately if active interventions are taken. (weight reduction, life style changes and physical exercise) to prevent obesity related respiratory sequelae in future.

Key words: BMI, spirometry, dynamic lung functions

INTRODUCTION

Obesity is a condition in which the natural energy reserve stored in the fatty tissue of humans is increased to point where it is associated with certain pathological conditions or increased mortality. Obesity is an individual clinical condition, which is increasingly being viewed as a serious public health problem. Excessive body weight has been shown to predispose individuals to various diseases, particularly Cardiovascular Diseases (CVD), type-2 diabetes mellitus, metabolic syndrome and sleep apnea. [1]

Respiratory functions like expiratory reserve volume (ERV), ERV/Inspiratory capacity have also been found to be affected with degree of obesity in adults. [2] There is strong epidemiological evidence indicating reduced FEV1 as a marker for cardiovascular mortality independent of age, gender and smoking history. [3] Pulmonary complications like asthma [4] and sleep apnoea [5] have been associated with obesity in students. Hence respiratory systems have been reported to be major system reflecting the adverse effects of obesity.

Spirometry is a measure of airflow and lung volumes during a forced expiratory maneuver from full inspiration. It is a simple and fundamental test to measure dynamic lung volumes to diagnosis and assess of

airways disease. [6] Spirometry provides four basic measurements FVC, FEV1, FEV1/FVC and PEF, all these parameters needed to interpret spirometry to demonstrate two basic patterns of disorders obstructive and restrictive. Prevalence of overweight and obesity is increasing in adolescents in India which is a concern in terms of the complications being seen in the later stage of life if not taken care of in time.

In the current study we are going to stress on the correlation between obesity and associated alterations in respiratory functions.

MATERIALS AND METHODS

Study Design: 60 Students in the age group 18-25 years were randomly selected to obtain mixed group of students from M.G.M. Medical College and were screened to identify the 1) Non obese group: healthy with BMI<23Kg / $m^2$and 2) Study group (obese): healthy with BMI >23 Kg/m2.

Method: Inclusion criteria included 1) Students in the age group of 18-25 years. 2) Students who are obese to their respective age and sex were selected. 3) 30 obese students and 30 non-obese students were selected according to the parameters mentioned. Exclusion criteria were 1) Students suffering from any medical ailments. 2) Anxious, apprehensive and uncooperative students. 3) Any history of smoking, addiction of tobacco, use of any medications to be excluded from the study. Institutional ethical clearance was obtained. Body mass index was calculated as per the formula:

Body mass index = Weight (Kilograms)/Height (Meter^2).

The students having BMI of more than the cut-off value for their respective age and sex were designated as the test/obese group (both overweight and obese students to be clubbed together). Identical number of age and sex matched non-obese medical students served as controls. Students were explained about the procedures to be undertaken. A brief personal history was taken and written consent was obtained as per Helinski declaration modified according to the test protocol.

Respiratory parameters (lung function tests)

Lung Function tests were performed using electronic spirometry. The software used in it was Uni-Em spirometry. The spirometry used for the study was of turbine flow type. This test is used to measure various dynamic lung functions.

The investigated lung parameters were :

FVC: Forced vital capacity.

FEV1: Forced expiratory volume in first second.

FEV3: Forced expiratory volume in three seconds.

FEF 25–75%: Mean forced expiratory flow during the middle half of the FVC.

Statistical analysis: Results were analyzed by using Unpaired Student T-test with "P" value < 0.05 for significance.

RESULTS AND DISCUSSION

60 subjects (group A non obese n-30) and (group B obese n-30) that have satisfied the inclusion and exclusion criteria were selected.

Table 1: Comparison of height, weight, B.M.I. in groups.

Groups	Height (mean±SD)	Weight (mean±SD)	BMI (mean±SD)
Goup A	169.9±12.89	55.00±9.396	19.09+2.652
Group B	163±13.19	78.50±9.641	30.12±6.356

Table-1. The two groups for the study were similar in age in terms of basic characteristics. Group A and Group B showed significant difference in Height, Weight and BMI ($p<0.001$)

Table-3 Spirometry test analytical values.

