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Effect of Obesity on Spirometry Tests among Healthy Male Adults.

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Abstracts -
INTRODUCTION - *Aim is to study the effect of obesity on spirometry tests among healthy young adults.*
METHODS - *A cross sectional comparative study was conducted among healthy adults. Subjects were divided into two groups depending upon their BMI. N = 45, Group 1 subjects with BMI 18 - 22.9 Kg/m^2 were selected as control and N = 30, Group 2 obese subjects were selected with BMI > 25 Kg/m^2. Forced vital capacity (FVC), forced expiratory volume at the end of one second (FEV_1), FEV_1/FVC ratio, peak expiratory flow rate (PEF) were measured using a computerized spirometer.*
RESULT -*PEF values in obese Group 2 were decreased significantly as compared to Group 1 (p value= 0.0005) and was found to be significant. FEV_1 (p value = 0.69), FVC (p value =0.59), FEV_1/ FVC ratio (p value =0.25) were not significant between the Group 1 and Group 2 subjects.*
CONCLUSION - *Obesity decreases PEFR among healthy male adults.*

Keywords - *FEV_1/FVC, forced expiratory volume in the first second, forced vital capacity, PEF, Peak expiratory Flow rate*

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I. Introduction

Obesity is a chronic medical condition in which excess fat accumulates in the body which is harmful to individuals.[1] According to World Health Organization, obesity has reached epidemic, which has affected people of all age groups worldwide.[2] From 1980 onwards obese population has got doubled.[2] Obesity leads to hypertension, heart diseases, diabetes, deranged lipid profile, obstructive sleep apnea and stroke.[2] Respiratory system is also affected by it and Pulmonary function tests (PFT) are used for its analysis. Age, weight, gender, height, and race alters PFT tests. With increase in age, the lung volumes and capacities decreases. The lung volumes and capacities are found to be at higher side in males as compared to females.[3] Obesity decreases respiratory muscle strength, pulmonary gas exchange, endurance, lung compliance, control of breathing, exercise capacity and impairs pulmonary function tests. Small airway dysfunction occurs and it affects expiratory flow and mechanics of respiration.[10-13] In obese people, changes in the thoraco-abdominal region affect diaphragm and rib movements which affect ventilation. Adipose tissue produces a large number of cytokines and mediators in obese people, a pro inflammatory state which leads to increased risk of asthma, atopy, bronchial responsiveness, and phenotypic modifications for this disease.[6] Different studies have investigated the lung function of subjects with different degrees of obesity and reported lung volumes and capacities in an individual manner. Therefore, a review is required which pools all the results of different studies in order to identify which parameters that evaluate lung functions are affected in obese individuals. So that it would be helpful to direct the proper care for the population. Hence the present study was developed with the aims and objectives of investigating changes in pulmonary fuction test associated with obesity. Spirometry tests are widely used as an initial screening test for pulmonary diseases as they are easy to conduct and non invasive procedure.

II. Materials And Methods

A cross sectional comparative study was conducted among healthy male first year MBBS students in the Dept of Physiology of Dr.BSA Medical College, Rohini, Delhi from Jan 2018 – May 2018. Informed consent was taken from all the subjects. Subjects were divided into two groups depending upon their BMI. Body mass index (BMI) was calculated using Quetelet's formula as the weight in kilograms divided by the square of the height in meters [BMI = weight (kg)/ height (m^2)]. Based on BMI, N = 45, Group 1 control male subjects having BMI of 18 - 22.9 kg/m^2 were considered as normal weight and N = 30, Group 2 male subjects having BMI >25 kg/m^2 were selected as obese.[10] Subjects were asked to take a maximal inspiration then forcefully expelled air for as long and as quickly possible. Forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), FEV_1/FVC ratio, peak expiratory flow rate (PEF) were recorded using an electronic portable computerized RMS Medspiror spirometer (Medicare system, Chandigarh, India). Inclusion criteria were male healthy subjects with age between 18 to 25 years, blood pressure and blood glucose levels were within the normal range. Subjects suffering from cough, fever, breathlessness, wheeze or history of upper respiratory tract infection in the past 4 weeks or having history of thoracic or cardiac surgery or chest deformities or those who worked in environments with a high concentration of dust or pollution were excluded were excluded from the study. Those having pleural disease, tuberculosis, chronic obstructive pulmonary disease (COPD), restrictive disease, asthma, smokers and those on treatment for chronic systemic illness, coronary heart disease ,underweight (BMI <18 kg/m2) were excluded from the study. Techniques recommended by the American Thoracic Society (ATS) were followed while performing the procedure**.** Subjects were asked to take rest for 5 minutes and detailed procedure was explained to them before performing the procedure. Procedure was done in sitting posture. Mouthpiece was inserted into the subject's mouth and was adjusted to suit the comfort of the subject. Nose - clip was fixed on the nose. After maximum inhalation, subject was asked to go for a forced quick expiration. Procedure was repeated twice and reproducibility of FVC, FEV_1, FEV_1/ FVC ratio and PEF were checked and recorded. Next procedure was explained to them and were asked to make a full expiratory and inspiratory loop as a single manoeuvre. Nose clip was placed on nose and were asked to do rapid full inspiration to his total capacity from the room air through the mouth piece then blow out air through expiration with maximum force till no more air can be expelled out, followed by a rapid maximum inspiration at the point where manoeuvre was complete.The mean and standard deviation for each group were calculated using microsoft excel software. Student unpaired t test was used for the analysis. P value less than 0.05 was considered statistically significant. P value less than 0.001 was considered statistically highly significant.

