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IMPACT OF OBESITY MARKER ON PEAK EXPIRATORY FLOW RATE IN YOUNG ADULT FEMALE

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ABSTRACT

Background: Even though several factors like respiratory muscle strength, lung compliance, resistance to airflow, and elastic recoil of lungs determine lung functions, physical factors such as height, weight and central pattern of fat distribution also affect the pulmonary functions. **Objective:** The present study was done to assess the impact of both general as well as central obesity markers on PEFR in young adult females. **Materials and Methods:** The study was conducted on 186 healthy young female in the age group of 18-22 years. The study group was divided into three groups based on BMI (as per WHO Asian guidelines). Those with BMI between 18.5 to 22.9 kg/m2 were considered as normal weight individuals, those having a BMI of 23-24.9 kg/m2 were taken as overweight individuals and those with a BMI more than 25 were considered as obese. Waist circumference (WC), Waist to hip ratio (WHR) and waist to height ratio were also calculated; these serve as measures for central pattern of fat distribution. PEFR was recorded with Wright's peak flow meter and the best of three readings was considered. The data obtained was statistically analyzed using one way ANOVA and Pearson's correlation tests. A p-value less than 0.05 was considered as significant. **Results:** Mean value of PEFR did not show significant differences when compared between three groups. On correlation a negative association of various adiposity markers with PEFR was observed and was more related with central adiposity markers than BMI. **Conclusion:** Our findings suggest that obesity itself and especially the pattern of body fat distribution have independent effects on PEFR in young adult females. Abdominal adiposity may influence pulmonary functions by restricting the descent of the diaphragm and limiting lung expansion as compared to overall adiposity which may compress the chest wall.

KEYWORDS: PEFR, pulmonary function, WC, WHR, WHtR.

INTRODUCTION

Obesity has emerged as a growing menace with its tentacles encompassing various body functions including the pulmonary functions. Respiratory function is determined by the complex interaction of lungs, chest wall, and respiratory muscles. Accumulation of the fat alters the relationship between the lungs, chest wall, and diaphragm.[1] ,Thus gaining excessive weight may have a gamut of effects on pulmonary function tests including impairment on pulmonary function testing, small airway dysfunction and expiratory flow limitation, alterations in respiratory mechanics, decreased chest wall and lung compliance, decreased respiratory muscle strength and endurance, decreased pulmonary gas exchange, lower control of breathing, and limitations in exercise capacity[2]

Peak expiratory flow rate (PEFR) is the most commonly used method to monitor lung function. PEFR is the maximal expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration and is expressed in litres/min.[3] PEFR measurement is very popular in primary care and is commonly applied as a quick screening method for assessing lung function in the clinic or at the bedside.[4] Males reach their highest PEFR by about 25 years, while the females achieve it a little earlier, at about 20 years of age.[5]

Gender differences in the accumulation of fat i.e., "apple vs. pear" shape, may also affect the way adiposity markers influence the pulmonary functions. So we undertook this study to assess the effect of various adiposity markers corresponding to overall and central obesity on pulmonary functions of young females using PEFR as a tool.

MATERIALS AND METHODS

The present study was conducted in the department of Physiology after obtaining the necessary approval from Institutional ethics committee. A total of 186 females in the age group of 18-22 years, leading a sedentary life style were recruited for the study from the students population. 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. Written informed consent was taken from each participant after describing in full detail the procedure and purpose of the study.

Anthropometric measurements such as height and weight were recorded. Height was measured to the nearest 0.5 cm with the help of a height scale. The body weight was measured by a weighing scale in kilograms without shoes, and the subjects wearing light weight clothes. Body mass index was calculated using Quetelet formula (BMI = weight in kilograms / height in m2). Participants were divided into three groups based on BMI (as per WHO Asian guidelines).[6] Those with BMI between18.5 and 22.9kg/m2 were considered as normal weight individuals, those having a BMI of 23 to 24.9kg/m2 were taken as overweight individuals and those with a BMI more than 25 were considered as obese.

The waist circumference (WC) was measured at a point midway between the lower rib and iliac crest, using non-stretchable flexible tape in horizontal position in a horizontal plane at the end of normal expiration, with the subject standing erect and looking straight forward. The hip circumference was measured in centimeters at the widest girth of the hip. The measurements were recorded to the nearest 0.1cm. and were used to calculate waist to hip ratio(WHR). Waist to height ratio was also calculated (WHtR).

PEFR was recorded using Wright's mini peak flowmeter (Clement & Clarke, UK) in standing position with the nose clip on. After adequate rest, subjects were instructed to take a deep breath and exhale as forcefully as possible in one single blow into the instrument. Three satisfactory readings were taken. Sufficient care was taken to ensure that a tight seal was maintained between the lips and the mouth piece. The highest among the three was considered as the PEFR.

Statistical Analysis

All the anthropometric and PEFR values obtained were expressed as mean ± standard deviation. PEFR values were correlated with the adiposity markers, using Pearson's correlation test. Study group was divided into three groups based on BMI as normal weight, overweight, and obese. PEFR values were compared between the groups using one-way ANOVA. A '*p*'-value of less than 0.05 was considered as significant. All the analysis was done using SPSS version 17.

RESULTS

A total of 186 young females recruited for this study were divided into three groups based on their BMI. The normal weight group comprised of 104 individuals, 36 women were overweight and 46 individuals fell into the obese group. On performing a one-way ANOVA to compare the mean PEFR values between the three groups, did not show any significant difference [Table 1].

