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EFFECT OF OBESITY ON PULMONARY FUNCTION

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ABSTRACT

The magnitude of the increasing obesity prevalence has become important health problem. The present study was done to correlate obesity with respiratory function in a group of Indian population. A total of 99 cases between age group 15-45 years of both sexes were taken with no history of asthma or any respiratory diseases. Their height, weight, BMI were measured. The persons having BMI 18.5-22.99 were taken as control group for age and sex. The persons with BMI 25kg/m² to 40kg/m² were taken as study(obese) group. Then Spirometry (both static & dynamic lung volumes) was performed in all subjects. FVC, FEV1, FEV1/FVC, ERV, MVV were used as measures of ventilatory function. FVC, FEV1, ERV & MVV were decreased in obese group. These results indicate that obesity had negative correlation with pulmonary function.

KEYWORDS:Pulmonary function test, Body mass index, Obesity, Spirometry

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INTRODUCTION

.The magnitude of upswing in obesity prevalence has been truly astonishing[1].Obesity is defined as abnormal or excessive fat accumulation that impairs health. Global increase in obesity is attributable to increased intake of energy dense food, decreased physical activity due to sedentary nature of work, industrialization & urbanization. According to WHO Western Pacific Region 2000 in Asians a person with BMI of 23kg/m² or more considered overweight & with BMI of 25kg/m² or more considered as obese[2].Many studies have been done regarding association between obesity & increased risk of various cancers, cardiovascular diseases, endocrine diseases & rheumatologic diseases[3,4]. But impact of obesity on lungs function is a subject of debate. Though it is well known obesity can decrease certain lung volumes & various studies have been done obesity in association with respiratory complications such as obstructive sleep apnoea[5], obesity hypoventilation syndrome[6] & asthma both in children & adults[7,8]. But large studies have not been done in our country showing correlation between obesity & various lung volumes (static & dynamic) in normal people. So I have chosen this topic to determine different lung volumes in the obese persons & compare the values with control group.

MATERIALS & METHODS

It was a cross-sectional study done in the IMS & SUM Hospital, Bhubaneswar during the period February 2013 to July 2013.

Inclusion criteria

- Age between 15 to 50 years
- Physically & mentally fit
- Co-operative & capable of understanding the procedure

Exclusion criteria

- Smoker
- Chronic restrictive disease like Asthma, COPD
- Acute respiratory illness at the time of examination
- Prior use of bronchodilator & bronchoconstrictor
- Recent hospitalization & surgery within last 6 months

The study comprised of 49 obese subjects in the age group of 15 to 50 years out of which 24 were male & 25 were female. The study also includes 50 normal weight subjects which were taken as control out of which 25 were male & 25 were female.

Following consent of the subjects, the subjects were thoroughly interrogated for the inclusion criteria. Detailed personal & family histories were taken & thorough medical examination was done. The cases were first subjected to anthropometric measurements. . All measurement procedures were as per the protocol described in Helsinki declaration.

- First age was recorded
- Standing height was recorded without shoes with a stadiometer in centimetres
- Weight was recorded without shoes and with light clothes on a weighing machine
- Body mass index(BMI) was calculated as weight in kilogram divided by height in meter² (kg/m²) as per Quetelet's index[9]

.The participants of this study were classified into two groups based on the BMI.

- Normal weight group had BMI 18.5 to 22.9kg/m² Obese group had BMI25kg/m² to 40kg/m²

The pulmonary function was assessed in all subjects by Medspiror. Medspiror is a computerized spirometer that measures all the lung volumes except residual volume (RV), functional residual capacity (FRC) & total lung capacity (TLC). The Room temperature was recorded with a 50°C mercury thermometer. The pulmonary function tests were recorded at noon before lunch, as expiratory flow rates are highest at noon[10]. For each volunteer three satisfactory efforts were recorded according to the norms given by American thoracic society & the result of best effort was taken[11]. The required tests were self demonstrated to help the subjects get conversant with the procedure. All the manoeuvres were done with the nose clip held in position on the nose. Before starting the test the person should rest for 5 to 10 minutes. The tests were carried out in a private and quite room in sitting position. Recording of pulmonary function tests were conducted in one sitting on the same day. First the technique of FVC was done, i.e.; maximum inhalation followed by maximum exhalation through the mouth piece. Second the procedure of SVC(slow vital capacity) was done, that is, normal breathing then after 3 to 4 normal breathing maximum inhalation followed by maximum exhalation and again there was normal breathing for sometimes. To measure MVV the patient was asked to take deep inspiration followed by forceful expiration as quickly as possible for 15 seconds.

The values which were used for the study were

- FVC-Forced vital capacity
- FEV1-Forced expiratory volume in 1 sec
- FEV1/FVC ratio
- ERV-Expiratory reserve volume
- MVV-Maximum voluntary ventilation

The pulmonary function tests were compared in both the normal & obese groups by the 'unpaired t test'. Data were expressed in as Mean±SD. Statistical significance was indicated by 'p' value<0.05.

RESULTS

Table 1

Comparison of anthropometric parameters in males.

