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Original Research Article

Effect of Body Weight on Peak Expiratory Flow Rate in the First Year Medical College Male Students

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ABSTRACT

Overweight/obesity in children and adolescent is growing problem in developed as well as in developing countries. Whereas Peak expiratory flow rate (PEFR) is simple and valuable tool in assessing the lung function. The present study was carried out to find the effect of body weight on PEFR in first year medical college student admitted for different courses. Out of 121 students we included 78 healthy male students of age group 18 to 22 years for the study. These students were divided in three study groups on the basis of their Body mass index (BMI). Out of 78 students, 26 were overweight (BMI >23), 26 were underweight (BMI <18.5) and 26 were normal weight (BMI between 18.6 to 22.9). Three PEFR readings were taken at the same time of the day from each individual with SPIR-O-FLOW peak flow meter and the best of three readings was considered for comparison between three study groups. Statistical analysis was done by one-way ANOVA test. Findings of the study suggest that PEFR values of overweight student are significantly less than normal weight and less than underweight students. Causes are not clear but altered respiratory muscles activity due to adiposity, altered airway calibre, increase resistance and remodelling of respiratory passage due to circulating inflammatory mediators may be responsible for less PEFR seen in overweight students. More research work on large scale is required to obtain the precise relationship between bodyweight and PEFR.

Key Words: Peak expiratory flow rate, Body mass index, Overweight, Underweight, Normal weight.

INTRODUCTION

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Worldwide obesity has nearly doubled since 1980. [1] Obesity is a public health problem with increasing incidence and prevalence, high costs and poor outcomes as a disease, with defined Pathologic and pathophysiologic complications. [2] Indo-Asian countries are now experiencing the unique challenge of a rapid rise in childhood obesity despite a persistently high burden of under nutrition. [3] Under nutrition coexists with obesity, thus demonstrating a "double burden of the disease". [4] All of the above studies indicate severity of obesity and this problem's economical burden over the developed as well as developing countries.

Clinical, laboratory and epidemiological observations have established links between obesity and many systemic disorders. Many studies have demonstrated an association between excess body weight and pulmonary dysfunction. Several breathing problems including obstructive sleep apnoea, obesity hypoventilation syndrome and asthma are linked with obesity. [5, 6] The Peak expiratory flow rate for obese children is significantly lower than non obese children even before physical exercise. [7] Adolescent males and young adult women initially being diagnosed with asthma are more likely to be obese. [8] Obese adults with asthma appear to have lower lung function than their non-obese counterparts, and obese adults with respiratory symptoms are more likely to be misdiagnosed with asthma. [9] The association of higher BMI with lower PEF may indicate that obesity is an important risk factor for reduced airflow or lung function in children. These findings emphasize the importance of prevention of obesity in children and adolescents in order to avoid possible future respiratory problems. [10]

Use of peak expiratory flow rate as a measurement of ventilatory function test is an ancient. This simple test, measured by peak flow meter, is very useful in diagnosis, management, follow up of asthma and predict the status of ventilator lung function. [11] PEFR is highly sensitive and accurate index of airway obstruction. [12] Peak flow measurement is sensitive indicator to measure the strength of muscles of respiration. [13] In a population of moderately to severely obstructed patients with COPD, PEFR is at least as important for prognosis as FEV_1. [14] Peak expiratory flow rate is a significant predictor of survival over even a relatively short period of time (6 years) in patients with younger-onset diabetes. In addition Study data indicate that peak expiratory flow rate is associated with risk factors for other complications of diabetes. [15] All these studies indicate that PEFR can be use as diagnostic tool to find out respiratory as well as some non respiratory disorder.

Field of the medicine is very vast. Student once admitted to medical colleges has to sit for hours to read the books so as to gain the knowledge. Students have to work in hospitals for hours to learn how to apply that knowledge to treat the patients. In this complete scenario there are hardly few students who bother about their health. These factors make them prone for obesity and related disorders. One of the research study done in AIMST University Malaysia reveals that the prevalence of overweight and obesity among the medical students of University is on the high, which is comparable to the findings of earlier studies conducted in Malaysia. [16] Considering the problem present study was conducted to find out effect of bodyweight as described by BMI on PEFR in first year medical college male students of different courses. So that the study results can be utilize for policy making of medical colleges as well as making changes in the personal life style of the students.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, Dr. Ulhas Patil Medical College (DUPMC) Jalgaon. Study was approved by the institutional ethical committee. There were total 121 first year students of different courses studying in DUPMC. To avoid age and gender bias, 78 healthy male adult students of age group 18 to 22 years were selected out of 121 for the study. The consent forms were filled up. Anthropometrical measurements Age, Height and Weight were recorded along with the medical history and preliminary

clinical examination to exclude any systemic disorder affecting respiratory system.

Exclusion criteria

1) Smokers and/or alcoholic.
2) Presence of any acute or chronic respiratory disorder.
3) Systemic illness which directly or indirectly affects the respiratory system.
4) Structural deformity of the thoracic cage.
5) Those who are doing yoga or any other kind of regular exercise.

