JMSCR Vol||05||Issue||09||Page 27737-27743||September 2017

www.jmscr.igmpublication.org
Impact Factor 5.84
Index Copernicus Value: 71.58
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v5i9.63

Journal Of Medical Science And Clinical Research
IGM Publication
An Official Publication Of IGM Publication

Original Article

Impact of Adiposity Markers on Peak Expiratory flow Rate in Young Adults

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ABSTRACT

Obesity is a commonly encountered health problem in the young adult population of today. It is negatively associated to the pulmonary functions. Weight and body mass index (BMI) are used as the measures of overall adiposity whereas waist hip ratio (WHR) and waist circumference (WC) are used as the measures for abdominal obesity. The nature of relationship of Peak expiratory flow rate (PEFR) with markers of adiposity is not clear. Hence we performed this study is to study the Impact of adiposity markers (WHR, BMI and WC) on PEFR in young adults. One hundred young healthy male and female volunteers between 17-30 years of age without any majors or minor illnesses, were selected for the study, based on predefined inclusion and exclusion criteria. Height and weight were measured and BMI was calculated. Waist circumference (WC) and Hip circumference were measured and WHR was calculated. PEFR was recorded on a Digital portable desktop spirometer of COSMED model Pony FX. We found that PEFR and WHR have a statistically significant negative correlation in males. PEFR is negatively associated to BMI and WC in males, although the correlation is not significant. In females no correlation was found between PEFR and WHR /BMI or WC.

Key words: *waist hip ratio, PEFR , BMI, young adult, waist circumference.*

INTRODUCTION

Obesity is a global health hazard and has been linked to numerous metabolic complications such as dyslipidemia, type II diabetes, & cardio vascular diseases and is negatively associated to the pulmonary function[(1)]. According to the World Health Organization (WHO) the prevalence of obesity is increasing rapidly in the world as well as in India. Recently in India it is estimated that in the whole country 135, 153 and 107 million individuals will have generalized obesity, abdominal obesity and combined obesity, respectively [(2)]. Weight and body mass index (BMI) as measures of overall adiposity are used as predictors of pulmonary function in many epidemiological studies [(3)]. While these measures are widely accepted as determinants of pulmonary function, waist hip ratio (WHR) and waist circumference

(WC) often used as a surrogate measure for abdominal or upper body obesity may influence pulmonary function through a mechanism that may restrict the descent of the diaphragm, limit lung expansion and mechanically by changes in compliance, work of breathing and the elastic recoil compared to overall adiposity, which may compress the chest wall [1,3].

Investigators have proposed that abdominal adiposity is a better indicator of visceral fat (the metabolically active fat depot) which has been implicated for various metabolic syndromes. Differential fat distribution among males and females tends to affect the pulmonary functions. Asians having increased tendency to abdominal adiposity may show different pattern of regional variability[1].

The peak expiratory flow rate (PEFR) is defined as the maximum or peak flow rate that is attained during a forceful expiratory effort after taking a deep inspiration. It measures airflow through the bronchial tree and provides an idea about bronchial tone. PEFR can be easily measured and is a convenient tool to measure lung functions. The PEFR values are also affected by various other factors, such as sex, body surface area, obesity, physical activity, posture, environment, and racial differences [4]. Several studies done in India have evaluated the relation of PEFR and BMI [4-7].

Very few studies in India [8] have addressed the relationship between adiposity markers (WHR and BMI) and Peak expiratory flow rate in young adults, both male and female.

Some authors have exclusively studied the relationship between WHR, WC and PEFR in young adult males[3] and others only in young adult females[9]. Most of the studies have been done outside India [10-12].

So there is paucity in literature in studies done to study the Impact of adiposity markers (WHR and BMI) on PEFR in young adults (male and female). Hence, we performed this study.

METHODS

The present study was done as per ICMR STS guidelines. Sampling technique used was convenient sampling technique. Study type was cross sectional study

The purpose and procedure of the study protocol was explained to each of the subjects prior to the start of the study. Institutional Ethical Clearance (IEC) was taken after approval of the project by ICMR. 100 healthy (male and female) volunteers between the age group of 17-30 years were recruited for the study after taking written, informed consent.

Inclusion criteria

Young adults of both sexes between 17-30 years of age without any major or minor medical or surgical illness.

Exclusion criteria for both groups:

1) Participants with history of cardiopulmonary disease
2) Chronically ill
3) Medication for long duration
4) History of any major surgery (cardiac, pulmonary, abdominal) related to study,
5) Smoker and alcoholics

Participants were instructed to empty their bladder prior to anthropometric measurements.

Height was measured using stadiometer. Subjects were instructed to stand straight with feet flat, heels and knees together and legs straight with arms at side and looking straight ahead. Their heels, hips, shoulder blades and occiput were pressing against the vertical bar. Height was noted against the horizontal slider which was on the top of the head pressing hairs. Heights were measured within the accuracy of 0.1 Centimeter.

Subjects were instructed to wear light cloths and to stand on foot bar of weighing machine without any footwear. Weight was measured to the nearest 100 g using digital scales.

