A Study Of Correlation Of Pulmonary Functions And Percentage Of Body Fat In Normal And Overweight Medical Students

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Abstract: **Background & Objectives:** Clinically less severe obesity like overweight is not generally thought to have significant effect on ventilator function. The purpose of our study is to explore effects of body fat percentage and its distribution on ventilatory functions. We hypothesized that there is significant difference in Pulmonary Function among normal and overweight young healthy adults. Objectives: To assess & compare the difference in Pulmonary Function Tests among normal and overweight young healthy adults and to detect the correlation between Pulmonary Function Tests and Body fat percentage if any. **Method:** The study underwent in one forty eight young healthy medical students (74 male & 74 female) of 18-25 years of SMS Medical College, Jaipur categorized into 4 groups - Normal weight (37 males and 37 females) & over weight (37males and 37 females) on the basis of BMI. After measuring skin fat thickness with the help of Lange calliper, body fat percentage was calculated by Durnin and Womersley method. Body fat distribution was also estimated by measuring waist hip ratio and then pulmonary function tests were recorded by spirometer(Medspiror) in all groups. **Results:** Analysis done by using SPSS window. Simple regression was used to determine correlation and 'r' is coefficient of correlation. In males and females overweight groups forced vital capacity (FVC), and FEV1 were decreased significantly ($P<0.05$). In males group body fat % showed significant negative correlation with FVC ($r = -0.2$), and FEV1 ($r = -0.20$). It is seen that body fat % in females also had negative correlation with FVC ($r = -0.2$) and FEV1($r= -0.24$). Whereas WHR with FVC in males shows($r= -7.3$) and with FEV1($r= -7.4$). In case of females subject WHR also shows negative correlation with FVC($r= -11.6$) and FEV1 ($r= -10.5$). **Interpretation & Conclusion:** Our study shows that increase in body fat percentage itself and the way of fat distribution have sovereign effects on pulmonary functions.

Keywords: Pulmonary function, Body fat %.

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Introduction: It is globally accepted that obesity is a health hazard because of its strong association with numerous complications like cardiovascular accidents hypertension diabetes mellitus[1]. Excess body weight is the 6th most important risk factor contributing overall burden of disease in worldwide[2]. Obesity has now become an important health problem in developing countries particularly in India which is currently experiencing a rapid epidemiological transition[2].

Recent National Health & Family Survey (NFHS-III) (2005-2006) have observed an increase in prevalence of overweight & obesity in age group of 18-45 yrs from total average of 10.6% (1998-99) to 14.4 (2005)[3]. The typical obesity phenotype observed in Indian consists of higher percentage of body fat at a lower value of BMI and high waist to hip ratio (WHR) [4]. There are very few studies on fat percentage and distribution in Indians[5]. The influence of increased percentage of body fat & central obesity on blood pressure & glucose inference has been well documented. Despite important health concerns, the limitations imposed on respiratory function by fat percentage and its distribution are rarely recognized & have received relatively little attention[6]. Obesity is associated with a variety of medical disorders including the lesser known but not less important respiratory complications vice, airway hyper-responsiveness, hypoventilation syndrome and asthma[7].

Obesity has clear potential to have a direct effect on respiratory well being since it increase oxygen consumption and carbon dioxide production while at the same time it stiffens the respiratory system and increase the mechanical work needed for breathing[8]. The purpose of this study is to find out fat percentage and its distribution in adults including normal & overweight subjects & to extend the findings of previous studies of exploring the effect of fat distribution on ventilation function in adult because clarification & wide recognition of adverse consequence of excess adiposity may be important both for public health & clinical practice.

Material and Method: The study was conducted in 148 young healthy medical students of both sex aged between 18 to 25 years in the Department of Physiology SMS Medical College, Jaipur. Following approval of the review committee and due consent of the medical students, were subjected for BMI examination, detailed history and physical examination and were grouped into four categories:

1 Normal Weight (BMI 18.5 to 24.9)
2 Overweight (BMI 25.0 to 29.9)
3 Obese (BMI ≥ 30.0)
4 Underweight (BMI <18.5)

Obese & underweight students were excluded from the study at the beginning.