Table 1: Showing PEFR values in three groups.

	Normal Weight (n= 104)	Overweight (n=36)	Obese (n=46)
BMI	20.38±1.27	23.74±0.66	27.77±1.99
PEFR	343.56±52.19	344.72±59.16	326.30±59.16

The different adiposity makers were correlated with PEFR (combined data from all the three study groups) by Pearson's correlation test. The PEFR exhibited a significant negative relation with all the adiposity markers and especially with WHR and WHtR it was extremely significant [Table 2].

Table 2: Showing the relation between adiposity markers and PEFR.

	BMI	WC	WHR	WHtR
PEFR	−0.15*	−0.30**	−0.53***	−0.35***
*Significant (*P* < 0.05); **Highly Significant (*P* < 0.0001); ***Extremely Significant (*P*<0.000001)				

DISCUSSION

PEFR is a fairly good indicator of bronchial hyper-responsiveness, and does not require body temperature pressure-saturated correction. So it is considered as one of the useful and simple parameters in the field for assessing the lung function status in general population.[7] Previous studies have revealed that PEFR values are affected by various factors, such as sex, body surface area, obesity, physical activity, posture, environment, and racial differences.[5,8,9]

Obesity has been linked with impaired pulmonary function and airway hyper-responsiveness.[7] The peak flowmeter is an inexpensive and practical way to measure lung function, and can detect the early warning signs of a decrease in lung function. So we took up this study to assess the relation between PEFR and obesity in terms of general and central adiposity markers in young adult females. PEFR attains it peak value at about 20years of age in females and age group of females in the present study was 18-22 years. In the present study the effect of overall obesity was studied by considering BMI as an indicator and the participants were divided into normal weight, overweight, and obese by using WHO Asian guidelines.[6]

Unlike our results, Ofuya *et al*.,[10] and Ghobain *et al*.,[2] noticed a significant reduction in PEFR between obese and non-obese individuals, but both the studies included male and female participants and the mean BMI of obese in these studies was more than 30 kg/m2. Moreover the study populations in these studies were ethnically different from the present one. Joshi *et al*.,[11] reported a similar result in females belonging to the same age group as of the current study from western India. Similar observations were also made by Mahajan *et al*.,[12] on Punjabi females in the age group of 26-40 years.

Saxena Y[7] also noticed an insignificant difference in PEFR in males of 20-30 age groups. Whereas their study differs from ours by means of male participants and age group (20-40 years). However, in the same study they also noticed a reduced PEFR in males >30 years and BMI criteria for obesity was >30. So this suggests that in younger age group, overall obesity has a limited role in decrement of lung function and it plays a role only as age advances.

The present study also noticed a negative relation between all adiposity markers and PEFR. These findings were in accordance with the fi ndings of Saxena *et al*.,[7] Gundogodu *et al*.,[4] also noticed a negative relation between PEFR and BMI in Turkish children of age group Of 6-14years. In the present study the markers of central adiposity such as WC, WHR and WHtR were found to have more negative impact on PEFR than total body adiposity indicated by BMI according to the *P*-value significance and the coefficient values. Similar to our study Dhungel *et al*.,[13] also noticed such a relationship between WHR and PEFR in Nepalese young females. The primary factors that affect PEFR are the strength of the expiratory muscles generating the force of contraction, The elastic recoil pressure of the lungs and the airway size. Accumulation of fat in and around the ribs, the diaphragm and the abdomen results in reduction in the chest wall compliance.[14] Zerah *et al*.,[15] studied airway resistance in mild, moderate, and morbid obese individuals and confirmed that the both respiratory resistance and airway resistance rose significantly with the level of obesity. These findings suggest that in addition to the elastic load, obese individuals must overcome increased airway resistance resulting from a reduction in lung volumes due to obesity. It is a well known fact that in female's primarily fat gets accumulated in hip region than in waist (abdominal) region as in males. Our observation of PEFR being more affected by WHR when compared to WC suggests that abnormal pattern of fat distribution in female's results in reduced lung function. To the best of our knowledge we are the first to assess the relation between PEFR and WHtR at least in this part of the world. The waist-height ratio, in principle, is a good measure to represent the waist circumference in relation to another easily measurable body proportion so that distortions based on the body frame size in different populations are removed.[16] The previous studies have proved that it is a good parameter of central obesity, and an increase of which indicates the risk for cardio metabolic disorders.[17] The result of this study also suggests that it can also serve as a good marker in pulmonary function study. The different studies carried by Joshi *et al*.,[11] Saxena Y etal.[18] also noticed a negative relation between adiposity markers and lung function parameters other than PEFR. Thus PEFR, a simple and easily measurable lung function parameter can be considered as an effective tool in assessing pulmonary functions.

CONCLUSION

It can, thus, be concluded that abdominal obesity may influence pulmonary functions by restricting the descent of the diaphragm and limiting lung expansion as compared to overall obesity which may compress the chest wall. Since we noticed these changes in sedentary individuals, lifestyle modification measures such as Yoga or regular exercise and less calorie intake by avoiding junk food can reduce the prevalence of obesity and there by the risk of compromise in pulmonary functions. Further studies in this field overcoming the limitations of the present study such as on other lung function parameters, in different age groups, indifferent ethnicity and longitudinal studies in this field may help to explore more relations between obesity markers and lung function.

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