Original Article

Effect of BMI on pulmonary function test in young adult males: A comparative study

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Abstract

Introduction: Obesity can be defined as a state of excess adipose tissue mass. Currently, overweight and obesity are classified by Body Mass Index (BMI) (weight in kilograms/ square of the height in metres -kg/m^2). In adults, overweight is defined as BMI of 25.0 to 29.9 kg/m^2; obesity is defined as BMI30kg/m. **Aims and Objectives:** To observe the pattern of changes in the pulmonary functions with increase in Body Mass Index. **Materials and Methods:** The present study was a cross sectional prospective study undertaken to study the effect of overweight on the Pulmonary function tests. The study period was 24 months. The study population was carried out in male subjects with age group 18 to 25 years. A total of 120 subjects in age group 18 to 25 years with Simple Random Sampling satisfying inclusion and exclusion criteria were included in the study. Age 18-25 years. Subjects who had given written consent. Individuals falling within the range of normal and overweight Body Mass Index were included into study and those who had physical deformities of chest wall. **Normal Group:** 60 Subjects with BMI 18.5 to 24.99**. Overweight Group:** 60 Subjects with BMI 25 to 29.9**. Result:** The mean forced vital capacity(% predicted) in normal subjects was 96.67±1.69. The mean FVC (%predicted) in overweight subjects was 90.70± 5.92. There was statistically significant decrease in forced vital capacity in overweight subjects compared to normal subjects(P<0.001).The mean PEFR (%)in normal subjects was 97.86± 2.60.ThemeanPEFR(%)in overweight subjects was 94.94± 4.88. There was statistically significant decrease in PEFR in overweight subjects compared to normal subjects(P<0.001). The mean FEV1 (%)in normal subjectswas3.95±0.51. The mean FEV1 (%)in overweight subjects was 2.94 ± 4.88. There was statistically significant decrease in FEV1 (%) in overweight subjects compared to normal subjects(P<0.001). The correlation of BMI and FVC shows that there was negative correlation with Pearsons value of -0.105 in normal subjects and also negative correlation in overweight subjects with no statistical significance. (P>0.05)The correlation of BMI and PEFR shows that there was negative correlation with Pearsons value of -0.152 and -0.105 in normal and overweight subjects respectively with no statistical significance. (P>0.05) The correlation of BMI and FEV1 shows that there was negative correlation with Pearsons value of -0.252 and -0.205 in normal and overweight subjects respectively with no statistical significance. (P>0.05) **Conclusion:** 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.

Key words: BMI (Body Mass Index), Pulmonary function test.

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INTRODUCTION

Obesity can be defined as a state of excess adipose tissue mass.[1] Currently, overweight and obesity are classified by Body Mass Index (BMI) (weight in kilograms/ square of the height in metres -kg/m^2). In adults, overweight is defined as BMI of 25.0 to 29.9 kg/m^2; obesity is defined as BMI30kg/m.[2] Overweight and obesity represent a rapidly growing threat to the healthy populations in an increasing number of countries.[3] Obesity is associated with an increased risk of morbidity and mortality as well as reduced life expectancy.[4] Health service use and medical costs associated with obesity and related diseases have risen

