(7) EEEFCT OF BODY FAT PERCENTAGE ON PEAK EXPIRATORY FLOW RATE (PEFR) IN YOUNG ADULTS OF INDIAN POPULATION

Dr. Smita P. Galphade[1], Dr. Manish D. Dhadse[2], Dr. Lalit H.Nikam[3]

1. Assistant Professor, Department of Physiology, Seth G. S. Medical College & KEM Hospital, Mumbai-400012.
2. Assistant Professor, Department of Physiology, Seth G. S. Medical College & KEM Hospital, Mumbai-400012.
3. Professor, Department of Physiology, Seth G. S. Medical College & KEM Hospital, Mumbai-400012.

Address for correspondence: Mobile No. 9699898673
Email-ID : ms.smita163@rediffmail.com

ABSTRACT

BACKGROUND : Obesity impairs quality of life by causing various hazardous effects on respiratory functions of an individual along with other medical complications

OBJECTIVES :. The objective of the study was to evaluate effect of body fat percentage on PEFR in young adults of Indian population.120 students of 18-25 years age group who had no lung disease were recruited. Their age, sex, height, weight were recorded and BMI was calculated.. Accordingly 60 students with BMI 25.0 - 29.9 kg/m^{2}constituted study group and 60 students with BMI 18.5- 24.9 kg/m^2 constituted control group. Skinfold thickness was calculated using 4-site method (biceps, triceps, subscapular and suprailiac) with the help of Skinfold Caliper. Body fat percentage was calculated by using Durnin and Womersley method.

METHODS : PEFR was recorded by computerised spirometry. The statistical analysis was done using appropriate tests.

CONCLUSION : The study group presented with lower values of PEFR than control group. Moreover PEFR was having strong negative correlation with body fat percentage. The effect of body fat percentage on PEFR indicates that independently obesity affects expiratory flow volume and pulmonary mechanics of an individual.

KEY WORDS : - Body fat percentage, Spirometry, Durnin and Womersley method, PEFR (Peak Expiratory Flow Rate)

INTRODUCTION

In the present era of modernization and globalization, developing countries like India is facing obesity as important health problem. Besides the genetic predisposition, adoption of sedentary lifestyle, lack of regular physical exercise, excessive intake of junk foods, stress of competitive world has made the environment conducive to the development of obesity [(1)]. Most popular index to compare body composition of people and to categorize them as obese and non-obese is the Body mass index (BMI). Although BMI is the major index in evaluating obesity but direct measurement of body fat and its distribution is more important [(2)]. Moreover the effects of obesity on ventilatory parameters may depend on both the distribution and size of excess adipose tissue [(3)].The deleterious effects of obesity on pulmonary functions led to various complications. Different expiratory flow rates are employed to demonstrate the narrowing of airways. Peak expiratory flow rate (PEFR) is a convenient tool to measure lung functions in a field study [(1, 4)]. It is the maximum velocity of flow with which air is forced out of the lungs. This maximum rate is recorded during procedure of rapid and forceful expiration after deep inspiration without stopping for at least 6 seconds. It is a fairly good indicator of bronchial hyperresponsiveness[(1,5)]. The current study looks into the association of body fat percentage with PEFR in normal weight and overweight M.B.B.S. students. So that the subjects who are at high risk can be identified. This will help to plan and execute preventive measures to prevent negative effects on health and quality of life. Overall the study depicts effect of obesity on pulmonary mechanics of an individual.

MATERIALS AND METHODS

The present study was undertaken in young adults of 18- 25 years medical undergraduate students from a well known tertiary hospital Mumbai. The proforma and plan of the study were submitted to the local Ethics Committee and were approved before undertaking this study. The plan and purpose of study were explained to students. Then every student signed informed consent. 120 medical undergraduate students of age 18-25 years including both males and females participated in this study. All students were normal without any symptoms. Participants with known history of any respiratory disease, heart disease or major surgery done, any neuromuscular disorder or skeletal muscle abnormalities were excluded.

