ORIGINAL RESEARCH

ASSOCIATION OF ABDOMINAL OBESITY WITH PEAK EXPIRATORY FLOW RATE IN ADULT INDIAN MALES

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ABSTRACT

Background: Obesity is linked to a wide range of respiratory diseases such as asthma, chronic obstructive pulmonary disease, obstructive sleep apnoea, pulmonary embolic disease and aspiration pneumonia.

Aims and Objective: To assess the correlation between Obesity markers (BMI and waist circumference) and PEFR in adult males.

Material and Methods: One hundred male subjects in the age group of 20-50 years were recruited, their obesity parameters BMI and WC were recorded by standard methods and Peak expiratory flow rates by Mini Wright's Peak flow meter.

Results: Pearson's correlation coefficient showed a significant negative correlation of BMI with PEFR (r = -0.3885) and Waist circumference with PEFR (r = -0.4010, p<0.05). Conclusion: Obesity produces significant deterioration in the PEFR.

Keywords: BMI, Obesity, Peak Expiratory Flow Rates, Waist Circumference.

INTRODUCTION

Obesity and overweight are the fifth leading risk of global deaths. Lifestyle indicators such as socioeconomic status and dietary habits influence obesity and health inference. It has been seen that consumption of fast food, trans fatty acids (TFAs), and fructose—combined with increasing portion sizes and decreased physical activity—has been implicated as a potential contributing factor in the obesity crisis.[1]

Not only overall adiposity but body fat distribution is also an important predictor of adverse health events such as diabetes, hypertension, hyper-lipidaemia, and coronary events. There are two main types of fat distribution viz central and peripheral. In central obesity, most of the fat deposits are in the abdominal area, both subcutaneous and visceral. The visceral fat deposits are highly correlated with cardiovascular risk. In peripheral obesity the fat deposits are mainly located subcutaneously in the lower body.[2]Many studies have established that central obesity is associated with greater health risk than peripheral obesity.

Changes in lung function due to increased body weight include small air way dysfunction and expiratory airflow limitation, decreased chest wall and lung compliance, decreased endurance and respiratory muscle strength, decreased pulmonary gas exchange, lower respiratory control, as well as limited exercise capacity.[3] It has been reported that respiratory muscle strength and lung function related to body weight and lean body mass in patients with chronic obstructive pulmonary disease (COPD) and central fat distribution have negative associations with lung function in healthyadults.[4]

The most accurate method to evaluate abdominal obesity is computed tomography (CT) or magnetic resonance imaging (MRI) to measure the amount of visceral fat. But they're expensive and require sophisticated equipment.Therefore, to measure the degree of obesity in clinical practice, common measurements are BMI and waist circumference (WC). Recent evidence suggests that WC alone may provide a more practical correlation of abdominal fat distribution and associated ill-health. Waist circumference is a convenient and simple measurement which is unrelated to height but correlates closely with BMI and WHR.[5-7]2002 WHO Expert Consultation recommended that, where possible, waist circumference should be used to refine action levels based on BMI.It is seen that levels based on BMI might be increased by one level if the waist circumference were elevated above a specified level.[8]

Peak expiratory flow rate (PEFR) is the maximum flow rate in litres per min measured during forced expiration after a deep inspiration. The pressure exerted by a forced expiration causes a diaphragm to move and while doing so it opens a progressively larger area of the orifice. The point at which no further movement of the diaphragm occurs depends on the maximal pressure and thereby peak expiratory flow that has been generated.[9]It is effort dependent and is one of the important and widely used lung function tests as it is easy, reliable, and reproducible.The primary factors which determine PEFR are strength of expiratory muscles, the lung and chest mechanics and the airway size.[10] In obese these factors can be compromised due to fat deposition and airway hyperresponsiveness. The normal range of PEFR for males and females is 450–550 L/min and 320–470 L/min, respectively.[11]

In the present study we recorded thePEFR in obese and non-obese malesand assessed the correlation of BMI and PEFR and the correlation of WC and PEFR in all 100 male subjects. The PEFR values of Obese and Non obese subjects were also compared.

