Analysis Of Lung Functions In Obese Young Adult Male

Ashvin Sorani*, Chirag Savalia, Bharat Chavda*, Bijal Panchal***, Payal Jivani*****

** Assistant Professor, *Tutor, ***Third year resident, Department of Physiology, P.D.U. Govt.Medical College, Rajkot 360001

Abstract: Background: To determine the effect of obesity on pulmonary function abnormality in young adult male medical students. Method : One fourty male subjects underwent physical examination, computerised pulmonary function tests (spirometry, lung volumes) and various anthropometric measurements (waist-hip ratio,BMI, skin fold thickness)out of which seventy were case and seventy were control. Result: Result showed that expiratory reserve volume and maximum voluntary ventilation were significantly decreased in overweight group (p<0.001). There was negative correlation observed between BF% and ERV(-0.49),FVC(-0.05),and MVV(-0.11). There was negative correlation observed between BMI and ERV(-0.46) and MVV(-0.17).WHR also showed negative correlation with ERV(-0.14).All skin fold measurements shows negative correlation with ERV ,FVC and MVV. Conclusion: A significant negative correlation of ERV, FVC with body fat percentage. It was also observed that statistically significant decreased ERV as the BMI increases.

Key Words: Pulmonary function tests, BF-body fat, BMI-body mass index, Waist Hip ratio, Skin fold thickness, Young adult male.

Author for correspondence: Dr.Chirag V. Savalia, Department of Physiology,P.D.U. Govt. Medical College, Rajkot –360001.e- mail: chiragsavalia2001@gmail.com

Introduction: An increase in the prevalence of obesity in young adults has been seen around the world.[1] Although the influence of obesity on pulmonary function tests has been examined, the role of body fat distribution has received limited attention. Pulmonary studies of patients severely affected by upper body obesity suggest they have more severely compromised lung volumes than obese patients with lower body obesity.

Multiple measures of adiposity showed a significant inverse relationship with both spirometry and static lung volumes. There is no doubt that the percentages are even greater nowadays because of physical inactivity and westernisation in diet. In adults, pulmonary function abnormalities are well reported complications of obesity; the most frequently reported abnormalities are reductions in lung volumes and expiratory flow rates.[2–6] Thus the aimof the study determine the effect of obesity on pulmonary function abnormality in young adults in our population.

Material And Method: Study was performed on 140 healthy, otherwise asymptomatic young individuals in the age group of 18 to 24 yrs selected from medical students. Individuals doing regular exercise, having respiratory infections or any other respiratory diseases, smokers, hypertensive, or having any musculoskeletal deformities of chest/vertebral column were excluded from the study.

The subjects, to be enrolled for the study, were informed about the study and procedure details and an informed consent was obtained. The subjects were all healthy asymptomatic.

All participants provided information on age, family history, personal habits (alcohol intake, tobacco consumption, type and level of physical exercise, drug ingestion, known pathological conditions). A detailed physical examination was conducted to exclude cardiac or pulmonary diseases. Our study was reviewed and approved by the Ethics Committee. All the records i.e. anthropometric measurements, skin fold measurements and recording of pulmonary function tests were conducted in one sitting on the same day.Anthropometric variables like height and weight were obtained. Height was measured to the nearest of 0.1cm and weight was measured to the nearest of 0.1kg with minimum of clothes and no shoes. Body mass index was calculated by Quetelet's Index .[7]

The waist circumference (cm) was measured at a point midway between the lower rib and iliac crest, in a horizontal plane. The hip circumference (cm) was measured at the widest girth of the hip. The measurements were recorded to the nearest 0.1 cm.

Skin fold thickness was measured at four standard anatomical sites with the help by measuring skin fold thickness at four sites (4SFT-biceps, triceps, subscapular and suprailiac) with the help of Harpenden's caliper. The percentage of body fat was estimated by using the method of Durnin and Womersley. [8]

Pulmonary functions were recorded on a computerized portable lung function unit SP-1. The recorded parameters were compared with the inbuilt pulmonary function norms for the Indian population depending upon the age, sex, height, and weight. Recording of static and dynamic pulmonary function tests was conducted on motivated young healthy volunteers in standing position [9]

These tests were recorded at noon before lunch, as expiratory flow rates are highest at noon. For each volunteer three satisfactory efforts were recorded according to the norms given by American Thoracic Society[10]. The essential parameters obtained were, tidal volume (VT), expiratory reserve volume (ERV), inspiratory capacity (IC), forced vital capacity (FVC), timed vital capacity (FEV1), maximum ventilator volume (MVV) and peak expiratory flow rate (PEFR).