The study was conducted using equipments: weighing machine, measuring tape, Skinfold Caliper and computerized PFT machine. Age (years), sex and anthropometric parameters (height (cm) and weight (kg) were noted. Weight was measured using a weighing machine whose least count was 0.5 kg. Height was measured using a measuring scale whose least count was 0.1cm. BMI was then calculated using Quetlet's index as:

BMI = weight (kg) / Height (metre) ^{2}

Participants were classified depending upon BMI as :

Control Group : 18.5 – 24.9 kg/m^2 and **Study Group :** 25.0 – 29.9 kg/m^2

In both groups each constituted 60 students having 30 males and 30 females in that individual group. Skinfold measurement method was most widely used body composition testing method for assessing percent body fat. Skinfold parameters measured were biceps (mm), triceps (mm), subscapular (mm) and suprailiac (mm). All these parameters were measured using skinfold caliper (make Anand Agencies) whose least count is 0.1mm. Skinfold caliper is a device which measures skinfold thickness with underlying layer of fat. All measurements were taken on right side of body while standing erect. The participants were instructed to keep shoulder and arm muscles relaxed during the test. All measurements were done on healthy, undamaged, uninfected dry skin. The skinfolds were picked up between the thumb and index finger of left hand and lifted up. The caliper was held in right hand and pressure plates were applied perpendicularly 1 cm above the fingers holding the skinfold tightly and allowing the pressure of the caliper alone to be applied to the skinfold. The reading was taken 2 seconds after the caliper application in mm. The grip was maintained throughout the measurement. Minimum of three measurements were taken at each site with atleast 2 min interval to allow the tissue to restore to its uncompressed form. Midpoint between tip of acromion process and tip of olecranon process keeping elbow in extended and relaxed position was identified using a measuring tape. At this midpoint vertical fold was raised on anterior aspect of arm for biceps skinfold. For triceps skinfold procedure is same except fold was raised on posterior aspect of arm. Subscapular skinfold measurement was taken on the oblique fold just below the bottom tip of scapula. Suprailiac skinfold measurement was taken on slightly oblique fold just above the crest of ileum in the midaxillary line just towards front from side of waist. The average of three readings at a particular site represented the accepted value for that site.The sum of accepted values at all four sites represented the final skinfold score which was entered into a table given by Durnin and Womersley for calculating body fat percent [6].

The evaluation of peak expiratory flow rate was performed by computerized PFT machine manufactured by MEDGRAFICS (CPFS/D USB Med Graphics preVent ™ Pneumotach). The participant was asked to sit comfortably in a chair. Each participant had been explained about the test in detail. They were also shown how to perform the test with sufficient trials. Peak expiratory flow rate (PEFR) or Forced expiratory flow at maximum effort (FEF_{max}) is the maximum flow rate attained during FVC maneuver. For recording Forced vital capacity (FVC), the participant was asked to inhale deeply and then exhale to the extreme rapidly and forcefully for minimum 6 seconds without stopping. Three efforts were done and the best effort was taken into consideration according to standard norms [7]. Maximum flow rate in this procedure was recorded. The readings for PEFR were expressed as L/min. The results were tabulated. The data entry was done in MS-EXCEL programme and analysis was done by SPSS-IS statistical software version 19.0 for windows. For statistical analysis, the data were submitted to unpaired‘t’ test. So that comparison of PEFR in study and control group was obtained. For finding correlation between body fat percentage and PEFR, Pearson’s correlation test was applied.