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dramatically and are expected to continue to rise. Indeed they are now so common that they are replacing more traditional problems such as under nutrition and infectious diseases as the most significant causes of ill health. Obesity is becoming a global epidemic,[5] and in the past 10 years all over the world, dramatic increase in obesity has occurred in both children and adults.[6] Through the use of BMI, the epidemic of obesity that began in the 1980s has been tracked through the end of the century. The original alarm was sounded in 1994 by the National Center or Health Statistics in USA when they reported data from the National Health And Nutrition Examination Survey (NHANES).[7] Obesity has major adverse effects on health and is responsible for cardiovascular diseases, type 2 diabetes mellitus, hypertension, certain cancers, sleep apnea/ sleep disordered breathing, gallstones, reproductive, bone, joint and cutaneous diseases.[1] The excessive amount of adipose tissue in children and adolescents and simple obesity in particular constitute a growing health problem throughout the world. As a chronic disease prevalent in both developed and developing countries, it is one of the most significant contributors to ill health. It has been estimated to affect 20-40% of the adults and 10-20% of the children and adolescents in developed countries.[8] The non fatal but debilitating health problems associated with obesity includes respiratory difficulties, chronic musculoskeletal problems, skin problems and infertility. Obesity can affect diaphragm, thoracic and abdominal muscles. Increased respiratory effort and impairment of gas transport system can result in altered pulmonary functions even though the lungs are normal.[8] Obesity places the patient at risk of aspiration pneumonia, pulmonary thrombo-embolism and respiratory failure. It is the most common precipitating factor for obstructive sleep apnea and obesity hypoventilation syndrome, both of which are associated with substantial morbidity and mortality. Increased risk of cardiovascular morbidity and mortality has been related to both lung function impairment and metabolic syndrome.[8] The major respiratory complications of obesity includes a heightened demand for ventilation, elevated work of breathing, respiratory muscle insufficiency and diminished respiratory compliance. Thus the effect of obesity on pulmonary functions is well established. But there has been no large studies which demonstrates the effect of overweight on the pulmonary functions in this geographical area.[8] So this study is undertaken to demonstrate the effect of overweight on the pulmonary function tests.

AIMS AND OBJECTIVES

To observe the pattern of changes in the pulmonary functions with increase in Body Mass Index.

MATERIALS AND METHODS

The present study was a cross sectional prospective study undertaken to study the effect of overweight on the Pulmonary function tests. The study period was 24 months. The study population was carried out in male subjects with age group 18 to 25 years. A total of 120 subjects in age group 18 to 25 years with Simple Random Sampling satisfying inclusion and exclusion criteria were included in the study. Age 18-25 years. Subjects who had given written consent. Individuals falling within the range of normal and overweight Body Mass Index were included into study and Those who had physical deformities of chest wall. Individuals suffering from respiratory diseases such as chronic obstructive pulmonary disease, bronchiectasis and interstitial lung diseases that might affect the pulmonary function. Individuals with present or past (in the last three months) upper respiratory tract or lower respiratory tract infections.

Individuals with history of chronic exposure to substances which results in altered pulmonary functions.Smokers and individuals suffering from hypertension, Alcoholics and individuals suffering from Diabetes Mellitus were excluded from the study.

Normal Group: 60 Subjects with BMI 18.5 to 24.99**.**
Overweight Group: 60 Subjects with BMI 25 to 29.9.

The study was approved by the Ethical Committee of the Medical College. Clinical history, Physical examination, Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV_1), Peak Expiratory Flow Rate (PEFR)Parameters Used For Assessment. All the subjects in the two groups included in the study were studied. Patient was given consent form and asked to sign if he agrees to be a part of study. Data were obtained by interviewing, extracting from patient's files then transferred to specific designed questionnaire and Case Record Form (CRF). This assessment and data collection was done by the principal investigator. The selected group of subjects was 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 as explained below. 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 patients as

well as the clinician involved in the study. Descriptive data were presented as Mean, Standard Deviation and Range values. ANOVA technique was used for multiple group comparisons and student t's t-test for two groups comparison. 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.

RESULT

Table 1: Comparison of FVC in Normal and Overweight subjects

Parameter	Normal	Overweight	t-value	p-value
FVC Predicted (%)	96.67 ±1.69	90.70± 5.92	9.6837	<0.0001, HS

Table 2: Comparison of Peak Expiratory Flow Rate in Normal and Overweight subjects

Parameter	Normal	Overweight	t-value	p-value
PEFR (%)	97.86± 2.60	94.94± 4.88	5.2803	<0.0001, HS

Table 3: Comparison of FEV1 in Normal and Overweight subjects

Parameter	Normal	Overweight	t-value	p-value
FEV1 (%)	3.95 ± 0.51	2.94 ± 4.88	5.2803	<0.0001, HS

Table 4: Correlation of BMI with FVC in Normal and Overweight subjects

Parameter	Normal		Overweight	
	r-value	p-value	r-value	p-value
BMI and FVC	-0.1053	0.4350, NS	-0.0172	0.9148, NS

