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ASSESSMENT OF PULMONARY FUNCTIONS IN OVERWEIGHT ADULTS- A CASE CONTROL STUDY

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ABSTRACT

Obesity is considered as the main risk factor for many systemic disorders. In recent years, studies have also proved the influence of increasing BMI in impaired lung functions .Simple clinical anthropometric measures may be conveniently used to assess obesity along with spirometry for lung function assessment. Aim of this study is to determine and compare FVC, FEV1, FEV1/FVC and PEF among normal and overweight individuals irrespective of gender. This is a case control study. Subjects were selected according to the inclusion and exclusion criteria with a sample size of 100, using a pretest proforma. Weight, height and lung functions were measured for each participant using standard methods. Then the data obtained was analyzed using unpaired t- test. Significant difference is observed in all the four parameters (Forced vital capacity (FVC), forced expiratory volume in first second (FEV1), %FEV1, peak expiratory flow (PEF) with p value <0.05, when compared between normal and overweight individuals irrespective of gender. Inverse relationship existing between BMI and lung functions proves that, overweight also acts as one of the risk factor for defective lung functions.

KEYWORDS: overweight; lung functions; FVC; FEV1; %FEV1; PEF

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INTRODUCTION

Overweight and obesity has become a major health problem in India. In the recent few years sedentary life style and dietary habits had played an important role in the occurrence of overweight and obesity. The World Health Organization predicts that 10% of the global population will be obese by 2015[1]. Many studies have proved the inverse relationship between BMI and many systemic diseases. It also acts as a risk factor for cardiovascular diseases, cerebrovascular diseases, and hypertension and diabetes mellitus[2]. Apart from all these commonly known involvement, overweight and obesity also causes defective pulmonary functions. Respiratory involvement includes alteration in respiratory mechanics, decrease in respiratory muscle strength and endurance, decrease in pulmonary gas exchange, lower control of breathing and limitations in pulmonary function tests and exercise capacity[3,4]. All these pulmonary compromises made can be assessed by pulmonary function tests[2]. And studies have proved that, the extent of compromises made in the lung function tends to be higher among those who are at greater BMI values[3]. And many researchers have found the correlation existing between obesity and lung functions[3, 4]. Whereas researches focusing on comparison of pulmonary functions among overweight were scarce. So, this study is mainly aimed to assess the alteration of lung function in overweight individuals; which will be helpful in the assessment of progressive worsening of lung functions with increase in BMI. Many indices like body mass index, waist circumference, waist hip ratio, waist to statue ratio, skin fold thickness are used to measure obesity. But BMI correlates well with pulmonary function tests and it is the most commonly used clinical method of anthropometric measure of obesity[5]. Most of the studies were done in narrow age groups of 18 to 25 years. So this study is aimed to assess the relationship existing between overweight and selected parameters of pulmonary function test (FVC, FEV1, FEV1/FVC and PEF), between the age group of 18 to 60 years irrespective of gender.

MATERIALS & METHODS

This is a cross sectional study conducted at the department of physiology, Mahatma Gandhi medical college & research institute, Pondicherry during January to April 2015. The subjects were healthy volunteers or hospital visitors or relatives of patients visiting the hospital, inclusive of both males and females between the age group of 18 to 55 years. No ethical issues are involved in the study. The purpose of the study was explained to the individuals and informed written consent was taken from the participants who had willingness to participate, in both English and Regional languages. All the participants of the study were interviewed by using pre-test proforma and history regarding the preliminary data, medical & surgical illness, personal habits like smoking, alcohol, occupational; followed by general and systemic examinations. And the subjects were selected according to the inclusion and the exclusion criteria of the study. Sample size of this study is 100. Among which, 50 normal (controls) and 50 overweight (cases) individuals were selected based on the inclusion and exclusion criteria.