III. Result

Table1: DEMOGRAPHIC DATA OF MALE SUBJECTS

DEMOGRAPHIC DATA	GROUP - 1 (CONTROL) N = 45 (Mean ±SD)	GROUP -2 (OBESE) N = 30 (Mean ± SD)	P VALUE
Age (Years)	19.7 ± 0.95	19.2 ± 1.09	0.06(NS)
Weight (Kg)	62.17 ± 7.86	81.13 ± 7.61	0.00001(HS)
Height (Cm)	173.87 ± 4.89	171.72 ± 5.23	0.1(NS)
BMI (kg/m^2)	20.36 ± 2.13	27.4 ± 3.03	0.00001(HS)

Table 2: SPIROMETRIC DATA OF MALE SUBJECTS

SPIROMETRIC PARAMETERS	GROUP - 1 (CONTROL) N = 45 (Mean ±SD)	GROUP- 2 (OBESE) N = 30 (Mean ± SD)	P VALUE
FEV_1 (L)	3.51 ± 0.67		0.69 (NS)
FVC (L)	4.32 ± 0.54	4.24 ± 0.6	0.59 (NS)
FEV_1/FVC (%)	82.64 ± 9.55	80.04 ± 7.66	0.25 (NS)
PEFR (%)	8.53 ± 1.13	6.88 ± 2.17	0.0005 (HS)

IV. Discussion

In the present study, spirometric parameters were studied between non - obese Group 1 and obese Group 2 subjects. Parameters like FEV_1, FVC, FEV_1 / FVC ratios were not significant between the obese and non obese subjects. PEFR parameters were statistically significant between the two groups. PEFR values of Group 2 obese subjects were lower as compared to non-obese Group 1 subjects. Obesity increases the resistance of airway of the respiratory system which decreases the PEFR. Hence, the increase in BMI and increase resistance of airway decreases PEFR in obese subjects.[11] There are studies which have shown no effect on the respiratory system while other studies have shown positive effects on it. The above discrepancy between the studies may be due to wide variations in ethnicity of various populations in PFT values or may be due to difference in methodology used in different studies. Studies that have used other pulmonary function tests (e.g. lung volumes and capacities) have shown that obesity is directly associated with these values. Our study was limited to the spirometric values (FEV_1, FVC, FEV_1/FVC and PEFR) and did not include the other pulmonary function tests (e.g. lung volumes and capacities). Study conducted by Mohammed Al Ghobain have shown results similar to our study. It has shown that obesity affects PEF amongst healthy non-smoking adults.[12] Study conducted by Devershetty et al produced results similar to those of our study. 30 obese young females who had no lung disease, were having sedentary lifestyle, non-smokers, were matched with 30 non obese control subjects. It was observed that there were no significant difference in FEV_1, FVC, and FEF 25%–75% between the females who were obese and non obese; however, there was a significant difference ($p < 0.05$) with regard to FEV_1 / FVC and PEFR. The obese subjects showed lower FEV_1 / FVC ratio and PEFR values than the non obese subjects.[13] The above lower level of spirometry parameters may be due to reduction in total respiratory compliance.[7] Naimark and Cherniack have supported our study. They reported similar results in their study. Total respiratory compliance was reduced by two-thirds of the normal values in obese individuals.[14] Obesity decreases the lung compliance due to increase deposition of fat around the chest wall and diaphragm pushed upward in the thoracic cavity due to the deposited fat around abdomen which increases the work of breathing and affects lung functions.[15] Fat deposition around the chest wall may limit the expansion of the chest wall directly or by affecting the functions of the intercostal muscles.[16] This reduction in PEFR may be due to decrease compliance of the chest wall or may be due to an increase in resistance of respiratory system.[17] Mild to moderate obesity may lead to restrictive type of defect of the respiratory system whereas severe and morbid obesity may lead to air flow obstruction. The decrease lung volume may lead to airway collapse in obese or may be independent. [16] Leptin hormone in obese is an inflammatory marker of the vascular systemic inflammation. Inflammatory factors may decrease the airway diameter.[18] The standard classification used worldwide for obesity is BMI as a reflection of obesity. It is a gold standard test at present time. It measures body mass and covers fat and lean mass. However, it does not explain about differences in fat distribution in the body. If obesity decreases lung volumes then abdominal and thoracic region fat are directly responsible for the reduction in lung volumes by restricting chest wall and diaphragm movement. However, fat around the thigh and hip areas do not affect lung functions directly. So,fat distribution in the body should modify BMI and lung volumes relationship.

V. Conclusion

So, we conclude that obesity decreases PEFR among healthy young adults. So, it is essential to implement healthcare programs for obese group, with the aim of improving lung functions and thereby quality of life.

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