RESULTS

TABLE 1: COMPARISON OF ANTHROPOMETRIC PARAMETERS, BODY FAT PERCENTAGE AND PEFR IN CONTROL (NORMAL WEIGHT) AND STUDY (OVERWEIGHT) GROUP

Parameter	Males		Females	
	Control	Study	Control	Study
Age (years)	19.80 ± 1.79	20.17 ± 1.90	19.37 ± 1.00	19.43 ± 1.30
Height (cm)	170 ± 7.43	163 ± 8.44	159 ± 6.95	158 ± 5.07
Weight (kg)	61.60 ± 6.71	70.72 ± 8.41	53.30 ± 6.65	66.40 ± 5.31
BMI (kg/m^2)	22.52 ± 1.95	26.52 ± 1.09	22.02 ± 1.89	26.18 ± 0.74
Skinfoldthickness (mm)				
Biceps	9.77 ± 1.17	11.30 ± 2.00	13.10 ± 2.09	19.53 ± 1.50
Triceps	11.23 ± 1.55	15.50 ± 2.10	14.30 ± 2.29	21.60 ± 1.60
Subscapular	11.20 ± 1.32	15.57 ± 2.50	16.37 ± 4.41	23.17 ± 2.20
Suprailiac	12.30 ± 1.84	17.30 ± 2.58	17.37 ± 4.60	24.67 ± 3.47
Body fat%	17.43 ± 1.21	21.42 ± 1.70	29.08 ± 3.03	34.40 ± 3.05
PEFR (L/min)	464 ± 23.92	381 ± 12.81	328 ± 10.11	272 ± 20.56

Mean ± SD, $p<0.05$ unpaired ‘t’ test, BMI- Body Mass Index, PEFR-Peak Expiratory Flow Rate

Table 1 shows comparison of various parameters between study (overweight) and control (normalweight) group. In this study, parameters age and height were not having much difference. But their weight and BMI were statistically different. The values of skinfold thickness (mm) at mentioned 4-sites along with body fat% were significantly higher in overweight adults than normal weight. As far as expiratory flow rates are considered, PEFR is lower in study group than control group. In females all anthropometric parameters including BMI, Skinfold thickness and body fat% were higher than their male counterparts. But PEFR values were lower in females. It was observed that body fat % was having strong negative correlation with PEFR in both males and females with Pearson’s correlation values : males (r= - 0.72) and females (r = - 0.61). Figure 1 and Figure 2 depict scatter plot diagram showing correlation of body fat percentage with PEFR in females and males respectively. Table 2 gives more details of this correlation.

TABLE 2 : CORRELATION OF BODY FAT % WITH PEFR IN MALES AND FEMALES

Body fat percentage		PFT-PEFR
Female (60)	Pearson Correlation	-0.611
	Sig. (2-tailed)	2.16E-07
	N	Significant
Male (60)	Pearson Correlation	-0.721
	Sig. (2-tailed)	7.96E-11
	N	Significant