Inclusion criteria

1. Subjects between 18 to 55 years of age including both males and females
2. Subjects with willingness to participate in the study
3. Subjects who falls in the category of normal and overweight according to BMI

Exclusion criteria

1. History of smoking, alcohol intake, occupational hazards, medical(asthmatic) or surgical illness, upper respiratory tract infection in the past 4 weeks
2. Physical examination findings suggestive of respiratory illness or skeletal deformity
3. Intake of drugs which influences lipid metabolism, upper abdominal surgeries, Diabetes Mellitus, Cardiovascular Disorders, Endocrinology Disorders.

Then subjects were made to undergo pulmonary function test using Easyone spirometer.

Height measurement

Height was measured to the nearest 0.1 cm, while the subject was standing in erect position with bare feet on flat floor against a vertical scale and with heels touching the wall and head straight at the OPD[5]

Weight measurement

Body Weight was measured using Bathroom weighing scale, while the subject was minimally clothed and without shoes, standing motionless on a weighting scale and it was recorded nearest to 0.1 Kg, at the OPD[5]

BMI calculation

Body Mass Index was calculated using the Quetlet's index .Then the participants of the study were classified into normal and overweight, according to the BMI. Revised WHO Criteria for Asian Indians was used for this categorization[6]

Measurement of FVC, FEV1 and PEF

Easyone diagnostic spirometer (Switzerland) was used for performing the spirometry tests. All Subjects underwent spirometry tests, using techniques recommended by the American Thoracic Society (ATS)[7]. The spirometry test was done in the morning session after proper explanation and demonstration of the techniques. Subjects were made to perform two trial sessions followed by the test proper.

Uniformity was maintained in cases of,

-Posture: standing posture was maintained to rule out the variations in relation to position

-Wearing a nose clip.

-Using the same device and conducted by the same investigator

The spirometer tests measured were the forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and peak expiratory flow. In addition to these, the ratio of FEV1 to FVC (FEV1/ FVC, expressed as a percentage) was calculated. These tests were carried out for both controls and cases.

Procedure

Subjects were instructed to take a deep inspiration followed by forceful expiration into the sensor/mouthpiece, as long as they can exhale or until he/she hears the beep sound from the spirometer[8]. Maximum of seven trials were allowed and best three satisfactory trials were selected according to American Thoracic Society[7]. Data was entered in Microsoft excel sheet. Statistical analysis was done using unpaired t test by comparing the spirometry parameters between normal and overweight. They were analyzed using the p-value obtained.

RESULTS

Our study group consisted of 100 subjects between 18- 60 years of age of both genders. Among which 50 were controls (normal weight) and 50 were cases (overweight).

Table I

Comparison of Mean±SD values of anthropometric parameters of normal weight and overweight individuals

	Normal (mean ± SD)	Overweight (mean ± SD)	t-test	p-value
age	39.94 ± 7.91	37.42 ± 9.97	1.3999	0.1647
height	167.34 ± 7.37	169.12 ± 6.67	1.2666	0.2083
weight	64.92 ± 7.6	76.98 ± 6.56	8.4908	0.0000
BMI	23.11 ± 1.38	26.89 ± 1.46	13.3080	0.0000

The anthropometric parameters of the male and female groups were compared in Table I. When compared between normal and overweight individuals, significant difference is observed in weight and BMI with p-values <0.05. Even though difference exists in mean± SD for age and height, they did not show significant difference with a p value of (0.1647 >0.05) and (0.2083>0.05) respectively

Table 2
Comparisons mean ± SD of spirometry parameters between normal weight and overweight individuals

	Normal	Overweight	t-test	p-value
FVC	3.24 ± 0.63	2.95 ± 0.55	2.459	0.016
FEV1	2.72 ± 0.51	2.33 ± 0.62	3.412	0.001
%FEV1	0.84 ± 0.05	0.79 ± 0.14	2.681	0.009
PEF	7.1 ± 1.66	6.29 ± 1.85	2.299	0.024

