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A study of correlation of FEV1/FVC ratio with body fat percentage in young individuals

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Abstracts:
Background:*For diagnosing pulmonary disease lung function tests are most important. The purpose of this study was to find out the association of body fat percentage and its distribution on pulmonary functions. We hypothesized that there is significant difference in Pulmonary Function FEV1/FVC among normal and overweight young healthy adults.*
Objectives:*To measure Pulmonary Function FEV1/FVC ratio among normal and overweight young healthy adults and to detect the correlation between FEV1/FVC and Body fat percentage, if any.*
Methods:*The study underwent in one forty eight young healthyindividuals (74 male & 74 female) of 18-25 years of in Department of Physiology,S.M.S. Medical College, Jaipur categorized into 4groups - 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 Medspiror spirometer in all groups.*
Results:*Analysis done by using SPSS window. Parameters were compared by unpaired t test. Mean value of FEV1/FVC among males of normal weight[(83±8.61,(n=37)]and of overweight[80±3.68,(n=37)]was noted, in females of normal weight [76±2.79,(n=37)]and of overweight [79.09±6.40,(n=37)]found. P value was >0.05 NS among both genders. Pearson's Coefficient of correlation (r) used. Non-Significant correlation(r) of FEV1/FVC with body fat% and WHR in overweight males r=-0.2,r=-0.1,where as in overweight females r=-0.1,r=-0.2 was noted respectively.*
Conclusion:*This study shows that with increase in body fat percentage itself and the way of fat distribution have no significant effect on FEV1/FVC ratio.*
Keywords:*Body fat percentage, FEV1/FVCratio,pulmonary function.*

I. Introduction

Overweight and obesity are rapidly escalating problem in developing countries[1, 2, and 4]. Excess body fat, in particular abdominal fat is a forerunnerofseveral adverse metabolic consequences including hyperinsulinemia, impaired glucose tolerance[3, 4, and 5]. It is well known that Asian Indians have excess fat content as well as increased abdominal adiposity at lower BMI[4, 6, 7]. Recent Indian studies have revealed that almost 20% of adults who were not overweight or obese still had central obesity, putting them at a greater risk of developing associated diseases[8].BMI [weight(Kg)/height^2(m^2)] is global measure of body mass that includes both fat mass and fat free mass and it does not accounts fat distribution. With regards to lung Function the evidence suggests that change in weight or change in body mass are negatively associated with changes in lung function in adults[9].Obese individuals face exertional dyspnoea without any pulmonary abnormalities due to increased work of breathing and the metabolic load placed on their gas transport system, when performing external work[10]. Although the impairment of lung function is now widely recognized among grossly obese individuals less is known about milder forms of obesity or the effects of regional fat distribution on pulmonary functions[11].To describe term how much fat in an individual, generic phrases fatness or adiposity are used to describe in this article. The aim of this study is first to calculate the adiposity in terms of fat percentage and its distribution in adults including normal & overweight subjects & secondly the findings of earlier studies of effectof fat percentage and its distribution on FEV1/FVC can be evaluated in adults and hence adverse consequences of excess adiposity can be recognised which can be important both for public health & clinical practice.

II. Material and Methods

The study was conducted in 148 volunteer young healthy individualsof both gender aged between 18 to 25 years in Department of Physiology, S.M.S. Medical College at Jaipur. Following approval of the review committee and due consent of the subjects, were examined for BMI. After 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 $\geq$ 30.0)
4. Underweight (BMI <18.5)

Obese & underweightsubjects were excluded from the study at the beginning.

III. Exclusion Criteria

1. Individuals having BMI < 18.5 and BMI $\geq$ 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. Smokers 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 (yrs.): 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. Skin Fold Thickness (mm): measurements 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 reference manual.

Skin folds (mm)	Site of measurements
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.
Subscapular	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
Suprailiac	Superiorly on the iliac crest in mid axillary line.

Then body fat percentage was calculated by Durnin and Womersley method and pulmonary function tests were performed[12].The following parameters were 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. Pulmonary function tests were 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[13].

IV. 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 student unpaired't' test. Data were expressed as Mean±SD. Statistical significance was indicated by 'P' value <0.05.Pearsons coefficient of correlation was used to determine the correlation between the variable fat percentage with FEV1/FVC also between WHR and FEV1/FVC in both genders. Coefficient of correlation expressed as 'r'.

V. Results

The anthropometric parameters of the male and female groups are given in Table I. In the present study age and height of the subjects were non-significanti.e. sampling 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 II.

Table I: 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
Subscapular*	16.43	±5.13	26.65	±4.71	20.51	±4.69	31.30	±7.35
Suprailliac*	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 significant unpaired't' test; Body Fat % – calculated by Durnin and Womersley method
**P>0.05 not significant, BMI= Body Mass Index, WHR=waist hip ratio

Table II: Comparison of Mean±SD values of FEV1/FVC ratio of the normal and overweight groups.

