Original Article

Impact of obesity on lung function in healthy young individuals

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Abstract

Background: Obesity is a chronic disease process characterized by excess fat accumulation in body leading to multiple organ specific consequences. It affects people of all ages, gender, race and class. It affects multiple organs including the respiratory system by various mechanisms. The lung function can be measured by spirometry which includes the FEV1, FVC and FEV1/FVC ratio. **Aim:** To study the impact of obesity on the lung function in young healthy individuals **Material and Methods:** Our study was conducted in Aarupadai Veedu Medical College and Hospital, Puducherry, for a period of one year from 2015 to 2016. A total of 50 individuals who were between 18 – 25 years of age, overweight or obese (BMI>25kg/m$^{2)}$, with no addictions/comorbid conditions. Individuals who had previous surgeries, TB/ infection affecting lung function or on drugs affecting the lung function were excluded from the study. They underwent Spirometry and data was collected. This was correlated with various parameters like gender, height, weight, BMI. HELIO spirometry was used and SPSS software was used for statistical purposes. **Results:** In our study we found a significant reduction in the FEV1, FVC values in individuals who were overweight to class III obesity. The mean of FEV1 and FVC reduced proportionally to increase in BMI. The ratio of FEV1/FVC was normal or slightly raised proving that a restrictive pattern of lung disease prevailed in overweight and obese patients. **Conclusion:** Obesity has a significant impact on the lung function of an individual. Obese people are at an increased risk of reduced lung function. The reduction in BMI by reducing weight can reduce the morbidity.

Key Words: Obesity, Pulmonary function test, lung function test, FEV1, FVC, FEV1/FVC, BMI.

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INTRODUCTION

Obesity is defined as a disease process characterized by excessive body fat accumulation with multiple organ specific consequences[1]. Obesity affects people of all ages, class and has reached epidemic proportions. In 2014, more than approximately 1.9 billion adults aged 18 years and older were overweight, of these 600 million were obese[2]. There are several phenotypes of obesity[3] classified according to its severity (mild, moderate or severe) or the type of distribution of this fat (gynecoid or android). Body fat content can be measured by several methods like hydro densitometer, plethysmography, CT, MRI, DEXA scans and anthropometrically using BMI. BMI is one of the most common and an easy method, which is measured by dividing the weight (in kg) by height (in meters) squared and the criteria applied are universally accepted. WHO grades BMI as <18.5 – under nourished, 18.5 – 24.9 – normal, 25 – 30 – over weight and >30 – obese. Obesity is again graded as Class I :31 – 35, class II : 35 – 40, class III:>40[4]. Obesity affects all systems of body and promotes metabolic and structural changes to make an individual susceptible to comorbidities. Obese and overweight people are at increased risk of respiratory symptoms such as breathlessness, particularly during exercise, even if they have no obvious respiratory illness.[5,6] Obesity has a direct effect on respiratory well-being, since it can alter respiratory physiology leading to abnormalities in

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ventilation and perfusion relationship, work load on respiratory muscles, pulmonary ventilation control and chest wall compliance.[7,8,9]The lung functions can be measured by spirometry, which includes parameters like FVC, FEV1, and FEV1/FVC. The effect of obesity affects the lung function also. The values of FEV1, FVC have an inverse relation with BMI making the FEV1/FVC ratio normal or slightly raised. The other factors affecting the spirometry values are age, height, weight, gender and race. Many studies have been done to know the relation between obesity and lung function test. The relations have been done in young age or with persons of comorbidities but not many have been done on overweight and obese individuals with BMI as a measuring tool with spirometry values. In our study we aim to measure the impact of obesity on lung function in a healthy young individual.

MATERIALS AND METHODS

This is an observational cross sectional study conducted at Aarupadai Veedu Medical College and Hospital, Puducherry with a sample of 50 people who were obese or overweight and did not have any other co morbidities. Duration of study is 1year from 2015 to 2016

Inclusion Criteria: Healthy individuals with no respiratory symptoms, Age: 18 to 45 years, BMI: >25 kg/m^2

Exclusion Criteria: Smoker/ alcoholic, on drugs affecting lung function, pregnancy, any co morbidities affecting lung functions like tuberculosis or other respiratory infections, surgeries etc. A total of 50 people with varied BMI were taken and after clearly explaining the procedure were asked to undergo spirometry. Their BMI was calculated using weight and height and results obtained were compared. The patients were defined as obese according to WHO criteria. Spirometry used was HELIOS and statistical software was SPSS 21 software for statistical analysis.

