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The Effect of Gender On The Relationship Between Body Fat Distribution & Lung Functions In Adult Indian Population

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Background: *Most population studies have reported weak or nonsignificant associations between body mass index (BMI; in kg/m2) and lung function.*
Objective: *This study focused on the distinct effects of fat distribution on lung function and examined these relations in elderly men& women*
Design: *The study was a done on 40 obese males & 40 obese femalesaged 30-55 yrs who were free from cardiovascular disease & respiratory disease & were from staff member of BJMC,& SASOON hospital pune.Anthropometric measurements were made & lung function was examined by using spirometry*
Results: *There was statistically reduced pulmonary function parameters among male & female subjects.among the adiposity markers WHR shows strong–ve co-relation with pulmonary function parameters like FEV1,FVC, &MVV in women than men*
Conclusion: *Thus, body fat distribution has independent effects on lung function that are more prominent in women than men*
Abstract: *Abdominal obesity, as measured by waist-to-hip ratio (WHR), has long been recognized as a risk factor for metabolic and cardiovascular diseases, little is known about the effect of WHR on pulmonary function, especially in women. In this study of 40 men and 40 women(30-55years) from BJMC &SasoonHospital,pune,were included w e assessed the association of respiratory parameters (WHR) as the markers of relative and abdominal obesity adiposity respectively. Statistical analysis was done to find out the association of FVC and FEV1 with over all and adiposity markers stratified by gender and adjusted to height and age. In women large values of WHR were associated with greater reductions of respiratory parameters FVC ,FEV1&MVV1.81+_0.26,1.56+_0.44,49.69+_12.12 resply&in men 2.29+_0.47,2.08+_0.5,63.18+_9.28resply.Thus, body fat distribution has independent effects on lung function that are more prominent in women than men.*

I. Introduction

Obesity is defined as "abnormal or excessive collection of fat in the body to the extent that the health is impaired" [WHO, 2000]. Today it is considered as an important global health hazard and has been linked to increased incidence of cardiovascular diseases, hypertension, metabolic disorders and pulmonary dysfunction [Afaf A S et al 2011, Heather M et al 2006].(1,2) Besides genetic predisposition, adoption of sedentary life style and inappropriate intake of calorie rich easily available junk food has made the environment conducive to development of obesity even in childhood [YogeshSaxena, et al 2008](3). Obesity is associated with reductions in lung volumes particularly vitalcapacity (VC) and forced expiratory volume in 1 s (FEV1) [4-7]. The mechanism for this reduction

In vital capacity has usually been ascribed to the mechanical effects of obesity on the rib cage and abdomen [1,5]. In recent years, however, it has been recognized that the pattern of obesity is an important predictor of adverse health effects such as diabetes [8-10], hypertension [8], hyperlipidemia [7],and coronary events [9,10]. Specifically, a pattern of central i.e., abdominal, obesity, as measured by waist-to-hip ratio(WHR), is associated with greater health risk than lower body obesity.Most previous studies of the relationship of obesity to lung function have used BMI as an indicator of overall obesity[4,12,13]. Little is known about the effect of WHR on lung function *per se*, particularly in women.The Clinical studies have reported that waist:hip ratio, as ameasure of abdominal obesity, was associated with poor respiratory function in both mildly obese (17) and morbidlyobese (14) persons. Another study reported that lung function was associated with waist:hip ratio in older men but not in women (15, 16). Inferences from these studies are limited,because many have been restricted to men, have focused on extreme levels of obesity therefore, the aim of present study was Does fat distribution, assessed by WHR, predict lungfunction in men and women even after accounting for overall obesity.& Can the gender difference in the relationship between
obesity and lung function be accounted for by different patterns of fat distribution

II. Materials And Methods

The present study was conducted in the Research laboratory, Department of Physiology, B.J.Govt Medical College., Pune.. The study subjects were briefed about the protocol and informed consent was obtained from each participant prior to the commencement of the study. A detailed history regarding their habits, physical activity, and history suggestive of any cardio respiratory or any other systemic illness was elicited. The study was approved by the Institutional Ethics committee.Individuals with regular physical activity or exercise, with a habit of alcohol and tobacco consumption, with respiratory or cardiovascular disorders and those with chest and spinal deformities were excluded from the study

Study group was consisted of 40 obese male & 40 obese female subjects randomly selected from the employees of BJGMC and Sassoon Hospital and general population Pune. The volunteers were asked to avoid tea, coffee and other stimulants to report with light breakfast at department of physiology, BJGMC Pune, in the forenoon to avoid diurnal variation. They were familiarized with procedure and demonstration of tests was done to help them to get adopted with procedure. Study Protocol The study was conducted in Physiology department, BJGMC,Pune. Following parameters were measured.Anthropometry

