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Research Article

COMPARATIVE EVALUATION AND CORRELATION OF ABDOMINAL OBESITY AND BODY MASS INDEX WITH FORCED VITAL CAPACITY

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A R T I C L E I N F O

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A B S T R A C T

Background and objectives: Obesity is a major cardiovascular risk factor and a well recognized cause of lung function deterioration. Obesity has effects on lung function that can reduce respiratory well being, even in the absence of specific respiratory disease, and may also exaggerate existing airway disease. There is good evidence that abdominal obesity is important in the development of insulin resistance and in the metabolic syndrome (hyperinsulinemia, dyslipidemia, glucose intolerance, and hypertension) that link obesity with CHD. Cardiovascular mortality and impairment of pulmonary function is closely correlated. Because BMI does not take into account the distribution of body fat it may not be an ideal index of obesity in prediction of pulmonary function. The aim of this study was to observe and compare the effect of abdominal obesity and BMI(body mass index) on FVC(forced vital capacity), which is an important parameter of pulmonary function. **Methods:** The study was conducted by cross sectional survey of 80 people aged 30-65 years from Patna district. Data was obtained about their age, height and weight. Body mass index (BMI) was calculated using height and weight. Abdominal circumference (AC) was measured using a measuring tape. The subjects were divided into two groups. Group A (n=40) with AC < 110 cm and Group B (n=40) with AC ≥ 110 cm. Forced vital capacity (FVC) off all 80 subjects was measured using a manual spirometer. FVC values of both the study groups wee compared**. Results:** Statistical analysis was done by student 't' test using graphpad software. Significant decrease in FVC was observed in Group B (P <0.5). These findings are comparable to the results of earlier studies by Ligion Huang *et al*, journal of physiological antropology, june 2019 and C hoe *et al*, Journal ploskorea, 2018. **Conclusion:** Obesity, particularly abdominal obesity might be related to decreased lung function. Hence, efforts to specifically decrease visceral adipose tissue could go a long way in maintaining healthy lung functions despite ageing.

INTRODUCTION

Obesity is associated with many health related problems, including respiratory diseases. Abdominal obesity consists of visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT). Unlike SAT, VAT is known to secrete cytokines and growth factors that stimulate the development of obesity related pathological conditions. The type of fat tissue that is more strongly associated with lung function remains unclear due to limited data. Lung function is affected by many factors such as age, gender, obesity, smoking status etc. The effect of age, gender and smoking status on lung function has been confirmed. As for obesity no unique conclusion is drawn yet. Obesity is known to decrease lung compliance. There are many reasons for this. Firstly, the position of diaphragm in the thoracic cavity is elevated by weight gain, resulting in extra work of breathing. Secondly, fat accumulation on the chest wall will impede the movement of thoracic cage, either by direct resistance or by abnormal function of intercostal muscles. Thirdly, obesity increases release of inflammatory markers in the lung, the major effect of which is on lung tissue compliance, with slight effect on airway diameter.

Thus obesity is associated with the lung volumes and not airway obstruction. Hence I chose FVC as the lung function parameter for my study. Present study is aimed to find the relationship between abdominal obesity and pulmonary function. Also, it aimed to determine whether obesity as a whole (indicated by BMI) or abdominal obesity in particular is a greater deteriorator of lung function in healthy non-smokers.

FVC (Forced vital capacity): it is the maximal volume of air which can be breathed out as forcefully and rapidly as possible following a maximum inspiration. It can be computed as

FVC= TV + IRV + ERV
Where FVC = forced vital capacity
TV = Tidal Volume
IRV = Inspiratory Volume
ERV = Expiratory reserve volume

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Normal value of FVC is 4.8 litres in males and 3.2 litres in females. FVC has 3 components:-

1. FEV1 –volume of FVC expired in first second of exhalation
2. FEV2 – volume of FVC expired in first 2 seconds of exhalation
3. FEV3 – volume of FVC expired in first 3 seconds of exhalation

FVC is used to distinguish between restrictive and obstructive lung diseases besides being a general indicator ofventilatory function oflungs in health and disease..

BMI (body mass index) is a simple index which is commonly used to classify underweight, overweight, and obese.

BMI = Wt.(in kilogrames)/ Ht. in metre squares
Normal range = 18.5 to 24.99
Overweight = ≥25
Obese = ≥30

Spirometer is an apparatus with doubled wall cylindrical chamber. The inner chamber or bell is made of light material like aluminium and it floats on the water contained in the outer cylinder. Air is blown through a mouth piece connected to a rubber tube into the bell as rapidly and forcefully as possible following a maximal deep inspiration. This air in the bell causes the indicator needle to move on the caliberated pulley. The volume indicated gives the reading of FVC.

