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LUNG FUNCTION CHANGES IN YOUNG OBESE WOMEN – A HARBINGER FOR GRAVER OUTCOMES

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ABSTRACT: Obesity is a global health hazard. As standards of living are continuing to rise, weight gain and obesity are posing a growing threat to health in countries all over the world. These obese individuals are at increased risk of morbidity and mortality because of its relationship with various metabolic disorders. It is also known to cause alterations in pulmonary functions, so the present study was planned to assess the effect of obesity on pulmonary function tests in young adult females of 18 to 25 years. Based on body mass index (BMI) participants were divided in to two groups. Both groups were age and physical activity matched. Pulmonary function tests were recorded using computerized spirometry. Results when analyzed statistically using students "t" test showed that there was a significant decrease in expiratory reserve volume in obese individuals compared to controls. Other tests were not significant. This result shows that obesity has an impact on respiratory functions even in younger age group hence we have to safeguard against the hazards of obesity by taking corrective steps through our health programs.

Key words: obesity, pulmonary function tests, expiratory reserve volume, body mass index

INTRODUCTION

Obesity is defined as "abnormal or excessive collection of fat in the body to the extent that the health is impaired" [WHO, 2000]. Today it is considered as an important global health hazard and has been linked to increased incidence of cardiovascular diseases, hypertension, metabolic disorders and pulmonary dysfunction [Afaf A S et al 2011, Heather M et al 2006]. Besides genetic predisposition, adoption of sedentary life style and inappropriate intake of calorie rich easily available junk food has made the environment conducive to development of obesity even in childhood [Yogesh Saxena, et al 2008]. Obesity can cause various deleterious effects to respiratory function, such as alterations 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 [Koeing SM. (2001), D Costa et al 2008]. Pulmonary function testing is a simple procedure for the assessment and monitoring of respiratory diseases. Studies have examined the relation between obesity and lung function using Body Mass Index (BMI) as a measure of overall adiposity and waist circumference (WC) or waist to hip ratio (WHR) as a measure of central adiposity. Previous studies have revealed that pulmonary function is influenced by BMI and WHR in men [Dayananda G (2009), Lynell C. Collins et al 1995, Rajab Ali et al 2011].

Since obesity is always associated with various alterations of pulmonary origin, it becomes necessary to assess the pulmonary function in obese to identify and treat these alterations at an early stage in order to prevent negative effects on health and quality of life. Therefore, the present study was designed to evaluate the impact of obesity on pulmonary functions of young adult women.

MATERIALS AND METHODS

The present study was conducted in the Research laboratory, Department of Physiology, Yenepoya Medical College., Mangalore. The study subjects were briefed about the protocol and informed consent was obtained from each participant prior to the commencement of the study. A detailed history regarding their habits, physical activity, and history suggestive of any cardio respiratory or any other systemic illness was elicited. The study was approved by the Institutional Ethics committee. Young adult female medical students between eighteen to twenty five years with a BMI more than 24.9 kg/m^2 were considered as study group and those of same age and similar physical activity having a BMI 18-24.9 kg/m^2 were taken as the control group. Individuals leading a sedentary life style were included. Individuals with regular physical activity or exercise, with a habit of alcohol and tobacco consumption, with respiratory or cardiovascular disorders and those with chest and spinal deformities were excluded from the study.
The study and the control group subjects were advised to refrain from consumption of heavy meals at least two hours prior to the recordings. They were asked to avoid hot drinks like tea, coffee and other stimulants before undergoing the tests. The laboratory was well ventilated throughout the recordings. All the recordings were taken between 10 AM to 1 PM at room temperature.

Anthropometric measurements

Anthropometric measurements such as height and weight were recorded. Height was measured to the nearest 0.5 cm with the help of a height scale. The body weight was measured by a weighing scale in kilograms without shoes, the subjects wearing light weight clothes. Body mass index was calculated using Quetelet formula BMI = weight in kilograms / height in m^2. The waist circumference (cm) was measured at a point midway between the lower rib and iliac crest, in a horizontal plane. The hip circumference was measured in centimeters at the widest girth of the hip. The measurements were recorded to the nearest 0.1 cm. and were used to calculate waist to hip ratio (WHR).

Pulmonary Function Testing

In this study, the instrument used to measure respiratory parameters was Spirometer Helios 401 (Recorders and Medicare System). The following parameters were assessed by computerized spirometry for both the control and study groups - Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV_1), Slow Vital Capacity (SVC), Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV) and Maximum Voluntary Ventilation (MVV). A transducer attached with disposable mouthpiece was connected to the computer. To perform the maneuver, the individual was made to sit upright and comfortably on a chair facing the spirometer. The subjects were made familiar with the working of the instrument. Different maneuvers (SVC, FVC and MVV maneuvers) were explained. The subjects were allowed to get accustomed to the instrument and also practiced the maneuvers before the actual measurement. It was ensured that there was no obstruction to the flow of air. The participants were asked to perform three different maneuvers thrice and the best of the three readings were selected.

Statistical analysis

The values obtained in both study and control groups were expressed as mean ± Standard deviation. Student's unpaired't'- test was done to compare the means between the two groups. A p value of < 0.05 was considered as statistically significant.

RESULTS

In the present study out of the 86 females recruited, 51 subjects had a BMI ranging from 18 to 24.9 Kg/ m^2 and were considered as controls. The remaining 35 subjects with BMI varying from 25 to 29.9 Kg/ m^2 were considered as the study group. On comparison, the anthropometric parameters, age and height showed no significant differences between the two groups, but there was a significant increase in the weight, BMI and WHR in the study group when compared to the control subjects (table 1). On analysis of the respiratory parameters between both the groups the study group showed a significant decrease in ERVcompared to the control group (Table 2). However, there was no significant difference between the two groups with respect to SVC, FVC, and FEV1, and MVV. However, a significant decrease in percentage of ratio between FEV_1 and FVC (FEV_1 / FVC) was observed in the group of obese in comparison with control group.

