



ORIGINAL RESEARCH PAPER

Physiology

RELATIONSHIP OF BODY MASS INDEX WITH PULMONARY PARAMETERS IN UNDERGRADUATE MEDICAL STUDENTS.

KEY WORDS: Medical Students, Body Mass Index(BMI), Forced Vital Capacity(FVC), Forced Expiratory Volume in 1st second (FEV₁), Peak Expiratory Flow Rate(PEFR)

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ABSTRACT
INTRODUCTION: Obesity, a chronic non-communicable disease, as indicated by the World Health Organization (WHO), is one of the most rapidly growing health problems worldwide. Obesity affects the respiratory functions and impairs the gas exchange, leading to alterations in pulmonary function tests (PFT). Younger generation and medical students are no exception in regards to the detrimental effects of obesity. Forced vital capacity (FVC), Forced Expiratory Volume in 1st second (FEV₁), Peak Expiratory Flow Rate (PEFR) are reliable pulmonary function tests to diagnose any respiratory disorder. In this study, FVC, FEV₁, PEFR of medical students were assessed to find their relationship with Body Mass Index (BMI). **MATERIALS AND METHODS:** A institution based cross-sectional observational study was done in Dept. of Physiology, Jorhat Medical College including the undergraduate medical students. Sample size was calculated as 160 using EpiTools Software. Height in centimeters, weight in kilograms and digital spirometry of 160 students were recorded. In case of more than two variables, P values were calculated using Anova Test and p value < 0.05 was considered significant. **RESULTS:** FVC, FEV₁, PEFR all were decreased in overweight and obese students compared to normal weight students and our observation was statistically significant in case of FEV₁ and PEFR by Anova test (p value: 0.0335 and 0.0428 respectively). **CONCLUSION:** Changing of life style that includes performing regular physical exercises, yoga, meditation, sticking to a routine time table for sports, study and sleeping hours and regular health check up in the form of Height, Weight, Spirometry could be beneficial for the students to prevent obesity related pulmonary ailments.

INTRODUCTION
 Obesity as per WHO is defined as 'the abnormal or excessive collection of the fat in the body that presents a risk to health'.¹

Pulmonary function is the long term predictor for overall survival rates .It is used as a tool in general health assessment.^{2,3} Pulmonary function tests play a significant role in the assessment, diagnosis, quantification of the pulmonary ventilator disorders. Pulmonary function is known to change with body mass index of the subject.⁴

Among different pulmonary function tests, Forced vital capacity (FVC), Forced Expiratory Volume in 1st second (FEV₁), Peak Expiratory Flow Rate (PEFR), are used as simple and reliable diagnostic and prognostic test procedures to diagnose any respiratory disorder.

Obesity affects the respiratory functions, including alterations in the respiratory mechanics, weakens the diaphragm and other respiratory muscle strength, also impairs the gas exchange, leading to limitations in pulmonary function tests (PFT).⁵ These diseases also affect the younger generation and medical students are no exception.

In the present study an attempt has been made to assess pulmonary parameters (Forced Vital Capacity, Forced Expiratory Volume in 1st second, Peak Expiratory Flow Rate), of medical students and to find their relationship with Body Mass Index(BMI).

MATERIALS AND METHODS
 The present study was done in Dept. of Physiology, Jorhat Medical College. It was a institution based cross-sectional observational study. Study population included undergraduate medical students of Jorhat Medical College. Sampling technique was simple random sampling. Considering prevalence of obesity as 24%⁶ and 11% as desired precision under 95% confidence interval, sample size was calculated and rounded up to 160 using EpiTools Software.

The study included students volunteers of age 17-25 years who were non-smokers and gave consent for the study. The study excluded those students who did not take part in all the tests procedures required for the study. Ethical Clearance was obtained from Institutional Ethical Committee (H), Jorhat Medical College, Jorhat.

Weight of the students were recorded in Kilograms by an analog Crown Victoria Deluxe weighing machine with a minimum calibration of 0.5 Kilogram and upto 130 Kilograms capacity. The height of the students was measured by the stadiometer having a measuring range of 20-210cm with 1mm graduation.