RESULTS

Our study was conducted with a sample size of 50 overweight and obese patients who underwent PFT. Out of the 50, 32 (64%) were male and 18(36%) were female. There were 29 patients who were overweight and 21 obese, who were further divided into class I, II and III obese. The numbers of patients in class I, II and III obesity were 9,10,2 in number respectively. The mean height overall was 1.6604±0.0728, weight was 82.96±14.5138 and BMI was 82.96±14.5138. The BMI for males was 30.21±4.643 and females was 29.551±4.115. The pulmonary function tests were done which showed a mean of 74.198±5.542 for FEV1, for FVC was 72.302±6.224 and ratio of FEV1/FVC was 1.032±0.0346. The BMI were compared to FEV1, FVC and FEV1/FVC and h and p values were calculated which showed a significant result of p value <0.0001 proving that the BMI had direct impact on the pulmonary function tests.

Table 1

BMI	FEV1	FVC	FEV1/FVC
Overweight	77.737±1.722	76.231±1.161	1.029±0.039
Class I Obese	74.477±0.386	72.7±0.61	1.024±0.007
Class II Obese	66.82±1.455	64.51±1.373	1.035±0.007
Class III Obese	58.5±0.707	52.5±0.707	1.114±0.028
'H' Value	38.839	38.912	15.221
'p' Value	<0.0001 (S)	<0.0001 (S)	0.0016 (S)

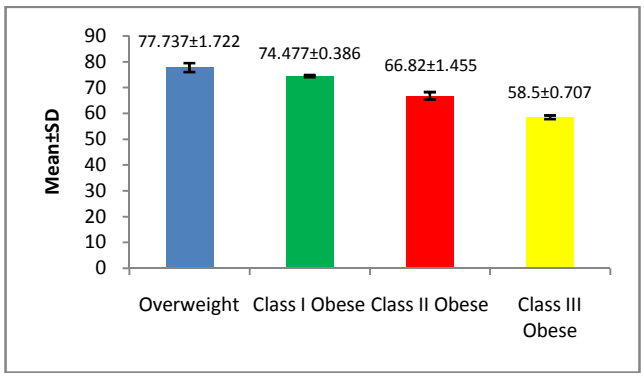

Figure 1

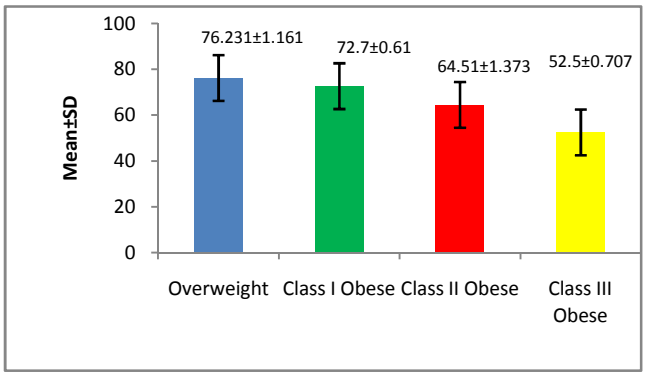

Figure 2

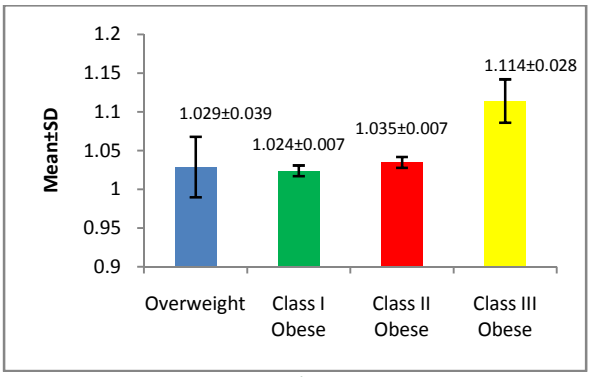

Figure 3: FEV1/FVC with BMI

From the table above we can find that as the BMI increased the FEV1, FVC reduced proportionately while the ratio was normal or slightly increased. The p value was <0.0001 in all the parameters proving that there is a strong correlation between BMI and PFT values. Our study did not find any significant correlation between ages, gender and BMI values with PFT parameters.