Table 1: showing anthropometric data

Parameters	Control group (n=51)	Study group (n=35)
AGE	18.65±0.74	18.56±0.61
Height	162.14±6.23	162. 05±4.34
Weight	55.43±6.08	72.17±7.28**
WHR	0.83 ± 0.05	0.90 ± 0.04**
BMI	21.06±1.71	27.48±2.49**

****Highly significant (p < 0.0001)**

Table 2: Showing Respiratory Parameters

Parameters	Control (n=51)	Test group (n=35)
Fev1	2.61 ± 0.34	2.48 ± 0.4
FVC	2.99 ± 0.44	2.96 ± 0.4
%(FEV_1/FVC)	87.46 ± 6.69	83.65 ± 7.24*
IRV	1.47 ± 0.28	1.52 ± 0.18
ERV	1.23 ± 0.21	1.03 ± 0.21**
SVC	3.16±0.42	3.01 ± 0.38
MVV	101.09 ± 14.2	100.11 ± 17.76

***Significant (p < 0.01)** ****Highly significant (p < 0.0001)**

DISCUSSION

Physiologically, obesity presents the intriguing questions of whether and how to anticipate its effect on pulmonary function. Relating normal physiological function in relationship to body size seems logical and appropriate. According to this, the larger the organism, the greater the amount of organ system function needed to maintain homeostasis. Most equations for predicting pulmonary function are based on data from normal subjects, using age and height as variables. Further by including body weight as a parameter to these equations the predictive ability can be improved [Darryl Y Sue 1997]. Since participants of both the groups in the present study did not exhibit any difference in terms of age and height but they differed significantly in weight, this study is an attempt to find the effect of gain of body weight in terms of adipose tissue on lung functions. Body mass index is a better indicator of accumulation of adipose tissue since it is calculated using height and weight of an individual.

The present study was an effort to compare the pulmonary function parameters between normal weight and obese young adult females. The significant reduction in ERV in obese group noticed in this study was also recorded in previous studies but these were done in elderly or in morbidly obese females (BMI>30Kg/m^2). [D Costa et al 2008, R L. Jones et al 2006, Rumeyza K Ý et al 1999, Srinivas.C.H et al 2011] however, the results of the present study are in concordant with the study conducted by Joshi et al [2008]. The reduction observed may be because of reduced mobility of the diaphragm, as the diaphragm is pressed upwards due to expanded abdominal volume in obese individuals. There is an increased intra-abdominal pressure with an accumulation of fat in the abdominal cavity. This increases the intra abdominal pressure due to the visceral obesity and pushes the diaphragmatic muscle upwards, thus causing a compression of the lung parenchyma, especially at the basal region of the lung. Visceral fat over-stretches the diaphragm leading to an elevation of the diaphragmatic domes, which in turn causes a decreased efficiency of the diaphragmatic muscles [Busetto L and Sergi G. 2005].

In the present study though an increase in IRV was observed in the obese group it was statistically insignificant. The results also showed no significant difference in vital capacity between the two groups. A significant increase in IRV with reduced ERV without any alteration in vital capacity was observed by Costa et al [2008], and is indicative of a compensatory mechanism. These findings suggest that obesity causes alteration in ventilatory mechanics which reduces the ERV but in compensation these changes seem to generate an overload over the accessory inspiratory muscles. However the obese subjects in this study were younger and with lesser BMI (25-30 kg m^{-2}) compared to the study group of Costa et al so only a numerical increase in IRV was observed in this study.

No significant difference was observed in values of FEV_1 and FVC. But ratio of FEV_1/FVC in obese individuals when compared to the control group was found to be reduced however, similar to the finding of Costa et al[2008], in current study also this reduced FEV_1/FVC ratio was within normal range (above 80%) and hence rules out any obstructive pattern of lung disease in obese group.

There was also no significant difference in the mean values of MVV between controls and overweight individuals. Significant differences in MVV have been observed only in gross obesity [Carolyn S.R et al 1983]. Further in a study done on morbid obese individuals (BMI= 40–69·9 kg m^{-2}) it was shown that MVV reduces as BMI increases [Ladosky W et al 2001]. Average BMI of the obese in this study was 27.49 kg m^{-2} and hence there was no significant reduction in MVV. This probably represents the beginning of a continuum of MVV values from normal through to morbid obesity. A critical issue here is that a "mechanical effect" explanation for decrease in ERV is based on the fact that abdominal obesity impedes diaphragmatic excursion. BMI though a more convenient measure is less likely to be influenced by sex or degree of obesity and can be easily applied in large scale epidemiological studies but it does not reflect regional distribution of adipose tissue.

WHR which is highly correlated with abdominal fat mass is therefore used as a surrogate marker for abdominal or upper body obesity [A Joshi et al 2008]. Present study showed a highly significant increase in WHR in obese group. The mean WHR value in controls was near predicted normal value (0.81) and in obese subjects it was more. So clearly the subjects in the present study were having a central pattern of fat distribution which may affect the lung function by altering the mechanics of ventilation.

In conclusion young overweight females exhibit mechanical modifications such as decrease in ERV without a compromise in other respiratory functions. But this can be altered by packing more pounds and hence this study serves as a harbinger for respiratory function detritions with increasing rates of obesity. A large sample size and a longitudinal study would validate this preliminary finding.

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