160 students were classified on the basis of Body Mass Index(BMI) as Normal weight (18.5<BMI< 24.9), Overweight (25<BMI<29.9), Obese(BMI≥30) and Underweight (BMI<18.5).

PROCEDURE OF DIGITAL SPIROMETRY
 Helios 401 Medspiror Digital Spirometer machine was used. The computer was turned on, entered into the Helios software, technical adjustments were done and the participants' details were entered. The subject was asked to elevate the chin and extend the neck slightly. The noseclip was placed on the nose and the subject was asked to take a big deep breath of air from room air and put the mouthpiece into mouth by sealing lips tightly around it and blast the air into the tube forcefully and as fast as possible followed by an equally forceful blow-in. This completed one forceful inspiration and expiration. The FVC, FEV₁, PEFR values were recorded and a print of the recorded data was taken out and saved for further analysis.

STATISTICAL ANALYSIS
 The response frequencies and descriptive statistics like mean and standard deviations were calculated and analyzed using MS Excel. In case of more than two variables, P values were calculated using ANOVA test by Interactive statistics software. The P value <0.05 was considered as significant and P<0.01

and $P < 0.001$ was considered as highly significant and extremely highly significant respectively.

RESULTS

In our study, out of total 160 students 93 (58%) were of normal BMI, 38 (24%) were overweight, 6 (4%) were obese and 23 students (14%) were underweight. (Fig 1)

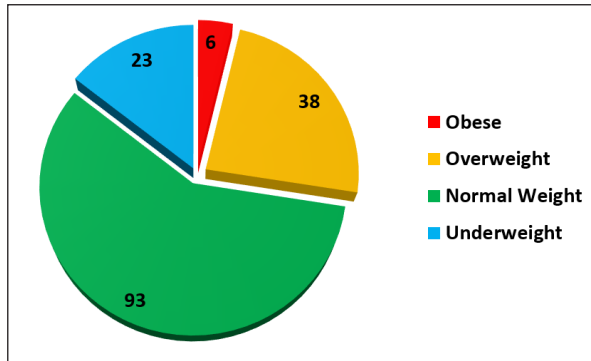


Fig 1: BMI category of the study participants (n=160)

In Table 1, comparison of spirometric variables with body weight showed that FVC, FEV₁, PEFR all were decreased in overweight and obese students compared to normal weight students. However, our observation was not statistically significant for FVC by Anova (p value: 0.8039). Contrary to this we recorded statistically significant observation in case of FEV₁ and PEFR by Anova test. (Table 1)

Table 1: Spirometry variables and Categories of BMI:

Parameters (Mean± SD)	Underweight (n=23)	Normal weight (n=93)	Overweight (n=38)	Obese (n=6)	P value
FVC (Liters)	2.76±0.71	2.77±0.78	2.63±0.87	2.62±0.78	0.8039
FEV ₁ (Liters)	2.11±0.73	2.42±0.78	2.05±0.85	1.85±0.78	0.0335*
PEFR (Liters/s)	5.56±1.79	5.82±1.78	5.05±1.60	4.34±1.51	0.0428*

*statistically significant

Comparison of PEFR values between normal weight, overweight and obese students showed that as BMI increased, PEFR decreased with exception to underweight. (Fig 2)

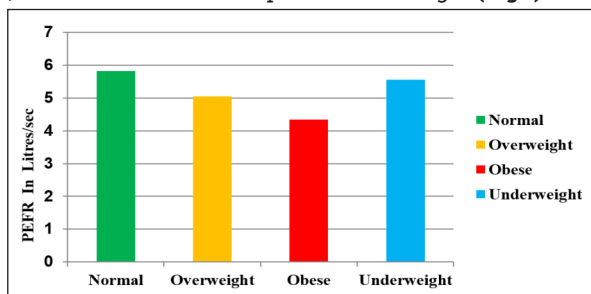


Fig 2: Variation of PEFR with BMI

DISCUSSION

Our study showed that there were significant differences between the obese, overweight and normal weight subjects in respect of PEFR and FEV₁. However, in regard to FVC our study comparison came to be insignificant.

