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Status of Pulmonary function in Indian young overweight male individuals

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ABSTRACT

Obesity has emerged as a growing menace with its tentacles encompassing various body functions as demonstrated in various previous studies. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low and middle-income countries, including India, particularly in urban settings. This study aims at quantifying the effects of obesity on pulmonary function in an Indian subpopulation and the findings would thereby serve as the proverbial “Red flag” for stemming the expected onslaught of obesity in India. This study compared select pulmonary parameters in males aged 18-25 years (44 were overweight and 48 were normal).Results when analyzed statistically using students “t” test showed that there was a significant decrease in Slow Vital Capacity, Forced Vital Capacity (FVC) and Forced Expiratory Volume in first second (FEV_1) in overweight individuals compared to controls. There was also a decrease in values of FEV_1/FVC and Maximum Voluntary Ventilation, but were not significant. These results show that overweight has an impact on respiratory functions and are in concordance with studies from other parts of the world and hence we also have to safeguard against the hazards of obesity by taking corrective steps through our health programs.

Key words: Vital capacity, FVC, FEV_1, Overweight

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INTRODUCTION

Obesity, perhaps the most prevalent form of malnutrition, can be defined as an abnormal growth of adipose tissue due to an enlargement of fat cell size or an increase in fat cell number or a combination of both [1]. However, fat mass in the human body is difficult to measure under field conditions, and the practical definition of obesity is therefore based on the body mass index (B.M.I) [2].

The World Health Report 2002 estimated that worldwide more than 2.5 million deaths per year are weight related. Obesity is prevalent in both developed and developing countries, and is now affecting children. This epidemic reflects changes in behavioral patterns, including decreased physical activity and over-consumption of high-fat, energy-dense foods. Furthermore, many individuals become obese because of a biological predisposition to gain weight readily when they are exposed to an unfavorable environment.

Obesity has been identified by the WHO as the tenth leading global risk factor affecting today's disease, disability and death rates [3]. The medical problems attributed to obesity include diabetes, degenerative joint disease, and hypertension. Less well known, though not less important, are the respiratory complications of this common condition. These complications can be appreciated by understanding obese person's unique respiratory physiology [4]. As accumulation of fat alters the relationship between the lungs, chest wall, and diaphragm, obesity has been expected to alter respiratory function in some characteristic manner even if the lungs themselves are normal [5].

Respiratory function is determined by the complex interaction of lungs, chest wall, and respiratory muscles. Truncal obesity reduces chest wall compliance, respiratory muscle function, peripheral airway size, and is likely a cause of decline in pulmonary functions [6]. Study of ventilatory function is one such battery of tests, which quantify the mechanical/pump function of the lungs [7].

Measurement of the ventilatory function is a well established part of pulmonary medicine and lung function parameters are used in the diagnosis of respiratory disease, assessment of clinical status and drug treatment responses, as well as in the surveillance of patients with a chronic pulmonary disease [8].

Since obesity can cause respiratory symptoms, many obese people are referred for pulmonary function tests (PFT). It is well known that obesity causes decrease in lung volumes, but only a limited literature is available showing the effect of increased BMI on pulmonary functions on otherwise healthy individuals at young age. The present study is an attempt to evaluate the effect of overweight status on pulmonary functions by comparing the same with normal weight individuals in young male South Indian population.

MATERIALS AND METHODS

The present study was conducted at K S Hegde Medical Academy, Mangalore after obtaining the approval from Institutional Ethics Committee.

The study subjects were briefed about the protocol and the 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 cardiorespiratory or any other systemic illness was elicited. Ninety two males aged between 18-30 years and leading a sedentary life style were recruited for this study. Individuals with a BMI more than 25 kg/m^2 were treated as subjects (n=44) and those with BMI between 18-25 kg/m^2 were considered as controls (n=48).

Individuals consuming alcohol or using tobacco, those with respiratory and cardiovascular disorders, with chest and spinal deformities and those who do regular physical activity or exercise were excluded from the purview of this study. The study and the control group participants were advised to refrain from consumption of heavy meals at least two hours prior to the recordings. The participants were asked to avoid hot drinks like tea, coffee and other stimulants before undergoing the tests. Individuals with acute respiratory problems were excluded from the study. All the recordings were taken in well ventilated room between 10 AM to 1 PM at room temperature.

Anthropometric measurements such as height and weight were measured. Height was measured to the nearest 0.5 cm with the help of height scale. The body weight was measured by a digital weighing scale in kilograms to the nearest 100 grams without shoes. Body mass index was calculated using Quetelet formula (BMI = weight in kilograms **/** height in m^2).

Pulmonary Function Testing

In this study, the instrument used to measure respiratory parameters was SPIROMETER HELIOS 401 manufactured by Recorders and Medicare System. 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 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) and Maximum Voluntary Ventilation (MVV). For obtaining these parameters 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, 92 males were recruited out of which 48 were with BMI ranging from 18 to 25 Kg/ m^2 and were considered as controls. The remaining 44 with BMI from 25 to 30 Kg/ m^2 were considered as subjects. On comparison, the anthropometric parameters age and height showed no significant differences between the two groups, but the two groups significantly differed in weight and body surface area as shown in table 1.