The spirometry parameters of the normal and overweight groups were compared in Table 2 When compared between normal and overweight individuals, significant difference is observed in all the four parameters (Forced vital capacity (FVC), forced expiratory volume in first second (FEV1), %FEV1, peak expiratory flow (PEF)) as shown in table 2; with p value <0.05

DISCUSSION

In the present study, significant difference is observed in all the four parameters (FVC, FEV1, %FEV1& PEF), which were used to compare the lung function in overweight and normal individuals. There was no significant difference in age and height of the individuals between both the groups, which clearly excludes the option of decreased lung functions due to these two factors. Results similar to our study has been observed in a study conducted by researchers during 2008, which showed a significant decrease in FVC, FEV1 and %FEV with p value <0.05. And these two factors are considered as the most common lung functions inversely related to BMI[9].A study conducted by Rubinstein also proved the same finding as mentioned above[10]. A recent research conducted by Arkanshu et al in Chennai during 2014 demonstrated the negative correlation existing between BMI and FEV1/FVC ratio[8]. And this study results supports our study findings with significant statistical difference. Our result is also supported by another study conducted by Donna Rinnie during 2007, which also has proved the inverse relationship between FEV1/FVC ratio and BMI in overweight and obese individuals[11]. Many other researchers including Lazarus et al[12], Biring et al[13] and Paralikar et al[14] have also shown decrease in FEV1/FVC in overweight and proved the strong negative correlation existing between FEV1/FVC and BMI. Even though many studies supported the inverse relationship between FVC, FEV1 & FEV1/FVC ratio, research conducted by Emel et al had shown no statistical differences in FEV1, FVC, or FEV1/FVC ratio. In the same research conducted by Emel et al, PEF is reduced in overweight with significant statistical difference supporting our result[15]. Results of another study conducted by Mohammed also had reduction in PEF, in accordance with our study result. But there was no significant reduction in other three parameters (FVC, FEV1 and FEV1/FVC)[16]. Majority of all the studies, which showed observations inclusive of both the supportive and contradictory facts were targeted with the same aim. The aim was to detect the relationship existing between increased BMI and altered lung functions; And also to detect the underlying reason for the same. Reason for reduction in these parameters of lung functions may be due to deposition of fat around the chest wall leading to decrease in the compliance of chest wall[11] and lowered respiratory muscle endurance with increased work of breathing, airway resistance[17] and gas transport[18]. Defective descent of diaphragm due to mechanical hindrance caused by deposition of fat around the chest wall also plays an important role in altered lung functions[19, 20]. Another reason has also been reported by many researchers, mentioning the role of adipose tissue in altered lung functions. Adipocytokines are released by adipose tissue as a result of hypoxemia induced by obesity. These adipocytokines affects systemic inflammation, leading to increase in inflammatory markers. Increased level of interleukins (ILs) 6 and 8, tumor necrosis factor α (TNF-α), CRP, leptin, and lower levels of adiponectin, which helps in regulating insulin sensitivity have all observed in individuals with increased BMI[21,22]. All these

factors act mutually in altering the lung functions with increased BMI above normal range. In our study, many of the individuals in overweight group have decreased lung function when compared to the normal group. Since other influential factors like age, smoking habits, respiratory disorders, drug intake and other surgical history have been excluded from the study, results clearly proves the role of overweight in altered lung functions.

CONCLUSION

Our study serves as a reaffirmation, for the proven fact that increasing BMI leads to defective lung functions. All the four parameters (FVC; FEV1; %FEV1; PEF) were found to have statistical significance, which proves overweight to be a major risk factor for defective lung functions. Therefore, factors which influence the increase in BMI like genetics, ethnicity, nutrition, physical activity and lifestyle can also influence the pulmonary functions. Limitations of the study may include smaller sample size and unequal gender sample. These limitations can be ruled out by conducting a study with the same aim in a larger population without gender bias, results obtained will be more confirmatory than a smaller sample size.