MATERIALS AND METHODS

STUDY DESIGN

Analytical cross-sectional study.

The study was conducted in Department of Physiology, RamaMedical Collegeand Hospital, Hapur, which included100non-smokers males in the age group 20-50 years visiting medical OPD of Rama Medical College and Hospital, Pilkhuwa campus,Hapur (U.P).After proper clinical examination of the selected subjects,approved questionnaire/ format was filled up.All subject other than male gender, with history of tobacco smoking,personal/family history of asthma, otherrespiratory andcardiovascular diseases were excluded from the study. Subjects were informed of the experimental protocol and their consent was taken.Theywere asked to avoid beverages like tea and coffeeand come with light breakfast before reporting. The study was approved by institutional ethical committee.

CALCULATION OF BMI

Anthropometric parameters; height (meters) and weight (kg) were noted for each subject. BMI was calculated using Quetelet's index:BMI=Weight(kg)/Height(m^2)

MEASUREMENT OF WAIST CIRCUMFERENCE

Subject stood in erect posture with feet 25-30 cm apart. Upper hip bone (Iliac bone) and top of the right iliac crest was located.Themeasuring tape was placed in a horizontal plane around the abdomen at midpoint between the lower border of rib cage and iliac crest, the tape was snug and did not compress the skin and was parallel to the floor. The measurement was made at end of a normal expiration.

RECORDING OF PEFR

PEFR was recorded using Wright's mini peak flow meter
(Clement & Clarke, UK)in standing position. Subjects were instructed to take a deep breath and exhale as forcefully as possible in one single blow into the instrument.It was ensuredthat a tight seal is maintained between the lips and the mouthpiece. Three satisfactory readings were taken, the highest among the three was considered as the PEFR.

CATEGORIZATION OF SUBJECTS

Subjects were divided into two categories based on their waist circumference viz Obese males and non-obese males. Abdominal obesity (AO) was defined as a waist circumference (WC) ≥ 90 cm for men using WHO Asia Pacific perspective guidelines.[12]

STATISTICAL ANALYSIS

Mean was calculated for different parameters in each study group. Mean is a measure of central tendency and is the one value around which other values are dispersed. Standard deviation which denotes the measure of variability from mean value was calculated. Analysis was done using licensed Stata (version 14.2) software. Student t-test was applied to compare the values between obese and non-obese males.The Pearson's correlation was used to show the relationship between BMI and PEFR and between WC and PEFR. The significance level was fixed at $p < 0.05$ and the significant range of correlation analysis was $-1< r < 1$.

RESULTS

Pearson's correlation coefficient of all the 100 subjects showed a significant negative correlation ofBMI with PEFR($r = -0.3885$) and alsowaist circumference with PEFR ($r = -0.4010$, $p<0.05$) (table 2).Mean values ofPEFR were significantly lower(437.8 ±58.1) in obese individuals (table 3) as compared to non-Obese wherein PEFR values were (493.9±63.9).Partial correlation analysis of the waist circumference after adjusting for age and height showed an inverse correlation of PEFR with waist circumference (Table 3). The results are shown in the following tables:

Table 1: Anthropometry parameters mean value

Anthropometry Parameters	Mean(n=100) ± SD
Age(years)	50.5±29.01
Height(cm)	167.52±7.94
Weight (kg)	76.25±11.49
Waist Circumference (cm)	93.75±8.29
BMI(kg/m^2)	27.15±3.58
PEFR(L/min)	462±66.54

Table2: Correlations in (A) Body mass index-PEFR (B) WaistCircumference -PEFR

Parameters	r- value	p-value
(A)BMI-PEFR(n=100)	-0.3885	0.0001
(B)WC-PEFR(n=100)	-0.4010	0.0000

Table3: Waist circumferences – mean PEFR correlation in abdominal obeseand non-obese