Our study findings were consistent with the findings of Ghobain⁷ who found significant difference between obese and non obese group with regard to PEFR. Similarly, previous research findings showed negative correlation between obesity and the PEFR values, which were lower in the obese patients.⁸

Ladosky et al reported reduction in FVC and FEV₁ proportional to the increment in BMI when comparing normal weight and obese patients.⁹ Lazarus et al reported an inverse relationship between FVC and BMI but found no correlation between FEV₁ and BMI.¹⁰ A study conducted by Costa D et al addressing the relationship between spirometric tests and obesity produced results similar to those of our study.¹¹

Similar results were seen by Rasslan et al in their study on Brazilian subjects. They recorded lower mean FVC value in obese as compared to non obese subjects.¹² The lower values of the FVC in both the groups in current study as compared to other studies may be attributed to the smaller size of the chest and shorter built of Indian subjects.

Contrasting results were obtained by Mahajan et al in their study conducted on adult males only. They found significant decrease in FVC and FEV₁ between obese and non obese participants, but insignificant differences regarding PEFR and FEF 25–75% between them, irrespective of age.¹³

Our study findings were in contrast with the study done by Sengupta et al.¹⁴ The possible cause of the difference between two studies may be age factor and mild COPD for both sexes in their study.

The most important change in pulmonary functions in obesity is a decrease in lung compliance due to increased weight of chest wall and the higher position of diaphragm in the thoracic cavity resulting in a decrease in the lung functions which subsequently leads to increase in work of breathing.¹⁵ In addition, the deposition of fat on the chest wall may impede the expansion and excursion of the rib cage, through a direct loading effect or by altering the inter-costal muscle function.¹⁶ Obesity is also associated with systemic and vascular inflammatory markers such as the hormone leptin. These inflammatory factors exert local effects on lung tissue which leads to reductions in airway diameter.

In our study, we also found decreased respiratory function in underweight in all the parameters viz. FVC, FEV₁, PEFR. Several studies have reported similar relationship between underweight and pulmonary function in healthy subjects.

A study on university students found that the underweight group has significantly lower FVC than the normal weight group.¹⁷ A study on children and adolescents has also shown that underweight participants have lower predicted FVC (%) and vital capacity.¹⁸

The relationship between underweight and pulmonary function is a matter of debate. Underweight status is associated with increased morbidity and mortality.¹⁹ In a recent cohort study, an increased mortality risk is observed in underweight individuals.²⁰ In case of acute respiratory distress syndrome (ARDS) or acute lung injury (ALI), high mortality rate is also observed in underweight patients.²¹

Moreover, previous reports have shown association between underweight and morbidity.^{22,23} However, due to the relative lack of attention, effects of underweight status on respiratory system have been rarely studied. Several studies have explored the relationship between respiratory function and underweight.^{24,25}

Many studies conducted in the other parts of the world addressing such relationship showed heterogeneous results. The effects of obesity on spirometric values are not consistent across all studies with some studies showing no effects and some other studies showing positive effects.

These variations may be explained by the wide variations in ethnicity of different population in PFT values or this may be a result of methodological differences in these studies.

STUDY LIMITATIONS: In our study we did not measure all the pulmonary function tests variables; our study was limited to FVC, FEV1, PEFr and did not include other lung volumes and capacities. This study was a Cross sectional study; as such the casual relationship of the risk factors could not be established. In our study, the Spirometric changes were relatively small and all were within normal limits. Therefore, whether these differences had clinical significance was unclear. These issues require more investigation and further follow-up studies

CONCLUSION

Our results showed that, obesity of moderate and severe degrees is associated with increased risk of pulmonary function impairment. We recommended for changing life style that includes reduced consumption of fat rich diets, fast foods, salt restriction, performing regular physical exercises, yoga, meditation, sticking to a routine time table for sports, study and sleeping hours. Regular health check up in the form of Height, Weight, Spirometry could be beneficial for the students to prevent obesity and the pulmonary ailments associated with it. It is highly desirable for such studies to be initiated so as to tackle the burden of noncommunicable diseases among the new-generation physicians.

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