MALE		Age (Yrs)	Height (m)	Weight (Kg)	BMI (Kg/sq. m)
Study group (n=24)	**Mean± SD**	29.00± 12	1.6± 0.08	81.00± 9	30.00± 3
Control group (n=25)	**Mean± SD**	29.00± 11	1.65± 0.05	58.00± 4.6	21.00± 0.98
P value		NS	NS	<0.001	<0.001

Table 2

Comparison of anthropometric parameters in females

FEMALE		Age (Yrs)	Height (m)	Weight (Kg)	BMI (Kg/sq. m)
Study group (n=25)	**Mean**± SD	29.00± 10	1.55± 0.04	71.00± 12	29± 1
Control group (n=25)	**Mean**± SD	29± 10	1.57± 0.03	53± 4	22± 1
P value		NS	NS	<0.001	<0.001

Table 3

Comparison of FVC, FEV1, ERV, FEV1/ FVC & MVV values in males

MALE		FVC (lit)	FEV1 (lit)	FEV1/FVC %	ERV (lit)	MVV (lit/min)
Study group	**Mean**± SD	2.22± 0.43	1.93± 0.59	94.32± 9.3	0.6± 0.32	88.87± 29.74
Control group	**Mean**± SD	2.68± 0.41	2.33± 0.38	96± 4.26	0.87± 0.28	109± 18
P value		<0.05	<0.05	0.55 (NS)	<0.05	<0.05

Table 4

Comparison of FVC, FEV1, FEV1/ FVC, ERV & MVV between female study cases & control group

FEMALE		FVC (lit)	FEV1 (lit)	FEV1/FVC %	ERV (lit)	MVV (lit/min)
Study group	**Mean**± SD	1.93± 0.32	1.87± 0.33	92.83± 11.62	0.49± 0.21	68.28± 11
Control group	**Mean**± SD	2.28± 0.43	2.11± 0.27	95.73± 5.86	0.71± 0.4	77.07± 13.79
P value		<0.05	<0.05	0.4 (NS)	<0.05	<0.05

Table 1& 2 show comparison of anthropometric parameters in male & female groups respectively. No significant difference in age or height was found among obese & control groups indicating samples were homogenous in this respect. However, as expected weight & BMI were significantly different between study & control group.

The observed value of various lung function parameters were given in Table 3 & 4. In male & female obese groups forced vital capacity (FVC), forced expiratory volume in 1sec (FEV1), expiratory reserve volume (ERV), maximum voluntary ventilation (MVV) were decreased significantly ($p<0.05$). But no significant alteration was seen in FEV1/FVC ratio ($p>0.05$).

DISCUSSION

This study demonstrated the relationship of pulmonary function with BMI in a group of people. The main findings of this study show decreased lung function in obese group which support findings from previous studies[12-15]. Obesity and pregnancy are two common causes for reduced FVC, since they interfere with diaphragm movement & chest wall mobility. Obesity may directly affect respiratory function through various mechanisms. The accumulation of fat may mechanically affect the expansion of diaphragm during forced inspiration. Low FVC & FEV1 value suggests restrictive lung patterns among obese persons. Fat deposits between the muscles and ribs may also decrease chest wall compliance thereby increasing metabolic demands & workload of breathing in obese. In the present study dynamic lung function values like Forced vital capacity and Forced expiratory volume in 1 sec showed a significant decreased value in comparison to control group in both male & female independently. This finding is consistent with the findings done by Schoenberg et al, Dontas et al, Chen et al & Joshi AR et al where they observed that increase in Body mass index associated with decreased pulmonary function[16-20]. PFT values initially increase due to muscle strength parallel with weight gain but subsequently decrease due to decrease in chest wall mobility. However Saxena et al found an inconclusive finding between obesity and evaluation of dynamic lung function test in male gender but suggested that obesity may be the cause of greater morbidity of respiratory function due to lower respiratory reserve. They observed a significantly negative correlation to BMI in female[21]. The normal value of FEV1/FVC ratio in my study may be due to the fact that inspiratory & expiratory muscle strength is normal as per finding of Joshi et al[20].

There are two types of altered respiratory function most frequently found in obesity. First changes proportional to obesity i.e.; reduced expiratory reserve volume and increased diffusion capacity & second reduced vital capacity & total lung capacity in extreme obese individuals. The reduction in expiratory reserve volume and functional residual capacity seen in obese individuals are caused by alteration of chest wall mechanics, decreased total respiratory compliance, decreased flow frequency, decreased lung volume, reduced residual volume & residual volume/total lung capacity ratio. Zied Rasslan et al in their study observed a significant decrease in ERV in both genders & present data in this study were compatible with those reported in the literature[22]. Maximal voluntary ventilation in the present study was low and was statistically significant in comparison to control group. This finding agrees with the findings observed by Bedell GM et al, Naimark A & Cherniak RM, Cullen JH & Formel PF, Barrera F et al, Rochester DF[23-28]. But Sharp et al in their observation found decreased MVV and attributed the cause of diaphragmatic muscle weakness and upper airway resistance[29]. Gilbert R et al, Kollias J et al, Dillard TA et al reported a normal MVV in obese individuals[25,30,31].

CONCLUSION

My study suggests that increase in body mass index is associated with modest decrease in the static (ERV) & dynamic

(FVC, FEV1, MVV) lung volumes in obese individuals. Although the magnitude of the effect is relatively small from a public health perspective, our findings in the present study indicates the consequence of increased body mass index on lung function. Present study is a random sample of individuals from the general population, so we were able to investigate this association in non obese individuals. The cross sectional nature of this study has a limitation, as it does not provide information about a temporal sequence. However a large sample size & longitudinal study will definitely be a great value in predicting the relationship between pulmonary function test & body mass index. Body mass index fails to distinguish between fat and fat free mass. So percentage of body fat distribution, skin fold thickness, waist to hip ratio & waist circumference also helpful in predicting the relationship between pulmonary function test & obese individuals more accurately.

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