FIGURE 1: SCATTER PLOT SHOWING CORRELATION OF BODY FAT % WITH PEFR IN FEMALES

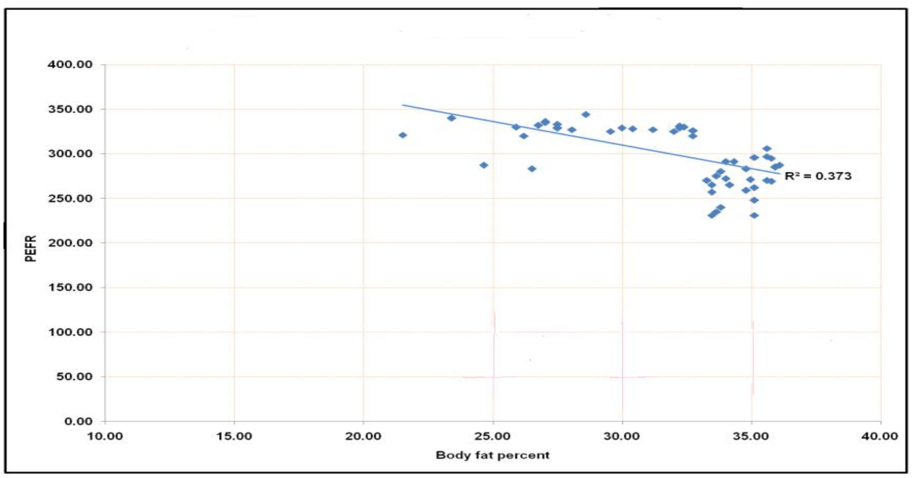
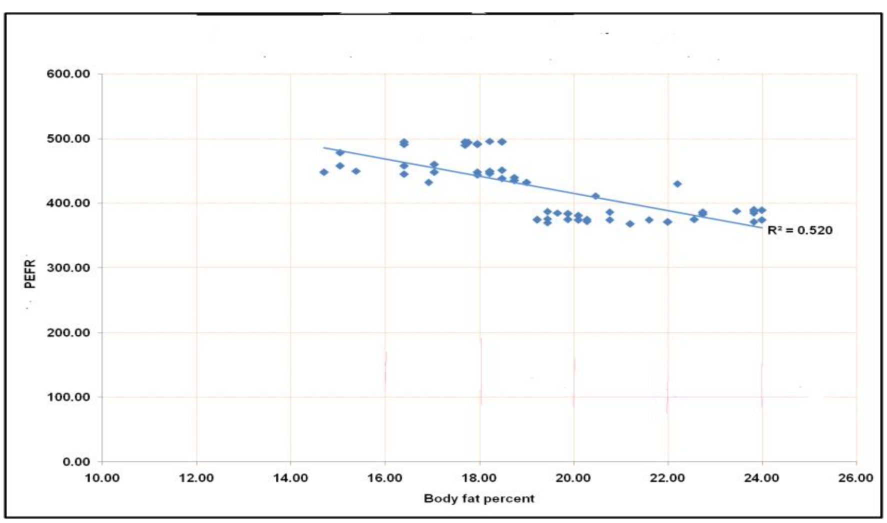


FIGURE 2: SCATTER PLOT SHOWING CORRELATION OF BODY FAT % WITH PEFR IN MALES.



DISCUSSION

Quantitative distribution of body mass provides the initial framework for the description of man's nutritional status [8].The fat content of the human body influences morbidity and mortality of individuals. PEFR is a fairly good indicator of bronchial hyperresponsiveness[1,5] and does not require body temperature pressure saturated (BTPS) correction. The PEFR values are affected by various factors, such as sex, body surface area, obesity, physical activity, posture, environment and racial differences [1, 9, 10, 11]. The primary factors that affect PEFR are strength of the respiratory muscles, respiratory compliance and the airway size. Obesity is characterized by combination of effects on lung and chest wall compliance [12,13].Lung compliance is decreased due to reduced distensibility of extra pulmonary structures, increased pulmonary blood volume, closure of dependent airways and increased alveolar surface tension [12,13,14] .The increased adiposity around ribs, diaphragm and abdomen leading to limited movement of ribs as well as decreased total thoracic and pulmonary volume pulling chest wall below its testing level cause reduction in chest wall compliance[15].

The impaired respiratory muscle function has been possibly related to fatty deposits, overstretched diaphragm, decreased isokinetic skeletal muscle endurance [16,17,18.19,20,21 22]. Decreased respiratory compliance, Intrinsic structural changes, thickening of airway wall combinely contribute to airflow limitation resulting in lower PEFR in obesity[19,23]. Lipid deposition, cellular hyperplasia and alveolar enlargement are seen in immature obese rats as studied by Inselman et al in 2004[24, 25]. Obesity is associated with adipokines causing systemic inflammation are associated with impaired lung function [26, 27, 28, 29, 30]. Although many studies regarding effect of obesity on pulmonary functions have been done from time to time, still we have not succeeded in bringing about curative measures. So the main importance now lies in identifying subjects at risk as means of preventive measures. The findings of our study indicate that measure of body fat percentage affects expiratory flow volumes which are evidenced by changes in PEFR in overweight adults. These findings suggest that obesity causes deleterious effects on pulmonary mechanics.

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