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Relationship Between Body Composition and Lung Functions Among Middle Aged Obese Subjects

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ABSTRACT

Objectives: *To explore the relationship between body composition and their influence on pulmonary functions among obese middle aged subjects.*

Methodology: *100 obese healthy subjects of age 35-55 years were included in the study. BMI, Body fat percentage (BF %), Fat Mass (FM) were estimated and Fat Free Mass (FFM) was calculated. Respiratory parameters were measured. Unpaired t-test, Pearson's correlation coefficient were used to analyze the variables.*

Results: *A non-significant inverse correlation of FM with FVC and FEV1 was observed. FM and FEV1 / FVC ratio showed a negative non-significant relation. A significant positive correlation was observed between FM and PEFR among obese subjects. The correlation of FFM with FEF25-75% and MVV was significantly positive.*

Conclusion: *It is important to take into account the body composition instead of BMI alone while determining early changes in lung functions among middle aged obese.*

KEYWORDS : Obesity, Lung function, Body composition, Body mass index

Introduction:

The global epidemic of obesity often named as 'globesity' has also affected India and it is well established that with increasing obesity, fat deposition in men tends to occur around the trunk and abdomen. Obesity reduces thoracic wall compliance by restricting diaphragm movement and thoracic cage expansion. It can profoundly alter pulmonary function and diminish exercise capacity by its adverse effects on respiratory mechanics, resistance within the respiratory system, respiratory muscle function, lung volumes, work and energy cost of breathing, control of breathing, and gas exchange. [1,2] A number of studies have shown decrease in lung volumes in obese people with an inverse relation existing between respiratory function and various indices of obesity or fat distribution. [2-6] However, only few studies have carefully examined the relationship of lung dysfunction with the components of Body composition among middle aged persons.

Body composition or measures of body fatness have been shown to be associated with lung function. It is useful to understand this relationship, as components of body composition may be modifiable risk factors. Several studies have evaluated the relation of waist circumference (WC) and WHR to pulmonary function testing variables with controversial results and the findings suggesting the relationship between various measures of body composition and lung function have been inconsistent. In the reports that investigated the association between the fat mass (FM), fat free mass (FFM) and lung function, FM showed to be inversely related to lung function but positively related to FFM.

In many respects, to the best of our knowledge, obesity as a risk factor for pulmonary dysfunction has not been well explored and documented among south Indian population, who are believed to be at higher risk of complications of obesity. Hence the present study is undertaken as an attempt to explore the relationship between body composition and its influence on pulmonary functions among obese aged 35-55 years.

Methodology:

This cross-sectional study was conducted in a Medical College and Research Centre, Davangere, a South Indian city. The subjects were apparently healthy adults aged 35-55 years. A thorough history regarding chronic exposure to substances which results in altered pulmonary functions, medical conditions, and the medications taken in the past 6 months was obtained followed by clinical and systemic examinations. Subjects with physical deformities of chest wall, established obstructive pulmonary disease, unstable coronary syndromes, currently smokers and alcoholics or were excluded. The sample size was estimated using the formula N = (Zα/2)2 s2/d2, A pilot study conducted on 8 middle aged obese adults resulted in a standard deviation (SD) of 9, with a power of 80%, and at an error rate of 5%, the minimum sample size required was estimated to be 76 subjects, after the allowance of 10% for nonrespondents is assumed, the corrected sample required was 84, however, a total of 100 obese subjects participated in the study. The study was approved by Institute's Ethical Committee and informed written consent was obtained from participants after briefing about the objectives of the study.

Anthropometric measures were obtained in the physiology lab after a minimum of 2 hours of light breakfast and according to the established guidelines. [7] Waist circumference (WC) and hip circumference (HC) were measured to nearest 0.5 cm.

Weight was measured using a spring weighing balance to the nearest 0.5 kilogram (kg) and Stature was measured in centimetres (cm) to the nearest 0.2 cm. [7] BMI (Quetlet's index) was calculated as weight/height^2, .Body fat percentage (BF%), Fat mass (FM), Fat free mass (FFM) were calculated using the following formulas.

BF% = (1.2 X BMI) + (0.23 X AGE) – (10.8 X SEX) – 5.4

FM (in kg) = weight X BF%

FFM (in kg) = weight – FM.

Helios 401 Medspiror spirometer was used for assessing the pulmonary functions. The largest of three acceptable Forced vital capacity (FVC), Forced Expiratory Volume in one second (FEV_1) and Peak Expiratory Flow Rate (PEFR) volumes were recorded. The ratio of FEV_1 to FVC was expressed as percentage. MVV was assessed by asking the subject to inhale and exhale as rapidly and deeply as possible for a period of 15 seconds.

Statistical analysis

The results are expressed as Mean ± SD or percentages. SPSS Software version 20.0 (SPSS Inc., IBM Corporation, Chicago, IL, USA) was used for analysis. Pearson's correlation coefficient was used to measure the degree of relationship. *P* <0.05 was considered significant.

Results:

The characteristics of the study population and the lung function measurements in % of predicted are as presented in table 1 and table

2 respectively.