Table 5: Correlation of BMI with PEFR in Controls and Overweight subjects

Parameter	Normal		Overweight	
	r-value	p-value	r-value	p-value
BMI and PEFR	-0.1528	0.2566, NS	-0.1058	0.5120, NS

Table 6: Correlation of BMI with Pulmonary FEV1 in Controls and Overweight subjects

Parameter	Normal		Overweight	
	r-value	p-value	r-value	p-value
BMI and FEV1	-0.2528	0.3566, NS	-0.2058	0.5120, NS

DISCUSSION

The present cross sectional study was undertaken to study the effect of overweight on the pulmonary function tests.

A total sample size of 120 patients enrolled in the study. It consists of patients with age group 18-25 years. All the subjects included in the study volunteered after proper consent. The study was conducted after obtaining clearance from the ethical committee of the institute. The data collection was done by using predesigned pretested questionnaire. A detailed history of selected subjects was recorded in relation to demographic factors, duration of the disease, symptom profile, physical signs profile and laboratory values profile. The mean BMI(kg/m^2) was 20.99 ±1.95 and 25.91 ±0.90 respectively in normal and overweight subjects with statistical significance. Almost all studies done earlier used BMI to classify obese, non-obese and overweight as discussed earlier, so that a standard set of parameters could be assessed and compared in a standard way. The differences in the mean value of each parameter for each subgroup was analyzed and discussed. In the present study, the mean forced vital capacity(%predicted) in normal subjects was 96.67±1.69. The mean FVC(%predicted) in overweight subjects was 90.70±5.92. There was statistically significant decrease in forced vital capacity in overweight subjects compared to normal subjects($P<0.001$). The correlation of BMI and FVC shows that there was negative correlation with Pearsons value of -0.105 in normal subjects and negative correlation in overweight subjects with no statistical significance. ($P>0.05$)

Similar findings were observed in study done by Sharlin B. Christian *et al*[9] showed that the FVC significantly reduces in overweight (mean ±SD; 3.14±0.73) and obese subjects (mean ±SD; 3.51 ±0.41) when compared to normal weight subjects (mean ±SD 3.68±0.42) and there was negative correlation of BMI with FVC in obese subjects.

The result of the present study was consistent with the study done by Chen Yue *et al*,[10] who observed negative correlation of BMI with FVC in overweight and

obese subjects when compared to normal subjects. They also stated that intra abdominal pressure that has a mechanical effect on the diaphragm is suspected of being a major reason for the association of obesity with lung dysfunction. Similar findings were also seen in study done by Anuradha R. Joshi *et al*[11], Shashi The mean PEFR(%) in normal subjectswas97.86± 2.60. The mean PEFR(%) in overweight subjects was 94.94±4.88. There was statistically significant decrease in PEFR in overweight subjects compared t o normal subjects(P<0.001). The correlation of BMI and PEFR shows that there was negative correlation with Pearsons value of -0.152 and -0.105 in normal and overweight subjects respectively with no statistical significance. (P>0.05)

Similarly in study by Sharlin B. Christian *et al*[9] showed that the PEFR significantly reduces in overweight (mean ±SD 287.68±167.46) and obese subjects (mean ±SD 402.04±94.89) when compared to normal weight subjects (Mean±SD; 424.73±63.36) and there was negative correlation of BMI with PEFR in obese subjects. The result of the present study was consistent with the study done by Yogesh Saxena *et al*[12] The truncal fat may compress the thoracic cavity and restrict the diaphragmatic movement resulting in reduced vertical diameter of the thoracic cavity. These changes may reduce the compliance of the lungs and the thoracic cavity and increase the load on the respiratory muscles. This may end up with the reduction in lung volumes and flow rates, especially PEFR. The mean FEV1 (%)in normal subjects was 3.95±0.51. The mean FEV1 (%)in overweight subjects was 2.94±4.88. There was statistically significant decrease in FEV1 (%) in overweight subjects compared to normal subjects(P<0.001). The correlation of BMI and FEV1 shows that there was negative correlation with Pearsons value of -0.252 and -0.205 in normal and overweight subjects respectively with no statistical significance. (P>0.05) There was a similar change observed when each age subgroup category was compared. There was also a consistent negative correlation with increasing BMI causing further decreases in FVC and PEFR. Low FVC & FEV1 value suggests restrictive lung patterns among obese persons. Fat deposits between the muscles and ribs may also decrease chest wall compliance thereby increasing metabolic demands & workload of breathing in obese. Obesity might impair pulmonary function via several mechanisms. Obese individuals have an increased demand for ventilation and breathing work load, respiratory muscle inefficiency, decreased functional reserve capacity and expiratory reserve volume, and closure of peripheral lungunits.[13] These often result in a ventilation-perfusion(V/Q) mismatch, especially in the supine position.