Anthropometry

(a) **Body Weight**

A digital weighing scale was used to measure the body weight with an accuracy of + 100 grams. Subjects were weighed without their shoes and with light summer clothing.

(b) **Height**

Standing body height was measured without shoes to the nearest 0.5 cm with the use of height stand with shoulders in relaxed position and arms hanging freely.

(c) **Body Mass Index**

BMI was calculated as body weight measured in kilograms and divided by square of standing body height in meters.

Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. [1] According to the WHO classification of BMI for Asian countries, we classified students of study group in three categories as those with BMI > 23 as overweight, BMI < 18.5 as underweight and BMI 18.6 to 22.9 as normal weight. [17, 18] Out of 78 students 26 were underweight, 26 were normal weight and 26 were overweight.

PEFR were measured by SPIR-O-FLOW peak flow meter. The test was done on the subjects with seated comfortably in an upright position. The subject was connected to the mouthpiece and was asked to breathe in order to familiarize himself with the procedure and equipment. Subject was encouraged to perform deep inspiration followed by deep expiration through mouthpiece of the instrument at their optimum level. Test manoeuvre was repeated for three times and the best matching result was considered for analysis. Due to diurnal variation, peak flow rate should be measured at the same time every day. [19, 20] So we took the readings in the subjects at the same time every day.

Statistical analysis

A one-way ANOVA test was conducted to compare and see the effect of body weight on PEFR in three study groups underweight, normal weight and overweight students.

RESULTS AND OBSERVATIONS

Table 1. Summary of the descriptive statistics results of comparison between three study groups to see the influence of body weight on Peak expiratory flow rate.

BMI based Classification	PEAK EXPIRATORY FLOW RATE							
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Overweight	26	405.96	87.24700	17.11054	370.72	441.20	240.00	575.00
Normal weight	26	499.04	112.69445	22.10120	453.52	544.56	280.00	675.00
Underweight	26	450.00	101.10391	19.82811	409.16	490.84	210.00	675.00
Total	78	451.67	106.66633	12.07758	427.62	475.72	210.00	675.00

Mean values in Table 1, suggest that different groups had different PEFR values with the normal weight highest and the overweight group showing lowest value. Even the lower and upper bound values of 95% Confidence Interval for Mean were less in overweight group than the underweight and normal weight group. Minimum and maximum PEFR values of the overweight group were also less than normal weight group.

Table 2. Summary of the ANOVA results for comparison of study groups to see the influence of body weight on Peak expiratory flow rate.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	112731.410	2	56365.705	5.538	.006
Within Groups	763351.923	75	10178.026		
Total	876083.333	77			

Table 2 shows the values of sum of squares and mean square between groups and within groups. To confirm whether the differences between groups were significant we consider the F value 5.538, whose significance value of 0.006 is less than alpha = 0.05. Therefore the conclusion was that there was a significant influence of bodyweight on PEFR at the $p<0.05$ level in the three study groups. [$F(2, 75) = 5.538$, $p = 0.006$]

Table 3. Summary of the ANOVA multiple comparisons for studying the influence of body weight on Peak expiratory flow rate.
Post Hoc Tests

Dependent Variable : PEFR							
(I) group	(J) group		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Bonferroni	Over	Normal	-93.07692*	27.981	.004	-161.5980	-24.5558
		Under	-44.03846	27.981	.359	-112.5595	24.4826
	Normal	Over	93.07692*	27.981	.004	24.5558	161.5980
		Under	49.03846	27.981	.251	-19.4826	117.5595
	Under	Over	44.03846	27.981	.359	-24.4826	112.5595
		Normal	-49.03846	27.981	.251	-117.5595	19.4826
*. The mean difference is significant at the 0.05 level.							

Table 3 shows Post hoc multiple comparisons of academic achievement using the Bonferroni test between three study groups. Mean difference value < 0.05 was considered to be the significant. Therefore conclusion was that the mean difference of overweight and normal weight was significant (Sig. 0.004). However, the mean difference of overweight and underweight (Sig. 0.359), normal weight and underweight (Sig. 0.251) was not significant.

Taken together, these results of three tables suggested that Peak expiratory flow rate was significantly influenced by body weight of the male students. Specifically Peak expiratory flow rates of overweight students were significantly less than normal weight students. Peak expiratory flow rate of overweight students was also less than even underweight students but the difference was not statistically significant.

DISCUSSION

In the present study first year medical college students of different courses are divided in three study groups on the basis of their BMI and their peak expiratory flow rate (PEFR) values are measured. 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. [21] It is an expiratory parameter which measures the caliber of the airways. It is a valuable tool in lung functions studies for diagnosis, treatment and in epidemiological and

occupational studies for identifying the presence of airflow limitation, assessing its severity and variation. [22] PEFR is dependent upon several variables including airway resistance maximal voluntary muscular effort and the possible compressive effect of the maneuver on thoracic airways. [23-25] Considering the value and simplicity of test we decide to measure PEFR in the students to assess their lung functions.