- **Age**-was recorded from birthday by calendar to the nearest of year<6mthsand>6mths
- Standing height- was recorded without shoes and with light cloths on a wallmounted measuring tape to nearest to centimeters (<5mm and>5mm)
- **Weight**-- was recorded without shoes and with light cloths on balance scale
- Body mass index (BMI) was calculated by formula ofweight (in kg) and
- height(inmeters) 2
- Waist circumference (WC):- WC was measurement with light cloths with feet 25-30cm apart and weight equallybalanced with tailors measuring tape in a plane erpendicular to long body axis at the level of umbilicus without compression of skin with nearest to 0.1cm.WC >90cm in men and>80cm in women were defined as abdominal obesity using WHO guidelines
- Hip circumference (HC) measurement done with minimal, adequate clothing across the greater trochanter with legs and feet together by measuring tape without compressing the skin fold
- Waist to hip ratio: -measured from the ratio of WC and HC and is measure of central pattern of fat distribution(>0.9 for male and>0.8 for female)

Respiratory parameters: pulmonary function tests were measured by using RMS-HELIOS-702 machine. The subjects were demonstrated the FVC maneuver in spirometry after they were allowed to rest for 5-10 min and after educating themabout the technique the test was carried in a sitting position andthe subject was asked to close the nose. The flow volume timed graphs were taken out in accordance to the criteria based on theAmerican Thoracic Society (Carey *et al.*, 1999) and best of the three acceptable curves was selected

The following spirometeric parameters were recordedFVC : Forced Vital capacity (L/sec)

FEV1 : Forced expiratory volume in 1st sec MVV: Maximum voluntary ventilation(L/min) The Forced Vital Capacity (FVC) manoeuvre was conductedin the following order:

- Subjects were instructed to take slow and deep inspiration.
- Then subjects were instructed to hold the mouthpiece in themouth with lips pursed around it and asked to blow forcefully into the mouthpiece as long as possible without hesitation and coughing. Then without removing them mouthpiece from the mouth, they were instructed to inspire maximally through the mouthpiece.Parameters recorded in this manoeuvre are
- Forced vital capacity (FVC) in litres.
- Force expiratory volume in one second (FEV1) in litres.

MVV: Maximum voluntary ventilation(L/min)-For calculating MVV subject was instructed to breathe asdeeply and as rapidly as he can for 15 sec.

III. Results

Table I illustrates the anthropomorphic parameters in obese male and obese female subjects showing no significant differences (p>0.05)between obese male and obese female subjects when age andheight were compared suggesting that the population studied ishomogenous in nature. As expected adiposity parameters like WC (112.8+_4.35) andWHR(1.06+0.04) were significantly (p<0.0001) higher inObese female group compared to obese male group WC (105.8+5.77) and WHR(1.03+_+0.03)

Table-2 shows the pulmonary function test parameters like FVC (1.81+_0.26),FEV1(1.56+_0.44) & MVV(49.69+_12.12) were significantly lower in obese female group compared to obese male group FVC(2.29+_0.47), FEV1(2.08+-0.5) & MVV(63.18+-9.28)

Table-3 shows the coorelation between adiposity markers &spirometric parameters in obese male & female group showing that BMI doesn't show any statically significant difference but there were statiscally difference of WHR & PFT Parameters in female & male obese group

*P<0.05, **P<0.001, #P<0.0001**Table-1 Comparison of Anthropometric measurement in Obese Male and Female Group**

Parameters	Obese Male	Obese Female
Age	46.4+_3.83	45.25+_7.25
BMI	29.99+_3.4	27.99+_3.04
Waist ratio	105.8+_5.77	112.8+_4.35
Hip ratio	101.7+_5.06	106+_5.22
WHR	1.03+_0.03	1.06+_0.04

Table-2 Comparison of FVC,FEV1& MVV in Obese Male & Female Group

Parameters	Male Obese Group	Female Obese Group
FVC	2.29+_0.47	1.81+_0.26
FEV1	2.08+_0.5	1.56+_0.44
MVV	63.18+_9.28	49.69+_12.12

Table 3: Correlation between obesity and spirometric parameter in obese male and female group

Parameter	Male		Female	
	BMI	WHR	BMI	WHR
FVC	-0.56 #	-0.42 *	-0.56 #	-0.72 #
FEV1	-0.57 #	-0.27	-0.53 **	-0.64 #
MVV	-0.39 *	-0.54 #	-0.32 *	-0.65 #