WC (in cm)	MeanPEFR(L/min)	p-value	r-value
WC <90 (n=43)	493.9±63.9	0.0003	-0.5
WC>90(n=57)	437.8±58.1	0.0052	-0.3

WC <90 = Non-obese males; WC >90= obese males

Fig1: Scatter plot showing means BMI and PEFR distribution(n=100)

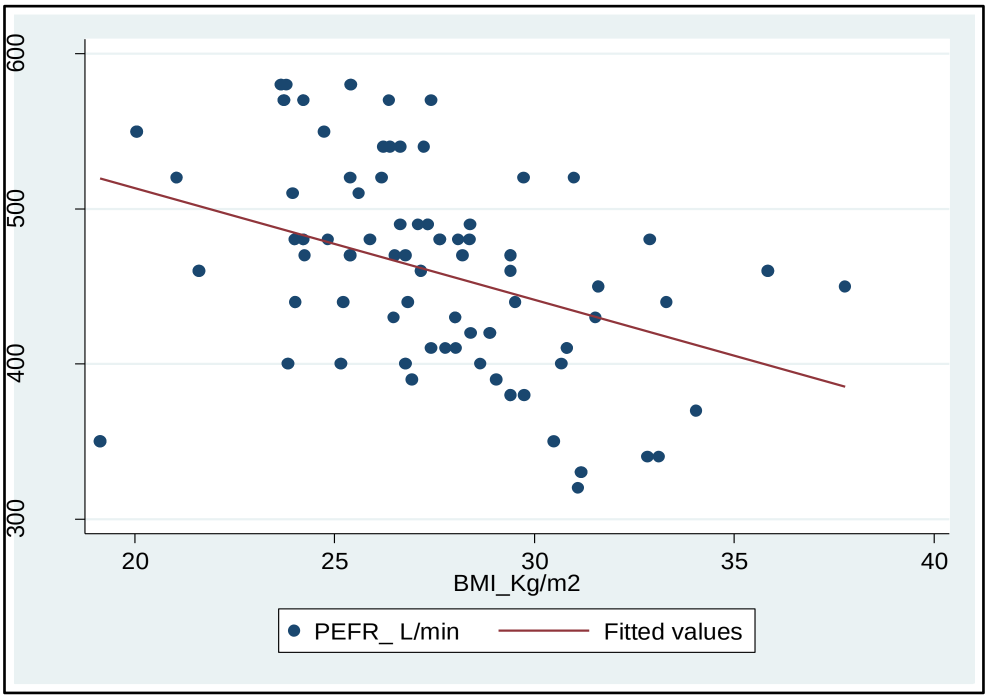
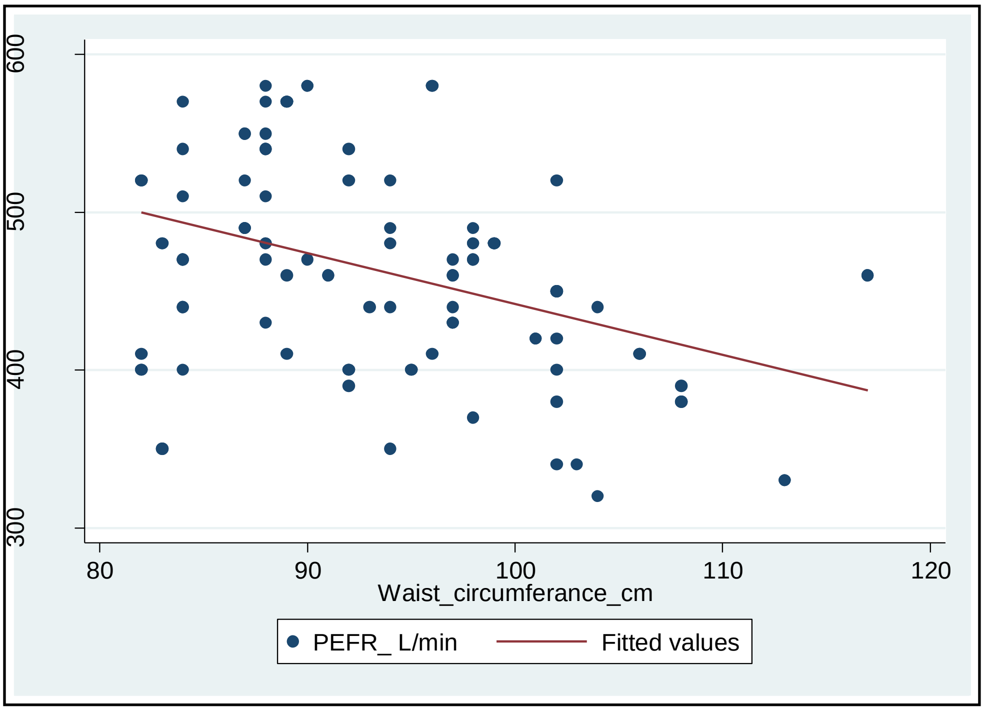