Exclusion Criteria:

1 Individuals having BMI < 18.5 and BMI ≥ 30.0
2 Subjects with history of cardiopulmonary disease
3 Medication for long duration
4 History of any major surgery (cardiac, pulmonary, abdominal) related to study
5 Smoker and alcoholics

By simple random sampling Normal weight groups (37 males and 37 females) and Overweight groups (37 males and 37 females) were selected to rule out gender effect on pulmonary functions and subjected first for anthropometric measurements for the determination of body fat and its distribution followed by pulmonary function tests in forenoon to avoid diurnal variation and were instructed with light breakfast but avoid beverages like tea, coffee and other stimulants before reporting. They were briefed & familiarized with the procedure.

Anthropometry: The study groups were subjected to anthropometry by using standard procedures. The following parameters were recorded.

1. Age: It was recorded according to the date of birth by calendar.
2. Height (m): It was measured with subject without shoes. The heels were placed together with buttocks, scapulae, and head were positioned in contact with the vertical bar of stadiometer, maintained in the Frankfort horizontal Plane position.
3. Body Weight (Kg): was recorded by a weighing scale with the subject without shoes with empty bladder.
4. Waist Circumference (cm) measured in standing position with arms at sides, done with minimal clothing with tailors measuring tape to the nearest 0.1 cm in a perpendicular to the long axis immediately superior to the iliac crest.
5. Hip circumference (cm): measured in standing position with minimal clothing's by measuring tape to the nearest 0.1 cm at maximal extension of at the level of trochanter.
6. Measurement of Skin Fold Thickness (mm): taken on right side of the body in standing position by using LANGE skin fold calliper (Cambridge Scientific Industries, Cambridge, Md) according to the technique described in anthropometric standardized References manual Measurements

Skin folds (mm)	Site
Biceps	Front of upper arm over the belly parallel to longitudinal axis of upper arm.
Triceps	Midpoint of the back of the upper arm between the tips of Olecranon and acromial processes, parallel to the longitudinal axis of the body .
Sub scapular	Below inferior angle of the scapula, at 45° to the vertical, along the natural cleavage lines of the skin to longitudinal axis of the upper arm
Supra iliac	Superiorly on the iliac crest in mid axillary line.

Then body fat percentage was calculated by Durnin and Womersley method[9] and pulmonary function tests were performed .The following parameters will be calculated from these data:-1. BMI = Weight / Height^2 (kg/m^2) Values used for classifying the subjects into four groups.WHR (waist hip ratio) used to indicate the distribution of body fat.FVC and FEV1 recorded in one sitting on the same day by Medspiror made in India (Chandigarh) .Three satisfactory efforts were recorded according to the norms given by American thoracic society[10].

Analysis of data: Statistical analysis was performed using SPSS 10(Statistical Program for the Social Sciences) for Windows. The lung function tests were compared in both the normal and overweight groups by the 'unpaired t' test. Data were expressed as Mean ± SD. Statistical significance was indicated by 'P' value <0.05.Simple Regression was used to determine the relation between the variables fat percentage with FVC and FEV1 also between WHR and FVC and FEV1in both males and females. Coefficient of correlation expressed as 'r'.

Results: The anthropometric parameters of the male and female groups are given in Table 1. In the present study age and height of the subjects were homogenous. There was significant difference in the waist to hip ratio and percentage body fat. The observed values of various lung function parameters are provided in Table 2.

TABLE 1: Comparison of Mean ± SD values of anthropometric parameters of four groups

	Males		Females	
Parameters	Normal weight(37)	Over weight(37)	Normal weight(37)	Overweight(37)
Age(years)	19.81 ±1.58	19.73 ±1.24	19.68 ±1.38	18.97 ±0.76
Weight(Kg)	63.73 ±6.19	79.32 ±6.28	54.52 ±4.90	71.05 ±4.61
Height(meter)	1.71 ±0.05	1.70 ±0.05	1.60 ±0.05	1.62 ±0.02
BMI	21.80 ±1.63	27.42 ±1.72	21.28 ±1.65	27.14 ±1.46
WHR	0.81 ±0.04	0.94 ±0.02	0.81 ±0.05	0.90 ±0.01
skin fold thickness(mm)				
Biceps	9.97 ±2.46	18.05 ±5.03	11.30 ±3.67	22.16 ±3.94
Triceps	12.41 ±4.58	22.57 ±4.80	19.59 ±3.97	29.57 ±4.38
Sub scapular	16.43 ±5.13	26.65 ±4.71	20.51 ±4.69	31.30 ±7.35
Supra illiac	17.62 ±5.16	27.08 ±5.95	20.97 ±5.86	32.92 ±7.29
Body Fat%	20.15 ±3.11	26.67 ±2.49	31.31 ±2.76	39.03 ±2.23

P<0.05 unpaired't' test; Body Fat % – calculated by Durnin and Womersley method

TABLE 2: Comparison of Mean ± SD values of lung function tests of the normal and overweight groups.

