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Original Research Article

A Study of Correlation of Pulmonary Function Tests and Body Mass Index in the MBBS Students and Health Care Workers of Bhagwan Mahavir Institute of Medical Sciences, Pawapuri

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Abstract

Aim: To evaluate the prevalence of deranged BMI, pulmonary function tests and correlation between BMI and pulmonary function test.

Material & Methods: A cross-sectional study was done on 200 MBBS Students and health care workers including 100 from rural area and 100 from urban area population in the age group of 18-35 years from Bihar Region.

Results: In obese I and II groups, the mean value of pulmonary function tests were higher in rural population except FEV1/FVC, which was higher in urban population and statistically significant in obese II group. The differences of mean value of FVC and FEV1 were statistically significant in both obese groups.

Conclusion: Prevalence of deranged BMI was significantly higher in urban population. Negative correlation found between BMI with Pulmonary function tests in both populations except FEV1 and FVC which showed positive correlation in rural population.

Keywords: Body Mass Index (BMI), Pulmonary Function Test (PFT), Forced Vital Capacity (FVC), Spirometery.

Introduction

Obesity is a major health problem of excessive adipose tissue accumulation in body which leads to problem in Asian countries like India. [1] Obesity is a result of rapidly changing life style which involves consumption of calorie rich food with lack of physical activity. The frequency of obesity results in decreasing the lung volume and its capacities by affecting both lung and chest wall compliance. [2] BMI is considered as most significant factor in diagnosis of overweight and obesity in clinical fields. [3] Female individuals found to have lower PFT values because of their

inspiratory and expiratory muscle endurance and chest wall compliance. [4]

Weight affects respiratory parameters because it causes small airway dysfunction, expiratory flow limitation, respiratory mechanics change, chest wall and lung compliance reductions, decreased respiratory muscle strength, decreased pulmonary gas exchange, lower breathing control and limitations in exercise capacity. [5]

Impairment of respiratory function occurs and lung expansion decreases if the fat deposits over diaphragm, abdomen and intercostal muscles. It leads to decreased functional residual capacity (FRC), expiratory reserve volume (ERV), forced expiratory reserve volume in 1sec (FEV1), and total lung capacity (TLC). [6] Generally vital capacity (VC) and total lung capacity (TLC) remains normal but it may be decreased by ≥30%, if obesity is severe. There is an increased breathing effort, if there is "abnormal chest wall resistance" or if there is increased airway resistance. [7] It is seen that if BMI is between 20 and 30kg/m2 then the changes in FRC and ERV are quite similar and there is no big difference in these BMI groups. [8]

Thus, the aim of this study was to evaluate the prevalence of deranged BMI, pulmonary function tests and correlation between BMI and pulmonary function test.

Material & Methods

A cross-sectional study was done on 200 MBBS Students and health care workers including 100 from rural area and 100 from urban area populations in the age group of 18-35 years from Bihar Region. Prior informed, written consent for the study was obtained from all the subjects both in English and Vernacular. For this study equipment used were Spiro Excel (Medicaid systems), Weighing scale, and Flexible metallic tape. Required measurements such as weight (kg) and height (m) were measured according to anthropometric standards. Three readings of each of the measurements were taken and then their average was calculated to ensure accuracy.

BMI = Weight (kg)/Height (m^2)

For Asian Indians[6]

Underweight – <18.5kg/m^2

Normal range - 18.5-22.9kg/m^2

Overweight at risk – 23-24.9kg/m^2

Obese I - 25 – 29.9kg/m^2

Obese II - ≥ 30kg/m^2

Pulmonary function tests were assessed by using a computerized spirometer which consists of transducer attached with disposable mouthpiece. To perform the procedure, firstly the subject was made familiar with the working of the instrument, and then the subject was made to sit erect and comfortably facing the spirometer. The subject was asked to inhale deeply and then exhale forcefully with maximum effort into the mouthpiece, by wearing a nose clip. For satisfactory results, the test was recorded at noon (11AM - 12PM), before lunch, as expiratory flow rate was highest at noon. [9-11] The parameters to be recorded were:-Respiratory rate, FVC (Forced vital capacity), FEV1 (Forced expiratory volume in 1 sec), FEV1/FVC (in %), Forced expiratory flow rate (FEF 25-75%) and PEFR (Peak expiratory flow rate).