IV. Discussion

A few previous studies have examined the relationship of fat distribution and pulmonary function in men [16,17],but no previous studies have been conducted in women. To our knowledge, we studied the effect of body fat distribution, assessed by WHR, on lung function in obese female & obese male group.The main finding of this cross-sectional study is that WHR is a more important determinant of pulmonary function in women than in men. WHR is a significant predictor of FEV1 in women only, and appears to have a greater impacton FVC in women than in men. This finding supports the hypothesis that the gender difference in the pattern of fat distribution is one mechanism for the sex difference in lung function impairment due to weight gain [18,21]. Using multiple regression analysis, it is also apparent that WHR has agrater effect on lung function than commonly used measures of general obesity such as BMI.Several possibilities could account for the gender difference that we observed. First, it is possible that there is a difference in the way that distribution of fat affects the thoracic mechanics in women compared to men. Second, and more likely, is that there is a threshold below which WHR doesnot affect lung function. In a study of men only, Collins *etal*. [13] reported that men with WHR greater than 0.95 had a lower FEV1 and FVC than those with lower WHR. In accordance with previous studies, we found that there was little overlap in the distributions of WHR between men and women In contrast to our finding Lazarus et al found no inverse associations of waist circumference and waist/hip ratio with FVC in women (16). These authors also reported an inverse association of abdominal girth/hip breadth ratio with pulmonary function after adjustment for BMI in men over a narrow age range in the Normative Aging Study. Collins et al examined 42 normal to mildly obese firefighters and found decreased pulmonary function in men with a waist/hip ratio of > 0.95 (17). The finding of an inverse association of BMI and waist circumference and the stronger association of abdominal adiposity and pulmonary function in men points to the importance of what has been called "apple vs pear-shaped" body types. As with other chronic conditions, increased abdominal adiposity or having an "appleshape" may be an important indicator of lung health.The results are consistent with finding of Scottish cross-sectional survey of men and women aged 25–64 y, by Chen et al (18) where WC was inversely associated with FVC and FEV1 in both men and women. In a British cohort study of 9674 men and 11876women aged 45–79 y, Canoy et al (19) analyzed the association of WHR with FVCand FEV1 in both men and women and found a significant inverse association. The associations persisted after adjustment for potential confounding factors like age and height and BMI. The current study also showed a tendency toward a stronger association between WC and FEV1 after adjusting with BMI only in case of females.

Our findings are similar to findings of Canoy et al on association of waist/hip ratio and pulmonary function however WC showed an inverse association that remained significant after adjustment for BMI only in females.Harik-Khan et al (25) investigated the association of fat distribution and pulmonary function using waist/ hip ratio & reported an inverse association of FEV1 and waist/hip ratio in men only, which is seen in females in our finding. Koziel et al in their study on 40–50 years of volunteers found no association of WHR with FVC & FEV1 in females however in males FVC was negatively associated with WHR & positively with BMI and FEV1was positively associated with BMI & WHR (26

Thus, it is possible that abdominal fat deposition in men was not high enough to adversely affect lung function. Inwomen however, abdominal obesity impaired ventilatory function.It is noteworthy that gender differences in the distributionof fat have been postulated to account for the male–female difference in sleep apnea syndrome [31]. Premenopausalwomen who develop sleep apnea are substantially heavier than men. Previous studies have also shown that theincrease in body weight that occurs following smoking cessationhas greater impact on lung function in men than in women 22]. This may also be accounted for by the differencein fat distribution between men and women.The adverse effect of abdominal obesity on lung functionis likely mediated through direct effects on the rib cage or thoracic compliance. It is also possible that compression ofthe abdominal viscera by local fat redistributes blood to the thoracic compartment, thus reducing vital capacity. This isthe explanation that has been given for the fall in vital capacitythat occurs in the supine position [33]. It has also been shown that increased abdominal fat deposition is associatedwith increased visceral fat in the abdomen . The accumulation of fat in the epicardium may also reduce vitalcapacity. We speculate that the body fat distribution may explain the link between low FEV1 and increased coronary risk. High WHR is associated with impaired glucose metabolism,, and hyperlipidemia, all coronary risk factors .In addition, it has been well established in general population samples that measures of lung function such as FEV1 hypertension and FVC are predictors of overall mortality as well as coronary mortality, and that this association cannot be explained entirely by cigarette smoking status [24,27,28]. However,the link between abnormal lung function and coronary risk is notknown. If central obesity is a marker for multiple coronaryrisk factors and also has a specific adverse effect on spirometry, then aberrant spirometry could be merely an epiphenomenon and not a direct cause of coronary death. In other words, it is possible that low lung function *per se* does not increase coronary risk, but is merely a marker for abdominal fat distribution and the associated coronary riskfactors. This speculation, however, must be tempered by the fact that low levels of lung function appear to be important predictors of coronary death in women as well as men [34].

The implication of this study is that, in women, the patternof fat distribution, measured by WHR, is an important determinantof lung function, and is a more direct predictor than BMI. These findings suggest that cross-sectionalstudy of lung considerthe function in women should potential confounding effect of fat distribution,rather than merely weight or weight gain *per se.*WHR is well-standardized and simple measure that may be easily includedin population studies. In men, however, neitherBMI nor WHR are important predictors of lung function and, therefore, it is unlikely that changes in lung functioncan be attributed to changes in weight over a wide range

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