MATERIAL AND METHOD

Due permission was taken for the study. All the subjects were explained about the test procedures in detail before conducting the study. 80 adultmales of the age group of 30-65 years were selected, all of whom were residents from Patna district. The study persons were fat but otherwise healthy. Their height, weight, occupation, degree of physical activity, body mass index, abdominal circumference were noted. Subjects with present or past history of respiratory diseases like tuberculosis, pulmonary oedema, pleural effusion, pneumothorax, emphysema, pulmonary fibrosis, poliomyelitis etc. were excluded from the study. Those with ascites and abdominal tumours were dropped. Smokers, alcoholics, industrial workers exposed to air pollution, construction work labourers were also excluded. The subjects were divided into two groups of 40 each in such a way that people with similar age, occupation, physical activity, body weight and height fell equally in both the groups. This ensured that the two groups comprised of persons with similar body surface area, respiratory muscle strength and obesity.

Procedure: The average BMI was calculated in both the groups and found to lie within a narrow range of 30-31, implying thereby, that they had the same degree of obesity for different heights. The abdominal circumference (AC) in centimeters was recorded using a measuring tape in all 80 subjects. The abdominal circumference (AC) at the level of umbilicus was noted. Mean AC (for n=80) was 110 cm. Now the subjects were divided into two groups as under:

Group A (n=40) - AC<110 cm
Group B (n=40) - AC ≥ 110 cm

Spirometry was done in the laboratory of Physiology Department, Nalanda Medical College. FVC values were recorded in all 80 subjects of both the groups at 9:00 a.m. in the morning empty stomach. Results were evaluated and compared.

RESULT

Statistical analysis was done by student unpaired `t' test using Graphpad software. The 'p' value obtained was 0.165 i.e., p<0.05, which is statistically moderately significant. It was evident from the test that abdominally obese subjects had a greater decline in forced vital capacity than obese subjects with similar body weight for height, who had lesser degree of abdominal obesity.

Table 1

Study groups	BMI	Mean FVC
Group A (n=40) AC<110 cm	30-31	3.535
Group B (n=40) AC ≥ 110 cm	30-31	3.08

Table 2

	Mean ± S.D	SEM	SED	P value	significance
Group A (n=40) AC < 11O cm	3.535±0.689	0.1378	0.183	0.0165	significant
Group B (n=40) AC ≥ 110 cm	3.08 ± 0.603	0.1206			

DISCUSSION

The results of my study are comparable to the results of earlier studies by Choe *et al*, 2018 and Ligion Huang *et al*, 2019. Compared with subcutaneous fat, intraabdominal adipose tissue has more cells per unit mass, higher blood flow, more cortisol receptors, probably more androgen receptors and greater catecholamine induced lipolysis. These differences make intra abdominal adipose tissue more susceptible to both normal stimulation and changes in lipid accumulation and metabolism. Abdominal obesity is a cardiovascular risk factor that is associated with insulin resistance, glucose intolerance, dyslipidemia and hypertension, all of which are features of syndrome X or metabolic syndrome. Insulin resistance is recognized as a low grade inflammatory condition and proinflammatorycytokines (i.e. adiponectin, leptin, tumor necrosis factor-α and interleukin-6) are associated with obesity. Systemic association is also thought to play a role in the association between reduced pulmonary function and cardiovascular mortality. Insulin resistance and inflammation that arise from abdominal obesity may mediate the impairment of pulmonary function.

A number of hypothesis have been proposed to explain the negative co-relation between pulmonary function parameters and measures of visceral obesity.One possible mechanism is mechanical limitation of chest expansion during the FVC manoeuver. Increased abdominal mass may impede the descent of the diaphragm and increase thoracic pressure. Also, abdominal obesity is likely to reduce expiratory reserve volume by compressing the lungs and diaphragm. In addition visceral adipose tissue influences circulating concentrations of interleukin-6, tumor necrosis factor-α, leptin and adiponectin, which are cytokines that may act via systemic inflammation to negatively affect pulmonary function. Investigators reported an inverse association of serum leptin concentrations with FEV1 as well as higher levels of C-reactive protein, leucocytes and fibrinogen, which are markers of systemic inflammation. Therefore, inflammation may be the link between abdominal obesity and lung function.

CONCLUSION

Abdominal obesity is negatively and consistently related to pulmonary function and according to this study, it is of greater importance than overall adiposity markers such as body mass index or total body weight in lung function deterioration. BMI takes no account of fat distribution in the body as an indicator of obesity. Therefore, investigators should consider the inclusion of markers of abdominal obesity as a potential confounding factor when investigating the determinants of pulmonary function.

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