Table 1: showing anthropometric data

	Control (mean ± SD)	Subject (mean ± SD)	'P'Value	Remark
Age (Years)	20.8 ± 2.62	20.9 ± 2.38	> 0.05	NS
Height (Cms)	171.67 ± 5.62	170.93 ± 7.24	> 0.05	NS
Weight (Kg)	63.93 ± 7.62	83.8 ± 15.51	< 0.0001	VHS
BMI (Kg/ m^2)	21.62 ± 1.52	28.56 ± 4.19	< 0.0001	VHS
BSA (m^2)	1.77 ± 0.12	1.97 ± 0.21	< 0.0001	VHS

Table 2: showing Respiratory Parameters

	Control (mean ± SD)	Subject (mean ± SD)	'P'Value	Remark
SVC (Liters)	4.29 ± 0.32	4.12 ± 0.32	< 0.05	S
FVC (Liters)	4.09 ± 0.34	3.91 ± 0.35	< 0.05	S
FEV_1(Liters)	3.45 ± 0.33	3.25 ± 0.36	< 0.01	H S
FEV_1/ FVC (%)	84.99 ± 4.58	82.92 ± 4.18	> 0.05	NS
MVV (lit / min)	135.33± 10.05	132.5 ± 14.82	> 0.05	NS

S – Significant, NS – Not Significant,
HS – Highly Significant, VHS – Very Highly significant

On analysis of mean values of respiratory parameters between two both the groups as shown in table 2, subject group showed a significant decrease in values of SVC, FVC and FEV_1 compared to controls. However there was no significant difference between the two groups with respect to values of percentage of ratio between FEV_1 and FVC (FEV_1/ FVC) and MVV.

DISCUSSION

The present study is an attempt to study the effect of overweight status on pulmonary functions. Obesity is a leading risk factor for various cardiovascular and respiratory diseases. It has been implicated in altering the relationship between the lungs, chest wall and diaphragm, thereby altering the respiratory function. Various studies in the past have shown that obesity adversely affects lung function. Lung function is important in medical practice, as it is predictive of both morbidity and mortality. It is also known that age and anthropometric characteristics affect lung function [9]. However in the present study there was no statistical significant difference between the mean age and height of the two groups but they differ by BMI which is due to an increased weight in subjects and is mainly because of accumulation of adipose tissue in this group.

The present study shows that the Pulmonary Vital capacity (as measured by SVC & FVC) was significantly reduced in the overweight individuals compared to the control group. These results are in concordance with other similar studies done previously [10, 11].

In obese individuals, the diaphragm is in a more elevated position resulting in a low functional residual capacity (FRC). Such modifications in resting end-expiratory lung volume may result in a passive change in airway resistance related to an increase in transmural pressure across the bronchial wall. In addition, chest wall resistance may be increased due to obesity [12].

In this study the reduction in vital capacity is suggestive of a restrictive pattern of pulmonary dysfunction. Obesity is known to induce respiratory mechanical impairment that may be combined with gas exchange abnormalities. The mass loading of the ventilatory system induced by obesity, particularly on the abdominal component of the chest wall, modifies the static balance within the respiratory system. Previous studies of lung function have shown a restrictive pattern with a reduction in lung volumes which in massive obesity amounts to 20 to 30 percent for total lung capacity (TLC) and vital capacity (VC) [12].

The present study also shows a significant reduction in air flow rate as measured by $FEV_{1,}$ in the overweight individuals in comparison to the controls, which is again, was detected by previous studies [10, 11]. FEV_1 is influenced by lung volume and airflow obstruction. The cause of increased respiratory resistance as evidenced by the above results could be due to existence of upper airway obstruction in these obese subjects because of fat deposition or lax pharyngeal muscle tone [12].

Sri Nageshwari et al [13], in their study on school children aged 12 to 16 yrs also found reduced FVC and FEV_1 in obese individuals which was similar to our results and the ratio between FEV_1 and FVC showed no statistical difference between the overweight and normal groups. The normal FEV_1/FVC ratio is due to equal reductions in FVC and FEV_1, suggesting the reduction may be due to restriction as opposed to air flow obstruction [14].

There was 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 [5]. Further in a study done on morbid obese individuals (BMI= 40–69·9 kg m^{-2}) it was shown that MVV reduced as BMI increases [15]. Average BMI of the subjects in this study was around (28.56 kg m^{-2}) hence there was no significant reduction in MVV, albeit a small numerical decrease can be noted. This probably represents the beginning of a continuum of MVV values from normal through to morbid obesity.

CONCLUSION

Thus an overweight status produces a restrictive pattern of respiratory dysfunction but with no change in parameters of respiratory endurance (MVV). A study using methods to determine regional obesity would probably able to throw more light on the intricacies of effect of increased adiposity on respiratory function.

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