Obesity is a classical cause of alveolar hypoventilation. Obesity also influence supper airway reflexes, lung mechanics and may affect the central control of breathing. It adversely affects chest wall mechanics, reduces FRC and ERV and causes a decrease in total respiratory compliance due to deposition of subcutaneous adipose tissue. There is also a decrease in lung compliance due to increased pulmonary blood volume. Respiratory muscle function might also be impaired in obesity due to the mechanical disadvantage induced by changes in chest wall configuration, fat deposition and increased energy expenditure to expand the lungs, and an increase in intra abdominal adipose tissue which interferes with the mechanical properties of the chest wall causing decrease in compliance and preventing full excursion of the diaphragm.

There are also effects of obesity on upper air way tone and hence resistance, which add a mechanical load that increases the work of breathing. Morbid obesity may also induce restrictive disturbance of respiratory function, related to reduced compliance of chest wall and or pulmonary parenchyma.

REFERENCES

1. Kasper DL, Braundwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. Harrison's Principles of Internal Medicine vol.1,16thed. United States of America:The McGraw Hill Companies;2005:422-429.
2. Clinical Guide lines on the identification, Evaluation, and Treatment of Overweight and Obesity in adults: The evidence report: National Institutes of Health. Obes Res1998;suppl2:51S-209S.
3. ParkK. Park's text book of preventive and socialmedicine.23rded.Jabalpur:M/S BandrsidasBhanot;2015;316-319.
4. Eckel RH ,York DA, Rossner S, Hubbard V, CatersonI, St Jeor ST, Hayman LL et al. American Heart Association. Prevention Conference VII: Obesity, a worldwide epidemic related to heart disease and stroke: executive summary.Circulation2004;10:2968-2975.
5. World Health Organization. Obesity: Preventing and managing the global epidemic. WHO technical reportseries No.894.Geneva. 2000.
6. Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States,1991-1998.JAMA1999;282:1519-1522.
7. Kuczmarski RJ, Flegal KM, Campbell SM, Johnson CL. Increasing prevalence of overweight among US adults :the National Health and Nutrition Examination Surveys,1960to1991.JAMA1994;272:205-211.
8. Flegal KM, CarrolMD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults,1999-2000.JAMA2002;288:1723-1727.
9. Sharlin B. Christian, Bharat Chavda, R.S.Trivedi, Sudha Parmar, AshvinSorani, Bijal Panchal. Effect of BMI on

pulmonary function tests in young adults. IJBAP. 2014; Vol 3 (1): 165-168.
10. ChenY, HorneSL, Dosman JA. Body weight and weight gain related to pulmonary function decline in adults: asixyearfollowupstudy.Thorax1993;48:375-380.
11. Joshi AR, Singh R, Joshi AR. Correlation of pulmonary function tests with body fat percentage in young individuals. Indian J Physiol Pharmacol. 2008 Oct-Dec;52(4):383-8
12. Yogesh Saxena, Brijesh Purwar and Rashi Upmanyu. Adiposity: Determinant of Peak Expiratory Flow Rate in Young Indian Adults Male. The Indian Journal of Chest Diseases & Allied Sciences. 2011; 53: 29-33.
13. Unterborn J. Pulmonary function testing in obesity, pregnancy and extremes of bodyhabitus. Clinics in Chest Medicine2001;22:759-767.

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