Parameter (L)	group A (mean±SD)	group B (mean±SD)	P-value*
Forced vital capacity	4.785 ± 0.8783	4.324 ± 1.037	0.0340(significant)
Forced expiratory volume (1st second)	4.071 ± 0.1418	3.339 ± 0.1262	0.0001 (significant)
Forced expiratory volume (3 seconds)	88.31 ± 8.644	85.16 ± 4.483	0.0412 (significant)
Forced expiratory flow25- 75%	4.786 ± 0.2401	3.808 ± 0.2265	0.0022 (significant)

P<0.05 - s i g n i f i c a n t .

Table 2: Gender ratio in obese and lean group.

Parameters	Male	Female
Group A	16	14
Group B	21	9

Table 4: Classification of obesity based on measurement of BMI according to WHO [7]

Normal --	18.5-22.9
Average Overweight	-- > 23
At risk --- --Increased	23-24.9
Obese –I – Moderate	---25-29.9
Obese – II Severe	>30

Table 3 shows Spirometric Evaluation for Lung function assessment as follow:

Comparison of FVC: There was a statistically significant reduction in FVC between Group A and Group B.

Comparison of FEV1: Group B subjects showed significant reduction in FEV1 ($p<0.001$) when compared to Group A in changes from the observed values.

Comparison of FEV3: Group B subjects showed significant reduction in FEV3 ($p<0.001$) when compared to Group A in changes from the observed values.

Comparison of FEF 25-75 %: Group B subjects showed significant reduction in FEV1 ($p<0.001$) when compared to Group A in changes from the observed values.

DISCUSSION

In the present study, lung functions like FVC, FEV1 ,FEV3 and FEF 25-75 % were estimated in normal and obese normotensive Medical undergraduate subjects in comparable age group. It was observed that there was a significant reduction in FVC, FEV1, FEV3 and FEF 25-75 % in the obese normotensive subjects when compared to normal lean individuals. There was significant difference in lung functions between obese normotensive and lean subjects. Our data shows that body composition and fat distribution are associated with lung function in middle-aged men, in that a central pattern of fat distribution is associated with a decrease in lung functions namely (FVC, FEV1, FEV3 and FEF 25-75 %). Our finding of a significant inverse relationship between adiposity indices (BMI,) and to lung functions like FVC, FEV1 & PEF expand on and complement the findings of previous report. [8-10] The altered lung function is suggestive of an obstructive and restrictive type of airway dysfunction.

Compared with subjects in the normal weight range lung volume and airway caliber were reduced in subjects with increasing BMI in linear fashion. [11] Higher BMI is inversely related to lung functions in our study and other studies. Previous studies of the relation of the body composition to lung function produced inconsistent results. Whereas most studies have reported that free fat mass is positively associated with lung functions. Some have failed to find any associations between obesity and lung functions. [12]

The amount of body fat and a central pattern of fat distribution might be related to lung function by several mechanisms. Mechanical effects of diaphragm to impeding its descent. Reduction in compliance of chest wall, work of breathing and elastic recoil of lungs [13] Adiposity and visceral fat tend to increase with age. [14] Our findings are in line with those of Chinn et al, [15] who observed an association between increase in fat mass and

reduction in FVC and FEV1. Enright PL et al reported that maximal inspiratory and expiratory pressures which are indices of strength of diaphragm and strength of abdominal and inter costal muscles decreased in obesity.

CONCLUSION

Obesity is important risk factor for the pathophysiologic changes contributing for altered lung functions in obese subjects in comparison to non obese students. In long term we can conclude that obesity adversely affects lung functions and which is controlled adequately if active interventions are taken. In our study it was observed that obese normotensives exhibit a significant decline in lung functions like FVC, FEV1, FEV3 and FEF 25-75 % when compared to normal subjects.

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