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Influence of body mass index on peak expiratory flow rate

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Abstract
Body Mass Index (BMI) is one of the important factors for each human being to keep oneself healthy. Assessment of BMI made easy to investigate the amount of adiposity. Many health consequences were associated with underweight and overweight. Lung function tends to decrease in underweight and obesity. Totally 60 males and 60 females were included in this study of age group between 18-25 years. The participants were selected based on inclusion and exclusion criteria. Only healthy individuals were recruited in this study and subjects with respiratory illness or history of any co-existing morbidities were excluded from this study. This study was approved by Institutional ethical committee. Lung function was assessed by recording PEFR using Wrights peak flow meter and Breath Holding Time (BHT) was recorded using stop watch. Data's was analysed using SPSS software. As a result PEFR and BHT were significantly reduced in underweight and obese (P<0.01). On comparison between males and females, PEFR and BHT were reduced drastically in females than males (P<0.05).

Keywords: PEFR, BHT, underweight, overweight

1. Introduction
At present sedentary life style raises various health issues due to lack of physical activity and food style. One of the major health issue is obesity. Body Mass Index (BMI) is one of the simple methods to assess oneself about their fat distribution. Common system likely to be affected is Respiratory system. Apart from pollution and hereditary, obesity has become one of the major factor which affect the lung function. Peak Expiratory Flow Rate (PEFR) and Breath Holding Time (BHT) is a simple method to assess lung function. Muxworthy [1] demonstrated breath-holding time has the direct effect on lung volume in 1951. BMI are used as the measures of overall adiposity. Many studies had been done on various types of obesity-induced dysfunctions, disorders and diseases. Gibson *et al.,* and Rubinstein *et al*., stated that obesity impairs the Respiratory functions by inducing airway hyper-responsiveness in adults [2, 3], whereas Young *et al.,* linked it with the development of asthma [4]. Many studies have been conducted in obesity and pulmonary function in the youngsters with the age group of 5 to 16 years or in the older people above 50 years of age [5]. But the age group of 16 to 25 years is the crucial adolescent age that is highly susceptible for obesity. Moreover, Pattern of fat distribution is different in Males and Females, which shows variation in lung functions. BHT is simple procedure to assess the lung function. Since 1900 BHT is done by Medical Practitioner as a part of their investigation. However in this study we are going to investigate lung functions in obese and non-obese subjects. Thus, the present study was undertaken to assesses and correlate the obesity and pulmonary functional status in obese and non-obese Male and Female subjects. Pulmonary functional status was assessed by recording PEFR and BHT. PEFR was selected because it is widely accepted as a reliable parameter of pulmonary functions and is simple to perform as a bed-side test. Hadorn introduced PEFR in 1942 and it was accepted as a parameter of pulmonary function test (PFT) in 1949 [6-8]. Hence in this study we are going to emphasize the effects of lung function in obese and underweight individuals.

2. Objective of the study

- To investigate PEFR and BHT in obese and underweight individuals in comparison with the normal subjects
- To compare the lung function between males and females

3. Materials and Methods

The present study was performed in 120 subjects includes both males and females in the age group of 18-25 years. This study was conducted in Department of Physiology, Madha Dental College and Hospital after obtaining Institutional Ethical Committee Approval. The students were explained about the procedure and benefits of this study. Informed consent was obtained from each volunteer. The subjects were selected based on inclusion and exclusion criteria. Only healthy subjects were participated in this study. Students having any Respiratory problems and taking treatment for any disease and those who are doing regular exercise of any type were excluded from the study. Data's were recorded between 9 am to 11 am to overcome circadian effect. PEFR and BHT were recorded in sitting position. The study group was divided into 3 categories: Underweight, Normal and Obese,

The body weight (Wt) was recorded bare footed to the nearest 0.1 kg. The height was measured using meter scale without footwear to the nearest 0.1 cm. BMI was calculated by Quetelet's index: Weight (kg) divided by the square of Height (m2).

3.1 Breathe holding time

The subject was instructed to take deep inspiration and hold the breath upto breaking point and Breath holding time was recorded Nose clips were kept on throughout the procedure. This was followed by recording of PEFR.

3.2 PEFR

PEFR were measured by Wright's peak flow meter. The recording was done in sitting position. The subject was instructed to take deep inspiration and asked to blow out forcefully through the mouth piece. Test manoeuvre was repeated thrice and the best result was considered for analysis.

3.3 Statistical analysis

The data's are expressed as mean ± S.D. A one-way ANOVA test was conducted to compare and see the effect of BMI on PEFR and BHT in three study groups underweight, normal weight and overweight students.