BMI was calculated using Quetlet's index as weight (kg) over height (m^2).

BMI = Weight (Kg) / (height in meter) ^{2}

Waist circumference (WC) was measured as per established method. A D-loop non stretch fiberglass tape was used for the waist circumference measures. Waist circumference was measured at the smallest circumference between the costal margin and the iliac crest to the nearest 0.1 cm while the participant in standing with the abdomen relaxed, at the end of a normal expiration. Where there was no natural waistline, the measurement was taken at the level of the umbilicus.

Hip circumference was measured at the maximum circumference between the iliac crest and the crotch while the participant was standing and was recorded to the nearest 0.1 cm.

Waist: hip ratio was then calculated from the waist and hip measures (waist circumference/hip circumference).

The volunteers were asked to report after taking light breakfast and to avoid beverages, like tea and coffee and other stimulants on the day of the test. Tests were done in the forenoon to avoid diurnal variation in respiratory parameters. Peak Expiratory Flow Rate (PEFR) was recorded on a Digital portable desktop spirometer of COSMED model Pony FX. The apparatus provides a detailed analysis of predicted and derived values. The apparatus was calibrated and operated within an ambient temperature range of 25-30°C.

The subjects were informed about the whole maneuver before performing the pulmonary function test along with the importance and non-invasive nature of the tests. They were motivated prior to the start of maneuver. Under all aseptic precautions, the test was performed within the subject in sitting position with using nose clips. The test was repeated 3 times after rest, of which the best readings were considered.

STATISTICAL ANALYSIS

The information collected was converted into a computer based spreadsheet using Microsoft Excel software. Statistical analysis of the data was done on the SPSS software 19.0. The variables were expressed as the means and standard deviations, and p value was calculated. Pearson's correlation coefficient was determined to find the association of various indices.

Significance testing for trend were conducted using regression models. A value of $p < 0.05$ was to determine statistical significance. Regression coefficients and 95 percent confidence intervals were also calculated.

RESULT

Out of the 100 young adults found suitable for the study 37 were females and 63 were males.

Mean age in the study was 20.75 ± 2.99 (Range 17- 30 years). The mean age of male and female adults in the present study was 20.87 ± 2.90 and 20.54 ± 3.16 Years, respectively. Most of the young adults were in the age group of 17-19 years (44), followed by 20-22 years (36), then 26-28 years (10) then 23-25 years (07) and finally 29-31 years (03) .

There was no significant difference in age, BMI, Waist circumference and Hip circumference between male and female adults. Significant gender difference was found in body weight, height and waist-hip ratio (Table 2). Mean WHR in our study was 0.85 ± 0.06. The mean WHR of male and female adults in the present study was 0.87 ± 0.05 and 0.82 ± 0.06, respectively.

The mean BMI in the study was 21.12 ± 3.83 kg/m2. The BMI in case of males was 21.27 ± 4.12 and in case of females was 20.86 ± 3.33.

PEFR was significantly higher ($p<0.0001$) in males than females.

PEFR was found to be negatively associated to WC in males although the association is not significant. There is lack of association between PEFR and WC in case of females.

PEFR is negatively associated to WHR in males and the correlation is statistically significant.

There is lack of association between PEFR and WHR in case of female adults.

PEFR was found to be negatively associated to BMI in males although the association is not significant. There is lack of association between PEFR and BMI in case of female adults.

Table 1: Physical characteristics of all participants of the study

Variable	Mean	Standard Deviation
Age (years)	20.75	2.99
Weight (Kg)	59.67	12.86
Height (cm)	167.84	9.06
BMI (kg/m^2)	21.12	3.83
Waist Circumference (cm)	80	3.75
Hip Circumference (cm)	94	2.74
Waist/ Hip ratio	0.85	0.06

Table 2: Physical characteristics of male and female young adults

Parameter	Male (n=63)	Female (n= 37)	p value
Age (Years)	20.87	20.54	0.594
Weight(Kg)	63.61	52.96	<.0001
Height(cm)	172.95	159.14	<.0001
BMI (kg/m^2)	21.27	20.86	0.602
Waist Circumference (cm)	82.1	76	0.001
Hip Circumference (cm)	94.3	93	0.367
Waist/ Hip ratio	0.87	0.82	<.0001

Figure 1: Sex wise breakup of young adults according to BMI: Normal (BMI between 18.1-22.9), Overweight (BMI between 23-25) and BMI >25 Obese groups.