	Males		Females	
Parameters	Normal weight(37)	Over weight(37)	Normal weight(37)	Overweight(37)
FVC	3.95 ±0.74	3.71 ±0.57	3.21 ±0.41	2.99 ±0.48
FEV1	3.26 ±0.68	2.96 ±0.53	2.48 ±0.34	2.30 ±0.55

P<0.05 Student unpaired't' test

In both overweight groups of males and females forced vital capacity (FVC), and FEV1 were decreased significantly (P<0.05). In males group body fat % showed significant negative correlation with FVC (r = –0.2), and FEV1 (r = –0.20). It is seen that body fat % in females also had negative correlation with FVC (r = –0.2) and FEV1(r = –.24). Whereas WHR with FVC in males shows(r= –7.3) and with FEV1(r= –7.4). In case of females subject WHR also shows negative correlation with FVC(r=– 11.6) and FEV1 (r= –10.5)

TABLE 3: Simple regression analysis of overweight males

	Variable	coefficient	SE	1 sided P value
FVC	intercept	9.19	0.4	<0.05
	fat%	-0.2	0.01	<0.05
FEV1	intercept	8.36	0.29	<0.05
	fat%	-0.2	0.01	<0.05
FVC	intercept	10.39	4.32	<0.05
	WHR	-7.3	4.74	<0.05
FEV1	intercept	9.74	4.01	<0.05
	WHR	-7.4	4.4	<0.05

TABLE 4: Simple regression analysis of overweight females

	Variable	Coefficient	SE	t	1sided Pvalue
FVC	intercept	11.26	0.4	23.18	<0.05

	fat%	-0.2	0.01	17	<0.05
FEV1	intercept	11.8	0.51	23.1	<0.05
	fat%	-0.24	0.01	18	<0.05
FVC	intercept	13.5	4.7	2.8	<0.05
	WHR	-11.6	5.29	2.2	<0.05
FEV1	intercept	11.8	5.55	2.12	<0.05
	WHR	-10.5	6.1	1.7	<0.05

Discussions: This study showed the correlation of pulmonary functions with body fat percentage in a group of young subjects. In this study, FVC correlated negatively with body fat % in both the male and female subjects. The observed values of decreased FVC suggested mechanical effect of excess fat on diaphragm and chest wall increases work of breathing. In this study in the males and females group FEV1 showed negative correlation with body fat %. Both FEV1 and FVC are the lung functions most strongly associated to body composition and fat distribution. Increase in adult body mass is a predictor of FEV1 decline also affirmed. The negative correlation of increased percentage of body fat and FEV1 was observed only in males as reported earlier. Indians have higher fatness it lower BMI. Body fat usually constitutes 15 to 20% of body mass in healthy men and 25 to 30% in healthy women these findings are supported by Cotes study[11] .These results are also similar to Collin's et al[12] . Increase in fat percentage tends to impair respiratory function in both genders like in study of Koziel et al[13]. In our study FEV1 and FVC are also negatively correlated with WHR. Waist to hip ratio (WHR) is highly correlated with abdominal fat mass. Canoy et al analyzed the association of WHR with FVC and FEV1 in both male and female found significant inverse association. Our findings are similar to finding of Canoy et al on association of WHR and pulmonary function[14]. Because increase WHR directly measures of upper body fat distribution (central adiposity) has significant effect on pulmonary function[15]. Abdominal and thoracic fat are likely to have direct effects on downward movement of diaphragm and on chest wall property[8].

Conclusion: Our study shows that increase in body fat percentage itself and the way of fat distribution have sovereign effects pulmonary functions. Present study shows altered respiratory functions even in mildly and moderately obese persons which indicate that pulmonary function test especially lung volumes must be interpreted carefully in this population. Our findings are of clinical and public health importance because they suggest that impaired ventilatory function should be added to already long list of adverse consequences of excess adiposity.

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