4. Result

Table 1: Comparison of Peak Flow between Underweight, Normal and Obese in Female Subjects

Parameters	Underweight	Normal	Obese
PEFR	195.9±48.7	296.3±52	203.3±44.4***
BHT	22.3±1.9	32.3±4.8	22±4.8*

Values indicate Mean ± SD, *P<0.05, **P<0.01, ***P<0.001

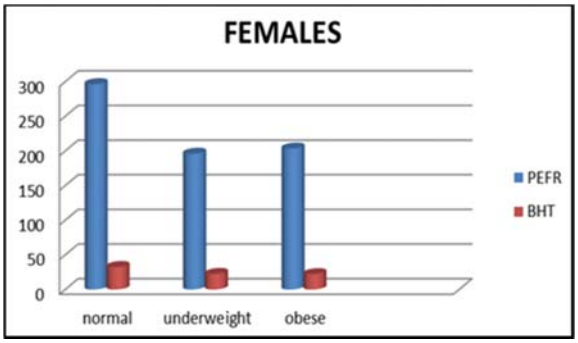
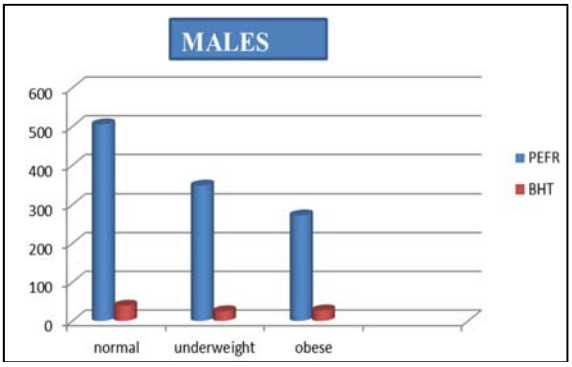


Table 2: Comparison of Peak Flow between Underweight, Normal and Obese in Male Subjects

Parameters	Underweight	Normal	Obese
PEFR	347.5±49.2	505.3±48	272±62.3***
BHT	24.2±2.16	39±17.8	26.8±2.6*

Values indicate Mean ± SD, *P<0.05, **P<0.01, ***P<0.001



The lung function were significantly higher in males: PEFR (Litres) - 505.3±48, BHT (sec)-39±17.8 as compared to females: PEFR (Litres) - 296.3±52, BHT (sec) - 32.3±4.8 as shown in Table I & II. Hence comparison between three BMI categories, Normal males and females had higher PEFR and BHT than underweight and obese.

Both underweight males and females showed reduced lung function. Underweight Males had PEFR (347.5±49.2) and BHT (24.2±2.16),females had PEFR (195.9±48.7) and BHT (22.3±1.9).Observation shows reduced lung function in females than males which is statistically significant (P<0.01). In case of obese subjects (male and female) shows reduced lung function when compared with normal. Obese female subject had significant reduction in PEFR (203.3±44.4) and BHT (22±4.8), obese male subject had PEFR (272±62.3) and BHT (26.8±2.6).On comparing, lung function is reduced more in females than males which is statistically significant (P<0.05)

5. Discussion

PEFR and BHT is one of the common and simple methods to assess lung function. Peak Flow Rate is an expiratory parameter which measures the caliber of the airways which provide us a valuable tool in diagnosis of lung functions. PEFR is depends on various factors which includes airway resistance, maximal voluntary muscular effort and BMI [9-11]. BMI assessment is a powerful tool for categorizing adiposity and body composition among adults and children. It is also known as the Quetelet's index and is commonly used as a practical means to assess body fatness. PEFR depends upon individual respiratory muscle power. Voluntary effort and force of contraction tends to decrease in obesity.

PEFR decreases in obesity due to deposition of fat in thoracic cage and mechanical effects on the diaphragm can lead to increase in the metabolic demands and work-load of breathing. In obesity increased respiratory effort and impaired transport of gas can result in altered respiratory function even if the lungs are normal. In obesity, the function of respiratory muscles is impaired and tends to decrease the PEFR [12]. In case of Undernourishment contraction of diaphragm and muscle mass reduces the lung functions and exercise efficiency which leads to muscle wasting and low Fat Free Mass [13]. Both low and high BMI were associated with poor lung functions which results in combination of airway narrowing and decreased lung recoil [14].

The cause of low dynamic lung functions in undernourished may be the lower level of muscle mass and also there is direct positive relationship between Fat Free Mass (FFM) and lung functions [15] which results in decreased respiratory and diaphragmatic muscle mass. When comparing both the sexes, PEFR and BHT were found to be very low in females than males. This is due to pattern of fat distribution. In females, fat deposition is more in the extremities (peripheral obesity) whereas in males, it is seen more in the truncal region (central obesity) [27, 28]. The truncal fat may compress the thoracic cavity and restrict the diaphragmatic movement resulting in reduced vertical diameter of the thoracic cavity [29] which reduces the compliance of the lungs and the thoracic cavity and also increases the load on the respiratory muscles. This may lead to reduction in lung volumes and flow rates, especially PEFR [30]. The diaphragm muscle fibres reduces in undernutrition and also cause deleterious changes in diaphragmatic muscle structure that ultimately impairs ability to generate Inspiratory force [16, 17].

In this present study subjects were divided into three groups based on BMI. PEFR and BHT values were measured. In our study, individuals with normal BMI have increased PEFR and BHT when compared with underweight and obese individuals which is statistically significant (P<0.001) This Study has shown a direct positive association between PEFR and BMI which correlates with the study of Lewis MI et, al., and Kelsen SG *et al*.,

6. Conclusion

Hence significant difference was observed between BMI and PEFR. PEFR and BHT were significantly reduced in underweight and obesity on comparing with normal (P<0.001). Comparing between males and females this study showed a significant fall in PEFR and BHT in females than males (P<0.05). Lung function can be improved by keeping our body fit and healthy to overcome Respiratory illness.

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