Result: The effect of body fat percentage on ventilatory lung function tests were compared in both the normal (BF<20%) and obese (BF>20%) groups by the 'unpaired t' test. Also the effect of body mass index on ventilatory lung function tests were compared in control (BMI18-25Kg/m2), overweight (>25 Kg/m2) groups by the unpaired T test Data were expressed as Mean±SD. Statistical significance was indicated by 'P' value <0.05.

Correlation of ventilatory lung function tests with body fat percentage was noted by using Pearson's correlation coefficient test. The non zero values of 'r' between -1 to 0 indicate negative correlation.

Anthropometric parameters of the subjects are given in Table 1. In this study there was statistically significant difference in body mass index and waist to hip ratio observed in obese subjects. There was also statistically significant difference observed between skinfold thickness of biceps and suprailiac skinfold thickness in this study.(Body Fat % – Calculated By urnin and Womersley Method)

Table 1: Comparision Of Mean±Sd Values Of Anthropometric Parameters Of Control And Obese Group

PARAMETERS	CONTROL(N=70) (BF<20%)	OBESE(N=70) (BF>20%)	P VALUE
Age(years)	19.03±0.24	22.14±0.24	0.834
Height(cm)	171.6±0.71	166.3±0.54	0.5901
Weight(kg)	64.89±1.036	80.09±0.53	0.6001
Bmi(kg/m2)	22.07±0.30	29.00±0.20*	P<0.0001
Whr	0.83±0.009	0.93±0.007	0.7854
Skinford thickness (mm)			
Biceps	7.8±0.31	14.6±0.22*	0.7854
Triceps	9.8±0.36	18.7±0.42	0.842
Subscapular	13.1±0.38	23.14±0.56	0.768
Suprailiac	15.31±0.4	27.04±0.68*	0.0256

*p<0.05 is statistically significant (student t-test ,unpaired observations)

Table 2 shows results of pulmonary function tests in control(bf<20%) and obese groups(bf>20%). Result shows that expiratory reserve volume and maximum voluntary ventilation were significantly decreased in obese group (p<0.001).

Table 2: ComparisionOfMean±Sd Values Of Pulmonary Function Tests Amongst The Control And Obese Groups

Parameter	Control (N=70) (Bf<20%)	Obese (N=70) (Bf>20%)	P Value
ERV(L)	1.1±0.041	0.71±0.0079*	<0.0001
IC(L)	3.31±0.018	3.14±0.041	0.8004
FVC(L)	4.18±0.047	3.74±0.03	0.751
FEV_1/FVC	0.7904±0.0025	0.79±0.0024	0.9154
MVV (L/Min)	127.5±3.56	118.9±1.31*	0.0257
PEFR (L/Min)	424.9±10.68	445.5±9.38	0.8500
$FEF_{25-75\%}$ (L/Sec)	4.913±0.014	4.919±0.011	0.7448

*P<0.05 is statistically significant (student tTest ,unpaired observations)There was negative correlation observed between BF% and ERV (-0.49),FVC(-0.05),and MVV(-0.11). There was negative correlation observed between BMI and ERV(-0.46) and MVV(-0.17). WHR also showed negative correlation with ERV(-0.14). All skin fold measurements shows negative correlation with ERV. In this study we have also made a correlation of BMI and pulmonary function tests by dividing subjects in two groups. Significant decrease in ERV and FVC was observed in overweight group.