DISCUSSION

PFT is a simple procedure for the assessment of pulmonary function in an individual. Obesity is defined as accumulation of excess body fat in human body that leads to increase in abnormal body mass[1]. BMI is the most commonly used parameter internationally to calculate adipose tissue as it uses the anthropometric data, like weight and height, of the individual. Many studies have been done comparing the pulmonary function test and obesity, but not many have dwelled upon overweight and obesity. Our study has compared the BMI values with spirometric values in comparison also with age and gender and tried to shed light on the impact of obesity on PFT. In a study by Prajapati *et al.*[10] it was concluded that increase in BMI was associated with a increase in abnormal PFT pattern. In our study it was observed that there was a significant reduction in lung function values of FEV1, FVC with normal or slightly increased FEV1/FVC ratio. The reduction in mean FEV1 value as seen in overweight to grade 3 obesity was in correlation with studies conducted by Carey *et al*,[11] Zerah *et al*[12], Thyagarajan *et al*[13], Steele *et al*[14] and Canoy *et al*. In the study conducted by Thyagarajan *et al*, there were 2191 men and 2543 women aged between 18-30 years and he found that people with BMI of >26.4kg/m2 had a reduction of 64ml in FEV1 in 10 years. In another study by Carey *et al*[15], had a sample of 1543 men and 1848 women aged 18 – 73y in whom he observed that an increase in 10 kg of weight had a decrease in FEV1 value by 96ml in males and 51ml in females. In our study we observed a reduction in FVC values in relation to increasing BMI. Our studies are in concurrence with other studies conducted by Thyagarajan *et al*[13], Steele *et al*[14], Canoy *et al*[15], Saliman *et al*[16]. In the study by Thyagarajan *et al*[13], all the people with BMI >26kg/m2 had mean reduction of 185 ml in FVC indicating that gained weight had a greater drop in FVC. Similarly Steele *et al*[14] found that central deposition seemed to be more strongly related to the lung function in men and woman. Other studies which is in concurrence are Sahebjami Gartside *et al*[17], who reported reduction in FEV1,FVC, maximum inspiratory flow rate and low maximal volume ventilation in obese subjects. They found a restrictive pattern of lung disease. In another study conducted by Lazarus *et al.*[18] also proved that FEV1, FVC anFEV1/FVC decreases with increases in overweight and obese individuals. Similarly in a study conducted by Biring*et al.*[19] had observed reduction in FEV1/FVC ratio and MEF (max. expiratory flow) which may be due to decrease in total respiratory system compliance. Devarshetty *et al*[20] in their study concluded that obesity had an impact on respiratory function even in younger age group. This study was done exclusively on females. Another study done by Thyagarajan *et al*[13] was a longitudinal study on the effect of BMI, lung capacity and age. He found that the age related decline in vital capacity was higher in overweight and obese people. Our study did not find any significant relation with age and gender as a risk factor. Pakkala *et al*[21] also found significant reduction in FEV1, FVC and FEV1/FVC ratio between obese and non-obese people in south India, as in our study, it coincides with decreased spirometry values. A restrictive pattern of lung function was found with increasing BMI, possibly due to collapse of small airways due to decreased lung volume because of obesity or may be independently as described by Jones RL *et. al.*[25] Naimark and Cherniack *et al*[22] have demonstrated a 2/3rd reduction in normal values in obese individuals, this is because a decrease in lung compliance that may relate to the increased pulmonary blood volume seen in obese individuals.[23] Another reason for decreased chest wall compliance is associated with accumulation of fat in and around ribs, diaphragm and the abdomen of people who

are obese.[24] Obesity may decrease the lung and chest wall compliance owing to the increase in the weight of chest wall and the higher position of diaphragm in thoracic cavity resulting in a decrease in FEV1, FVC and FEV1/FVC ratio which subsequently leads to increase in work of breathing. The central pattern of deposition of fat on chest wall may impede the expansion and excursion of rib cage through a direct loading effect and by altering intercostal muscle function. From the above results we conclude that BMI plays a major role in reducing lung function and there is a significant impact of obesity on pulmonary function proving weight loss or reducing BMI could potentially decrease morbidity due to deteriorating PFT.

LIMITATIONS

Our study was done on a small sample size of only 50 patients. BMI was the only indicator used for measuring obesity and did not account for fat distribution in the body. This study did not quantify the effect of different pattern of fat distribution on spirometry in obesity. Only spirometric values were used and no other PFT (DEXA scan, helium dilution method) were used to recheck or correlate the findings. Due to lack of further follow up detailed correlation between PFT and Obesity could not be obtained. Further studies with larger sample size are warranted.

CONCLUSION

BMI has a significant impact on lung function. The more obese or abnormal BMI there is reduction in lung capacity.