Fig2: Scatter plot showing means WC and PEFR distribution (n=100)



DISCUSSION

The results of the present study show that abdominal obesity affects PEFR significantly. The risk related to obesity is associated with the magnitude of obesity and the presence of abdominal fat.[13] Fat subjects are likely to have lower lung volumes and less chest wall compliance. This can be due to the fact that mass loading of ventilatory system induced by obesity, particularly on the abdominal component of the chest wall,modifies the static balance within the respiratory system.[14]

In our study 57 subjects (WC >90) had PEFR values of 437.8 $\pm$58.1. These values were significantly less when compared to 43 subjects (WC <90) who had a PEFR value of 493.9$\pm$63.9.

Farooq et al also observeda reduction in PEFR in obesecompared to non-obese anda negative correlation of PEFR with BMI and other obesity markers.[15]Zerah et alstudied airway resistance in mild, moderate, and morbidly obese individuals and confirmed that both respiratory resistance and airway resistance rose with the level of obesity.[14]

In our study we found a negative correlation between BMI and PEFR and also WC and PEFR. In a similar study Mafort et al found a significant negative correlation between TLC and waist circumference (rs = −0.34; p = 0.03).[16]

Obesity is associated with reduced respiratory system compliance, which itself is exponentially correlated with BMI, waist circumference, and waist-hip ratio. Changes in chest wall compliance are more affected by the amount of fat in both the chest and upper abdomen than by the amount of fat only in the chest, suggesting that respiratory system mechanics may differ in obese individuals with the same BMI but with different patterns of body fat distribution.[16]

Mcclean KM et al suggested that excess weight impairs respiratory function via mechanical and metabolic pathways. The accumulation of abdominal fat may limit the descent of the diaphragm, and in turn, lung expansion, while the accumulation of visceral fat can reduce the flexibility of the chest wall, sap respiratory muscle strength, and narrows airways in the lungs.[17] The expiratory reserve volume is also reduced, and the work of breathing is increased.

Some studies reportthat intra-abdominal adipocyte are more lipolytically active than those from other fat depots. FFA release in portal circulation has adverse metabolic actions, especially on the liver**.**

The results of this studyreinforce the concept that abdominal fat depositionhasa deleterious effect on mechanical ventilation and also plays a role in the development of restrictive lung disease.

CONCLUSION

We concluded that not only overall adiposity, but the pattern of fat distribution also affects the lung mechanics. PEFR values were lower in abdominally obese males.Weight loss can reverse many of the alterations of pulmonary functions produced by obesity. Major lifestyle changes, improving eating habits, and incorporating exercise in the individual is the need of the hour.

LIMITATIONS

Small sample size, purposive sampling, exclusion of female participant and being a hospital based study, it would not have captured all aspects. Acommunity-based study with larger sample size would be more useful to determine the extent of impact of obesity on respiratoryhealth.

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