Table 3: shows pearson correlation coefficients in all subjects

	ERV(L)	IC(L)	FVC (L)	FEVI/FVC	MVV (l/min)	PEFR (l/min)	FEF 25-75%
BF%	-0.49	0.22	-0.05	0.227	-0.119	0.126	0.032
BMI (Kg/m^2)	-0.46	0.31	-0.11	0.250	-0.175	0.071	0.031
WHR	-0.14	0.18	0.01	0.045	-0.108	0.107	0.099
BICEPS SFT(mm)	-0.42	0.20	-0.13	0.263	-0.145	0.117	-0.036
TRICEPS SFT(mm)	-0.36	0.27	-0.20	0.273	-0.141	0.148	0.077
SUBSCAPULAR SFT(mm)	-0.46	0.27	-0.04	0.199	-0.087	0.144	0.002
SUPRAILIAC SFT(mm)	-0.42	0.21	-0.05	0.190	-0.133	0.122	0.055

Table 4: ComparisionOfMean±Sd Values Of Pulmonary Function Tests Amongst The Control, Overweight Group

PARAMETERS	CONTROL (n=70) (18-25 Kg/m^2)	OVERWEIGHT (n=70) (>25 Kg/m^2)	p value
ERV(L)	1.045±0.49	0.66±0.096*	<0.0001
IC(L)	3.32±0.17	3.11±0.35	o.6374
FVC(L)	3.67±0.41	3.10±0.51*	<0.0001
FEV_1/FVC	0.79±0.022	0.80±0.02	0.7865
MVV(L/Min)	121±32.16	117.8±8.6	o.9653
PEFR(L/Min)	428.6±66.15	439.7±63.48	0.8743
$FEF_{25-75\%}$ (L/Sec)	4.92±0.14	4.98±0.10	0.7864

*p<0.05 is statistically significant (student t-Test ,unpaired observations)

Discussion: The present study demonstrated the relationship between pulmonary function and body fat percentage in young males in age group 18-24 yrs. Collected data were analyzed by comparing BMI as well as calculated body fat percentage and their relationship with pulmonary functions in young individuals

Fat% And Pulmonary Function: In the present study obese group showed decreased ERV, FVC, MVV. There was no significant difference observed in IC , FEF25-75%,FEV1/FVC ratio .Decreased ERV, FVC,MVV were also statistically significant(p<0.05). In present study we observed that fat% had negative correlation with ERV,FVC,MVV. The obese group with more than 20% increased fat% showed significant decreased ERV,FVC and MVV. Results obtained in the present study were in tune with the previous studies.[5,19]

BMI And Pulmonary Function: In the present study it was observed that increase in BMI is associated with significant decrease in ERV. Inverse relationship of BMI with FVC was observed in the present study. There was no significant correlation of BMI and IC, FEV1/FVC,MVV,PEFR and FEF25-75% Many previous studies also observed that increased BMI is associated with decreased ERV , as seen in our study also.[11,12,13,14,15]

BMI is a global measure of body fat mass that includes both fat and lean mass and takes no account of differences in fat distribution. Body mass index has been proposed to analyze the effects of increased weight on pulmonary function tests, but its use is only valid for lung function indices where the contribution of fat and muscles are synergistic.

The site of fat accumulation is crucial in determining the effect of obesity on respiratory system mechanics. BMI alone does not provide sufficient information about the bodily distribution of fat mass (FM)4. it was also noted that Indians are considerably obese at low BMI20 . So the evaluation of the change in pulmonary function in overweight subjects should be done by estimating body fat percentage.

In present study there was no significant effect of BMI on FEV1/FVC ratio observed. Body fat% also showed no positive correlation as well as no significant decrease in FEV1/FVC ratio .These all findings are in tune with previous studies and also observed that major effect of obesity is on lung volumes with no direct effect on airway obstruction.[20-24]

Another possible mechanism for the association of abdominal adiposity and pulmonary function is a mechanical limitation of chest expansion during the FVC maneuver. Increased abdominal mass may impede the descent of the diaphragm and increase thoracic pressure.

The cross sectional nature of this study is a limitation, as it does not provide information about temporal sequence. However longitudinal studies of longer duration are needed to further investigate how abdominal obesity and body fat influences pulmonary function.