IMPLICATIONS

Thus we can conclude that if we reduce BMI, by reducing weight we can improve lung function.

REFRENCES

1. API textbook of medicine, 10ed, 2015
2. World Health Organization (WHO). Obesity and overweight. Fact sheet, update june 2016: WHO; 2016.
3. SociedadeBrasileira de Cirurgia Bariátrica e Metabólica (SBCBM). Consenso bariátrico. São Paulo: SBCBM; 2006.
4. World Health Organization (WHO). BMI classification [Internet]. Genebra: WHO; 2011.
5. Bai J, Peat JK, Berry G, Marks GB, Woolcock AJ. Questionnaire items that predict asthma and other respiratory conditions in adults. Chest 114: 1342–1348, 1998.
6. Sahebjami H. Dyspnea in obese healthy men. Chest 114: 1373–1377, 1998.
7. Koenig SM: Pulmonary Complications of obesity. Am J Med Sci 2001, 321:249-279
8. Faintuch J, Souza SAF, Valexi AC, Sant'ana AF, Gama-Rodrigues JJ: Pulmonary function and aerobic capacity in asymptomatic bariatric candidates with very severe morbid obesity. Rev Hosp Clin Fac Med S Paulo 2004, 59:181-186.
9. Chery MS, et al: physiology of obesity and effects on lung function. J ApplPhysiol 2010, 108:206-211.
10. Prajapathi P, Singh N, Prajapati RK, Singh JP. A prospective study of pulmonary function test in obese patients. Int J Adv Med 2016; 3:73-6.
11. Carey IM, Cook DG, Strachan DP. The effects of adiposity and weight change on forced expiratory volume decline in a longitudinal study of adults. Int J ObesRelatMetabDisord. 1999; 23(9):979-85.
12. Zerah F, Harf A, Perlemuter L, Lorino H, Lorino AM, Atlan G. Effects of obesity on respiratory resistance. Chest. 1993; 103(5):1470-6.
13. Thyagarajan B, Jacobs DR Jr, Apostol GG, Smith LJ, Jensen RL, Crapo RO, et al. Longitudinal association of body mass index with lung function: The CARDIA Study. Respir Res. 2008; 9:31.
14. Steele RM, Finucane FM, Griffin SJ, Wareham NJ, Ekelund U. Obesity is associated with altered lung function independently of physical activity and fitness. Obesity (Silver Spring). 2009; 17(3):578-84.
15. Canoy D, Luben R, Welch A, Bingham S, Wareham N, Day N, et al. Abdominal obesity and respiratory function in men and women in the EPIC-Norfolk Study, United Kingdom. Am J Epidemiol. 2004, 159(12):1140-9.
16. Saliman JA, Benditt JO, Flum DR, Oelschlager BK, Dellinger EP, Goss CH. Pulmonary function in the morbidly obese. SurgObesRelat Dis 2008;4(5):632-9
17. Gabrielsen AM, Lund MB, Kongerund J, Viken KE, Roislien J, Hjelmesaeth J. The relationship between anthropometric measures, blood gases, and lung function in morbidly obese white subjects. Obes Surg. 2011; 21(4):485-91.
18. Lazarus R, Sparrow D, Weiss ST. Effects of obesity and fat distribution on ventilatory function: The normative aging study. Chest 1997; 111:891-8.
19. Biring MS, Lewis MI, Liu JT, Mohsenifar Z. Pulmonary physiologic changes of morbid obesity. Am J Med Sci 1999; 318(5):293–7.
20. Devershetty J, Metta S, Uppala S, Kamble G. Effect of obesity on pulmonary function tests in apparently healthy young women. Int J Med Sci Public Health 2015; 4:1519-22.
21. Pakkala A, Pakkala A. Effect of obesity on lung function tests in South Indian population. Kas Al Ainy Med J 2015; 21:76-9.
22. Naimark A, Cherniack RM. Compliance of the respiratory system and its components in health and obesity. J ApplPhysiol 1960; 15:377–82.
23. Zerah F, Harf A, Perlemuter L, Lorino H, Lorino AM, Atlan G. Effects of obesity on respiratory resistance. Chest 1993; 103: 1470–6.
24. Carey IM, Cook DG, Strachan DP. The effects of adiposity and weight change on forced expiratory volume decline in a longitudinal study of adults. Int J ObesRelatMetabDisord 1999; 23(9):979–85.
25. Jones RL, Nzekwu MU. The effects of body mass index on lung volumes. Chest. 2006; 130(3):827-33.

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