Table 1: Distribution of parameters among obese subjects

Characteristics	Mean±SD
Age (years)	45.0±6.4
Weight (kg)	79.5±9.98
Height (m)	1.59±0.07
BMI (kg/m²)	31.9±1.78
MAC (cms)	30.8±1.81
WC (cms)	102.8±7.04
HC (cms)	106.9±6.49
WHR	0.96±0.03
BF%	37.99±6.03
FM (kg)	30.65±5.19
FFM (kg)	50.37±7.69
FMI (kg/m²)	13.99±3.06

Table 2: Correlation of FM and FFM with Pulmonary Functions among Obese Subjects.

Parameters	Mean±SD	Correlation coefficients (r) with FM (kg)		Correlation coefficients (r) with FFM (kg)	
		r	p	r	p
FVC (L)	3.57 ± 0.86	-0.24	0.09, NS	+ 0.94	< 0.001**, HS
FEV_1 (L)	3.34 ± 0.85	-0.26	0.07, NS	+ 0.89	< 0.001**, HS
FEV_1/FVC (%)	93.8 ±9.6	+ 0.05	0.74, NS	+ 0.15	0.30, NS
PEFR (L/Sec)	7.36 ±1.90	+0.35	0.01*,S	+ 0.07	0.62, NS
$FEF_{25-75\%}$ (L/Sec)	3.35 ±0.81	+0.12	0.43, NS	+ 0.65	< 0.001**, HS
MVV (L/min)	117.9 ±33.8	-0.32	0.02*, S	+ 0.94	< 0.001**, HS

r – pearson's correlation coefficient
* - p<0.05, S ; ** - p<0.01, HS

A non-significant inverse correlation of FM with FVC and FEV_1 was found among obese subjects. This inverse correlation shows that as FM increases there will be reduction in the levels of FVC and FEV_1. The Correlation coefficient of FM and FEV_1/ FVC ratio showed a negative non-significant relation and so also there was no relation between FM and Mean forced expiratory flow during the middle of FVC ($FEF_{25-75\%}$). A significant positive correlation was observed between FM and PEFR among obese subjects (Table 2, Fig 1). The correlation coefficient was significantly negative between FM and MVV however, as FM increased there was significant reduction observed in the levels of MVV (Table 2, Fig 1)

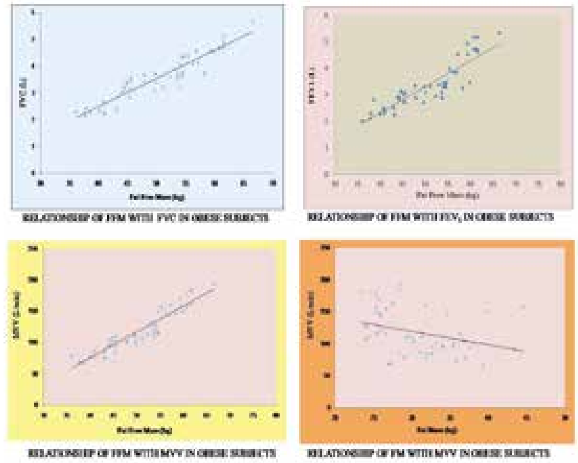

Fig 1: Relationship of FM and FFM with lung functions.

A significantly positive correlation of FFM was observed for FVC and FEV_1. The correlation of FFM with $FEF_{25-75\%}$ and MVV showed to be significantly positive (r = +0.65 and r = +0.94 respectively). The above results shows that as FFM increases there will be significant increase in the levels of FVC, FEV_1, $FEF_{25-75\%}$ and MVV among both (Table 2, Fig 1).

Discussion:

This study showed a significantly higher FFM and FM in obese (p<0.001). This goes in agreement with studies done by Yu et al. [8] In present study the level FVC, FEV_1, $FEF_{25-75\%}$ was significantly higher in subjects with BMI >30kg/m² than with lesser BMI. It reflects a negative correlation of BMI with certain pulmonary functions. This is supported by the study of Yogesh saxena et al [9] which showed that Obesity per se has less effect on dynamic function test. Study by Lazarus et al on cohort of men (aged 21-80 years) found that BMI was negatively associated with FVC among the age of 40 and 69 years. [10]

Pulmonary functions are less influenced with the extent of total fat mass however, the pulmonary functions initially increases in parallel with weight gain due to the related increase in muscle strength could be the probable explanation for the results obtained in our study. [11] A study done on pulmonary function in obese subjects with normal FEV_1/FVC ratio reported that much more severe obesity required to affect the pulmonary functions. [12]

A lower level of PEFR in the obese individuals was observed which is in accordance with the work of Ofuya et al. [13] Fat deposition reduces the movement of thoracic wall and Rubenstein et al confirmed that in obese subjects maximal expiratory flow rates were reduced at low lung volumes suggesting peripheral air flow limitation and obese people must overcome airway resistance.[14] In the present study increased waist circumference was accompanied by a significant reduction in FVC and FEV_1. This can be explained by the larger mean waist circumference seen in obese. In 1998, Lean et al. reported a negative correlation between waist circumference and FEV_1/FVC ratio as also observed in the present study. [15]

Higher BMI is associated with both increased FM and muscle mass (ie, FFM), which have been shown to have opposite effects on lung function in this and other studies. [16]

Conclusion:

Body composition is important predictor of early changes in pulmonary functions among obese middle aged subjects and hence it is important to take into account the body composition instead of BMI alone while determining early changes in lung functions.

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