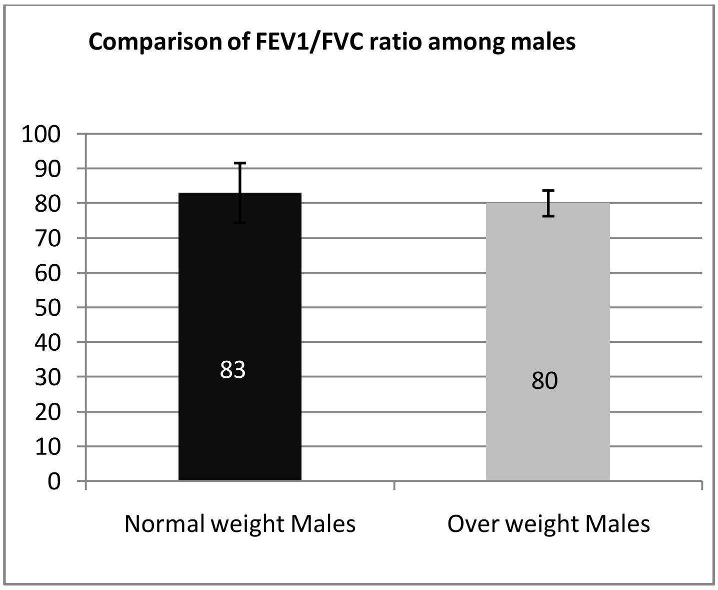
	Males				Females			
Parameter	Normal weight(37)		Over weight(37)		Normal weight(37)		Overweight(37)	
FEV1/FVC	83	± 8.61	80	±3.68	76.89	±2.79	79.09	±6.40

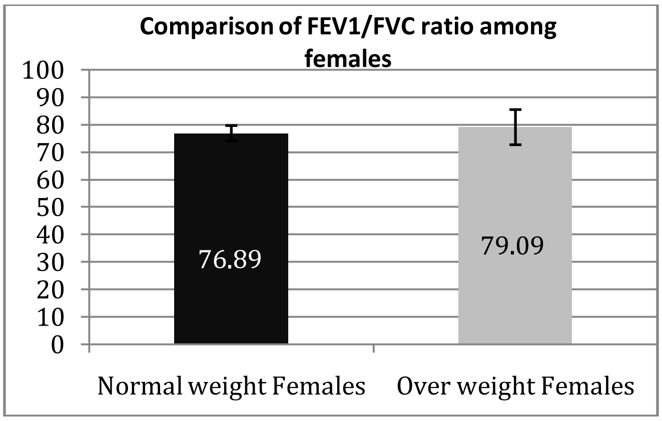
P>0.05Not significant Studentunpaired't' test

Table III: Correlation of FEV1/FVC ratio with Fat% and WHR among overweight males and females

Parameters	Overweight males(37)	Overweight females(37)	P value
Fat%	-0.2	-0.1	>0.05
WHR	-0.1	-0.2	>0.05

P>0.05 Not Significant





VI. Analysis Of Results

In both overweight groups of males and females ratio of FEV1/FVC were not significantly affected (P>0.05).The coefficient of correlation FEV1/FVC and body fat % in overweight male was r=-0.2, and with WHRwas(r=–0.1), whereasin females the value of coefficient of correlation with fat% was (r =-0.1) and WHR(r = –0.2).In both overweight group non-significant correlation were observed with both Fat% and WHR.

VII. Discussion

This study explored the correlation of FEV1/FVC ratio with fat% and its distribution. Predicted values of pulmonary function tests depends on gender, age, height and body weight[14]. It is well established that BMI is conveniently used butitdoesn'tdifferentiate the relativecontribution of fat mass and fat free mass also not considered the distribution of fat in body. Fat mass are adipose tissue and fat free mass, consisting of everything else[15, 16, and 17]. The changes in fat mass and fat free mass can affect the lungs however they have opposite effect on pulmonary functions[18]. Increase in fat mass, particularly of upper body (or central) is negatively associated with Spirometric variables whereas with increase in fat free mass raises these variables[19].The negative association fat percentage with FEV1 and FVC confirms the effect of fat on ventilator function is not limited to extreme obesity[11]. In this study the FEV1/FVC ratio is remain unaffected by fat percentage and its distribution in both overweight males and females indicating that both FEV1 and FVC are influenced up to same extent. This finding implies that the major effect of obesity on lung volumes with no direct effect on airway obstruction[9,20,21,22,23,24,25,26]. Pulmonary functions are influenced by extent of fat and its distribution directly through various mechanisms. With increase of waist hip ratio ,fat distribution goes more towards upper part of body due to which thoracic volumes decreases, respiratory muscles power reduces and eventually worse the mechanical efficiency, more work is required to move the heavier chest. The accumulation of fat may mechanically affect the expansion of diaphragm probably by encroaching into the chest wall or diaphragm or by impeding the descent of diaphragm during forced inspiration. The mechanical effects of the intra-abdominal pressure on the diaphragm are probably the major basis for the association of central obesity with compromised lung functions[11, 17, 19, and 27]. In a previous study observed that subjects with severe obesity reported more wheeze which indicate asthma, their airway hyper responsiveness,and airway obstruction did not support the suggestion of a higher prevalence of asthma in this group[28]. The FEV1/FVC ratio was not significantly abnormal and were found to be within predicted range is in both groups is consistent with findings from National Health and Nutrition Examination Survey, which suggest that no association between adiposity and air flow obstruction[17].

VIII. Conclusion

The body fatness is the best assessed by calculating the Fat percentage rather than body weight and BMI. Body fat percentage and its distribution are inversely associated with Parameters FEV1 and FVC except FEV1/FVC ratio, implies that there is not direct effect on airways.

IX. Strength and Limitations of the Study

In this study by use of Skin Fold thickness and Durnin-Womersleymethod,adiposity was calculated in terms of fat percentage which is superior to BMI since it include both fat mass and fat free mass therefore results of correlation of fat percentage and pulmonary function are more precise. The entire population that was included in the study was Indian and findings may not be translated to other population is a limitation of this study. Despite the all possible confounders we could not totally rule out residual confounding factors. Further exploration this study is still needed.

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