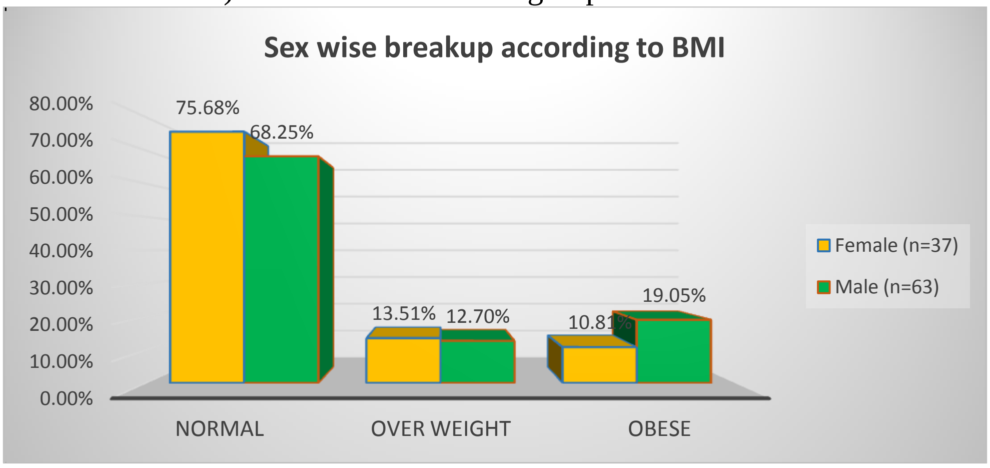

Table 3: Comparison of PEFR in male and female adults

Parameter	Male (n= 63)	Female (n=37)	p Value
PEFR(L/s)	7.37	4.69	<0.0001

Table 4: Correlation of Spirometric parameters with adiposity markers in males and Females

Correlation of PEFR with		Pearson correlation coefficient (r)	p-value
Male	WC	-0.206	0.106
	WHR	-0.375	0.002*
	BMI	-0.126	0.325
Female	WC	0.156	0.357
	WHR	0.021	0.902
	BMI	0.174	0.303

* P<0.05- Significant

Table 5: Multiple regression norms for the prediction of pulmonary function measurements

Pulmonary function	Variable	Regression equation	R	R2	SEE
PEFR	BMI	6.463-0.004(BMI)	.008	.000	2.057
	W_H	2.215+4.887(W_H)	.144	.021	2.036

BMI- Body mass index; W_H: Waist hip ratio; SEE, standard error of estimate.

DISCUSSION

Consistent with other research studies [13,14], the mean BMI value in our study was found out to be greater in male participants than the female participants.

The PEFR values, due to their relation with BMI, were also found out to be significantly higher in males than the females similar to findings in other studies [13-15]. The reasons behind these variations might be hormones, structural and morphological differences. Increased estrogens levels tend to increase fluid retention and therefore increase blood volume, which could potentially affect gas exchange in the lung. In addition, progesterone and estrogens receptors have recently been identified in mast cells in human airways. This discovery may help to explain and account for some of the effects of sex hormones in airway function and differences in ventilation [16].

We found PEFR is negatively associated to BMI in males in our study, although the association is not significant. A strong negative correlation was found between BMI and PEFR in males by Jones et al [17] and Saraswathi et al [8].

We did not observe any correlation between PEFR and BMI in female adults, similar to Saraswathi et al [8].

The possible cause for this gender difference in the effect of obesity on PEFR may be the pattern of fat distribution between males and females. In females, fat deposition is more in the extremities (peripheral obesity) whereas in males, it is seen more in the truncal region (central obesity) and it is independent of overall fat in the body [18]. The truncal fat may compress the thoracic cavity and restrict the diaphragmatic movement resulting in reduced vertical diameter of the thoracic cavity. These changes may reduce the compliance of the lungs and the thoracic cavity and increase the load on the respiratory muscles. This may end up with the reduction in lung volumes and flow rates, especially PEFR [19].

PEFR was negatively associated to WHR in males in our study and the correlation is statistically significant. No correlation was found between PEFR and WHR in case of female adults.

The reason for this difference may be attributed to the group of the selected subjects; our study included the young adults in their post-adolescent age with maximum subjects with normal BMI whereas the other studies included the older population and severe obesity

Saraswathi[8] and Lazarus[20] did not find any correlation between WHR and PEFR. Shenoy et al [9] noticed a negative relation between all adiposity markers and PEFR in a study on young adult South Indian females. These findings were in accordance with the findings of Saxena et al [3], and Farooq S. N. et al who studied young Saudi adults [10].

PEFR was found to be more related with central adiposity markers than BMI by Shenoy et al [9] and Dhungel et al., [11] in Nepalese young females. Contrary to the above, Lazarus et al [20] observed no effect of the central pattern of fat distribution (WHR) in the mean age 35.2±1.3 years. They found upper body subcutaneous fat was significantly associated with the flow rates.

Hasnain et al [12] concluded that there is a statistically significant variation in PEFR with an increase in waist hip ratio in their study done on medical students of Karachi, Pakistan. Moreover young females have more waist hip ratio and PEFR values than their young male counterparts.

PEFR and WHR's negative correlation could be because of mechanical effects on the diaphragm (impeding descent into the abdominal cavity) and also because of the fat deposition between the muscles and the ribs that can lead to increase in the metabolic demands and work-load of breathing [3].

CONCLUSION

The study concludes that PEFR and WHR have a statistically significant negative correlation in males. PEFR is negatively associated to BMI and WC in males although the correlation is not significant. In females no correlation was found between PEFR and WHR /BMI or WC.

ACKNOWLEDGEMENTS

The authors would like to thank Indian Council of Medical Research for funding this study through its STS program for MBBS students.

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