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REFERENCES

1. World Health Organization Obesity and overweight. Fact Sheet No 311. Accessed 2010 May 15. http://www.who.int/mediacentre/factsheets/fs311/en/ index.html. Updated Sep 2006.
2. National Task Force on the Prevention and Treatment of Obesity. Overweight, obesity and health risk. Arch Intern Med; 160:898-904, (2000).
3. Bottai M., Postello F., PedeFdi., Corrozzi L., Baldacci S., Matteelli G et al. Longitudinal changes of body mass index, spirometry and diffusion in a general population. EurRespir J, 20: 665-673, (2002).
4. Rasslan Z., Junior RS., Stirbulov R., Fabbri RMA., Lima CAC. Evaluation of Pulmonary Function in Class I and II Obesity. J Bras Pneumol,30:508-14, (2004).
5. Ramya K., Jai Ganesh K., Mukundan A. A study of anthropometric indices between hypertensive and normotensive adults . Int J Cur Res Rev, 06 (06):36-43, (March 2014).
6. Physical Status: The Use and Interpretation of Anthropometry. Technical Report Series No. 854, World Health organisation expert committee, Geneva, 427-438, (1995).
7. American thoracic society. Standardization of spirometry. 1994 update Am J Respir & Crit Care Med, ; 152: 1107–1136, (1995).
8. Arkanshu A., Sanjay A. Relationship between Certain Pulmonary Function Tests and Anthropometric Measures in Normal Male M.B.B.S Students. International Journal of Health Information and Medical Research, 1(3), (Apr – Jun 2014).
9. Anuradha R Joshi., Ratan singh and A. R. Joshi. Correlation of pulmonary function tests with body fat percentage in young individuals. Indian J Physiol Pharmacol 52 (4) : 383–388, (2008).
10. Rubinstein I., Zamel N., DuBarry L., Hoffstein V. Airflow limitation in morbidly obese nonsmoking men. Ann Intern Med, 112:828-32, (1990).
11. Yue Chen., Donna Rennie., Yvon F Cormier., and James Dosman .Waist

circumference is associated with pulmonary function in normal-weight, over- weight, and obese subjects. Am J Clin Nutr,;85:35–9, (2007).
12. Lazarus R., Sparrow D., Weiss ST. Effects of obesity and fat distribution on ventilatory function. Chest, 111:891-8, (1997).
13. Biring MS., Lewis MI., Liu JT., Mohsenifar Z. Pulmonary physiologic changes of morbid obesity. Am J Med Sci, 318:293-7, (1999).
14. Paralikar SJ., Kathrotia RG., Pathak NR., Jani MB. Assessment of pulmonary functions in obese adolescent boys. Lung India, 29:236-40, (2012).
15. Turkey Emel Torun., Erkan Cakir., Fatma Özgüç., İlker Tolga Özgen. The Effect of Obesity Degree on Childhood Pulmonary Function Tests. Balkan Med J, 31(3), (2014).
16. Al Ghobain M. The effect of obesity on spirometry tests among healthy non-smoking adults. BMC Pulmonary Medicine, 12:10, (2012).
17. McClean KM., Kee F., Young IS., Elborn JS. Obesity and the lung: 1. Epidemiology. Thorax. 63:649–654, (2008).
18. Santiago SQ., Silva ML., Davidson J., Aristóteles LR. Evaluation of respiratory muscle strength in overweight/obese children and adolescents. Rev Paul Pediatr 26:146-50, (2008).
19. Lazarus R., Gore CJ., Booth M., et al. Effects of body composition and fat distribution on ventilatory function in adults. Am J Clin Nutr 68:35–41, (1998).
20. Obesity and respiratory diseases. International Journal of General Medicine, 3/20, (oct 2010).
21. Leone N, Courbon D, Thomas F, et al. Lung function impairment and metabolic syndrome. The critical role of abdominal obesity. Am J Respir Crit Care Med,179:509–516, (2009).
22. Franssen FME, O'Donnell DE, Blaak EE, Schols AMWJ. Obesity and the lung: 5. Obesity and COPD. Thorax, 63:1110–1117, (2008).