Body mass index (BMI) assessment is a powerful tool for categorizing individual's weight in health and in disease. [26] BMI defines and measures adiposity and body composition among adults and children. It is also known as the Quetelet index and is commonly used as a practical means to assess body fatness. [27] The International Task Force on Obesity has agreed that BMI is the most practical tools available to define overweight or obesity and to screen for it. [28-30] Therefore we have considered calculation of BMI as a tool to classify the students as overweight, normal weight and underweight.

Present study has shown that PEFR values in overweight students are significantly less than normal weight and less than underweight students. In healthy subjects 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. [31] The lower values of PEFR could be linked to obesity through several mechanisms, such as mechanical effects on the diaphragm 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. Adiposity- the pattern of fat distribution has also been suggested as a significant predictor of decreased PEFR as abdominal adiposity restricting the descent of the diaphragm and limiting lung expansion as compared to overall adiposity which may compress the chest wall. [32] In obesity increased respiratory effort and impairment of the gas transport system can result in altered respiratory function even if the lungs are normal. As well as having a direct effect on the mechanical behavior of the respiratory system by altering lung volume, airway calibre or respiratory muscle strength. [33, 34] PEF is considered to be an objective measure of airflow resistance in the lungs; Study shows that PEF is lower in obese children which mean that there is an increase in respiratory resistance with obesity. [10] In obesity, the function of respiratory muscles is impaired from the increased resistance they must overcome and from the reduced capacity of these muscles. [35] All these studies stated that in obesity the altered mechanical muscular activity due to adiposity, altered airway calibre and increase respiratory resistance may be responsible for the reduced lung function and lower PEFR.

Obese subjects may have impaired lung function, but the mechanism for this is unclear. [36] The visceral adipose tissue influences the circulating concentrations of cytokines such as interleukin-6 and TNF-alpha. [37, 38] A decreased level of adiponectin in thereby increases the levels of systemic inflammation, which might in turn negatively affect the pulmonary functions. [39] The molecular mechanisms through which adiponectin mediates its effects in the lungs are not clearly defined; however, AdipoRs expression on lung epithelial cells of COPD patients strengthens the hypothesis of its role in pathophysiological conditions of the lungs. [40] The airway calibre of the obese persons is reduced, possible mechanism could be remodelling of the airway by pro-inflammatory adipokines and/or by the continuous opening and closing of small airways throughout the breathing cycle. [41] Therefore the exact

mechanism is still unclear but remodelling of respiratory passage due to circulating inflammatory mediators, adipokines and adiponectin may be responsible for lower values of PEFR in overweight students.

Key finding of this study is PEFR values of overweight students are significantly less than normal weight and less than underweight students. Our findings are consistent with the finding of Yogesh Saxena et al. [32] Similar results of our study are also noted by Farida M. El-Baz et al., [42] Wannamethee et al. [43] and Khwaja Nawazuddin Sarwari et al. [2] In the research study by Umesh Pralhadrao Lad et al. [44] no participant was diagnosed asthmatic, expiratory flow rate was taken as a marker for obstructive lung diseases like asthma and COPD. They found a significant difference across the three BMI ranges, with the lowest mean values in overweight males. Study by Febrina Z. Siregar et al. [7] shows that PEFR for obese children is significantly lower than non obese children even before physical exercise.

Physical activity of the students is always less in professional colleges, as main stress is given on sitting for hours to do the study. Providing 45 minutes of daily physical activity can increase fitness and decrease the prevalence of overweight and obese youth. [45] Weight loss reduces airways obstruction as well as PEF variability in obese patients with asthma. The results suggest that obese patients benefit from weight loss by improved pulmonary mechanics and a better control of airways obstruction. [46] Our study suggests that over weight students should be encouraged to make healthy changes in their life style so as to reduced the weight and prevent future respiratory complications. Same suggestion is also applicable to the normal weight as well as underweight students to maintain or even to improve their respiratory performance and avoid obesity.

The limitation of the present study was in its design. This was a small group study which was carried out in single institute. A larger sample size and a longitudinal study will definitely be of a great value in predicting the relationship between PEFR and overweight or obesity. Further, the association needs to be studied in female subjects. We are planning to expand the study by including more parameters of pulmonary function test and compare them in both the sexes in different age groups and different body weights so as to obtain more precise correlation.

CONCLUSION

Present study is based on the premise that the body weight of a student has an effect on lung function and in turn PEFR. More specifically the purpose of this study is to examine the Effect of body weight/BMI of the student on PEFR. Based on the results of this study, negative relationship is observed between body weight, as rated by the BMI, and PEFR. In other words, PEFR values of overweight students are significantly below than their normal weight and below than their underweight counterparts. Causes for this difference are not clearly known but altered mechanical muscular activity due to adiposity, altered airway calibre and increase respiratory resistance along with remodelling of respiratory passage due to circulating inflammatory mediators may be responsible for less PEFR seen in overweight students. Our study suggests that professional institutes should encourage the students to improve health and wellness to avoid overweight or obesity. This can be also result in improvement of pulmonary function for some students.

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