Conclusion: A significant negative correlation of ERV with body fat percentage, indicating that ERV diminishes in inverse proportion of body fat percentage. A significant negative correlation of FVC with body fat percentage . The observed values of decreased FVC suggested displacement of air by fat within thorax and abdomen. It was also observed that lung volumes decreased as the BMI increases. In the present study it was also observed that although BMI of control group volunteers was within normal range, observed body fat percentage was on higher side. Hence, body fat percentage is more reliable marker for assessment of obesity.

References:

1. WHO. Obesity: preventing and managing the global epidemic: report of a WHO consultation. WHO technical report series; 894. Geneva: The Office of Publication, World Health Organisation, 1999
2. Koenig SM. Pulmonary complications of obesity: a review. Am J Med Sci 2001;321:249–79.
3. Biring MS, Lewis MI, Liu JT, et al. Pulmonary physiological changes of morbid obesity. Am J Med Sci 1999;318:293–7.
4. Lazarus R, Sparrow D, Weiss ST. Effect of obesity and fat distribution on ventilation function: the normative aging study. Chest 1997;111:891–898.
5. Collins LC, Hoberty PD, Walker JF, et al. The effect of body fat distribution on pulmonary function tests. Chest 1995;107:1298–302.
6. Jenkins SC, Moxham J. The effects of mild obesity on lung function.Respir Med 1991;85:309–11.
7. Garrow JS, Webster J. Quetelet's index as a measure of fatness. Int J Obes 1985; 9(2): 147–153.
8. Durnin JV, Womersley J. Body fat assessed from the body density and its estimation from skinfold thickness measurements on 481 men and women aged 16 to 72 years. Br J Nutr 1974; 32: 77–97.
9. Townsend MC. Spirometric forced expiratory volumes measured in standing verses sitting posture. Am Rev Respir Dis 1984; 130(1): 123– 124.
10. American thoracic society. Standardization of spirometry. 1994 update Am J

Respir&Crit Care Med 1995; 152: 1107–1136.

11. Ray cs,suedy,brayg,etal.fects of obesity on respiratory function .am rev respir dis 1983;128:501-506.
12. Richard l jones ,marymagdalene , effect of body mass index on lung volumes, chest 2006;130:827-833.
13. Bedell GN, Wilson WR, Seebohm PM. Pulmonary function in obese persons. J Clin Invest 1958; 37:1049–1060 22
14. McClean KM, Cardwell CR, Kee F. Longitudinal change in BMI and lung function in middle-aged men in Northern Ireland. Ir J Med Sci. 2007;176 Suppl 10:S418
15. Rubinstein I, Zamel N, DuBarry L, et al. Airflow limitation in morbidly obese, nonsmoking men. Ann Intern Med 1990; 112:828–832
16. Sahebjami h, dyspnea in obese healthy men. Chest 1998;114:1373-1377.14
17. J E Cotes, D J Chinn*, J W Reed, Body mass, fat percentage, and fat free mass as reference variables for lung function: effects on terms for age and sex. Thorax 2001;56:839–844
18. Cheryl M. Salome,Physiology of obesity and effects on lung function,JApplPhysiol 108:206-211,2010
19. Anuradha r. Joshi, ratansingh and a. R. Joshi, correlation of pulmonary function tests with body fat percentage in young individuals, Indian J PhysiolPharmacol 2008; 52 (4) : 383–388.
20. Mohan V, Deepa R. Obesity and abdominal obesity in Asian Indians. Indian J Medical Res 2006; 123: 593–596.
21. Sahebjamih,gartsideps.pulmonary function in obese subjects with a normal fev1/fvc ratio .chest 1996;110:1425-1429.13
22. SchachterLM,SalomeCM,PeatJK,Obesity is a risk factor for asthma and wheeze but not airway hyperresponsiveness.Thorax 56:4-8,2001.
23. Sin DD,JonesRL.Obesity is a risk factor for dyspnea but not for airflow obstruction.Arch Intern Med 162:1477-1481,2002.
24. Smith SR, Lovejoy JC, Greenway F, Ryan D, deJonge L, de la Bretonne J, Volafova J, Bray GA. Contributions of total body fat, abdominal subcutaneous adipose tissue compartments, and visceral adipose tissue to the metabolic complications of obesity. Metabolism. 2001;50(4):425-35.

Source Of Financial Support-Nil
Conflict Of Interest-None