Data was tabulated and statistically analyzed by using SPSS version 20. Mean, Standard deviation, Student t-test (p value), Pearson's correlation test (r value) were used to investigate the relationship between the BMI and lung function tests among study groups, respectively. The study was approved from the Institutional ethical committee.

Results

Comparison of mean and standard deviation values of BMI and Pulmonary function test in rural and urban population

(Table 1) indicated that all the parameters were higher in rural population except BMI and FEV1/FVC. p value was statistically significant for Height, FVC, FEV1, PEFR and FEF.

Prevalence of deranged BMI was higher in obese 1 cases of urban population as shown in Fig 1, while prevalence of deranged pulmonary function tests was found to be maximum in mid restriction in both populations as indicated in Fig. 2.

On comparing pulmonary function tests among various groups of BMI we found , the mean values of pulmonary function tests were higher in rural population as compared to urban population. This difference was not statistically significant (Table 2). In overweight group, the mean value of FEV1/FVC was higher in urban population while PEFR and FEF were higher in rural population. This difference was not statistically significant as shown in Table 2. In obese I and II groups, the mean value of pulmonary function tests were higher in rural population except FEV1/FVC, which was higher in urban population and statistically significant in obese II group. The differences of mean value of FVC and FEV1 were statistically significant in both obese groups (Table 2).

Table 1: Comparison of values of BMI and pulmonary function tests in rural and urban populations

Parameter	Rural (n=100) (Mean±SD)	Urban (n=100) (Mean±SD)	p value
Weight(kg)	56.78 ±11.91	55.50±12.38	0.90
Height(m)	1.57±0.073	1.48±0.064	0.001*
BMI(kg/m^2)	23.36±5.37	25.48±4.57	0.004*
FVC (l)	2.70±0.49	2.38±0.59	0.001*
FEV1 (l)	2.41±0.45	2.19±0.42	0.001*
FEV1/FVC (%)	90.81±6.78	92.57±4.80	0.339
PEFR (l/m)	5.92±1.42	5.66±0.94	0.001*
FEF (l)	4.48±1.10	4.28±0.88	0.050*

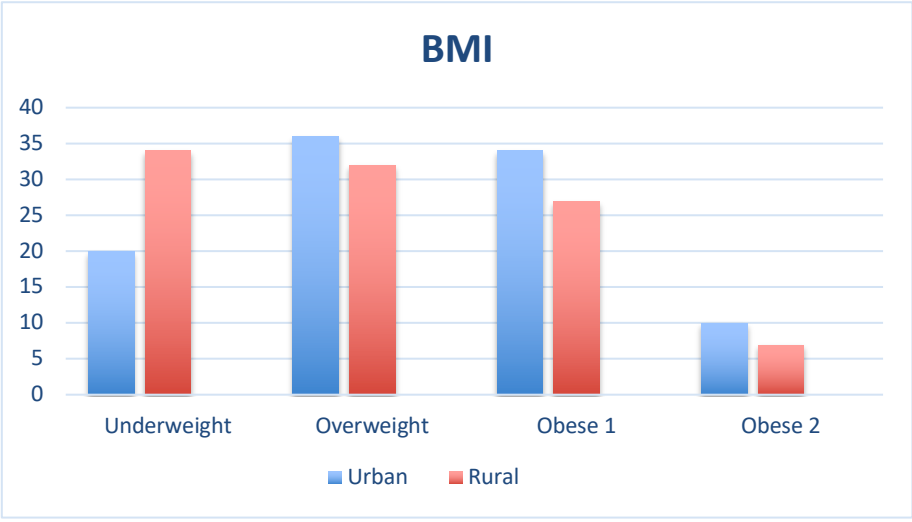

Figure 1: Prevalence of deranged BMI

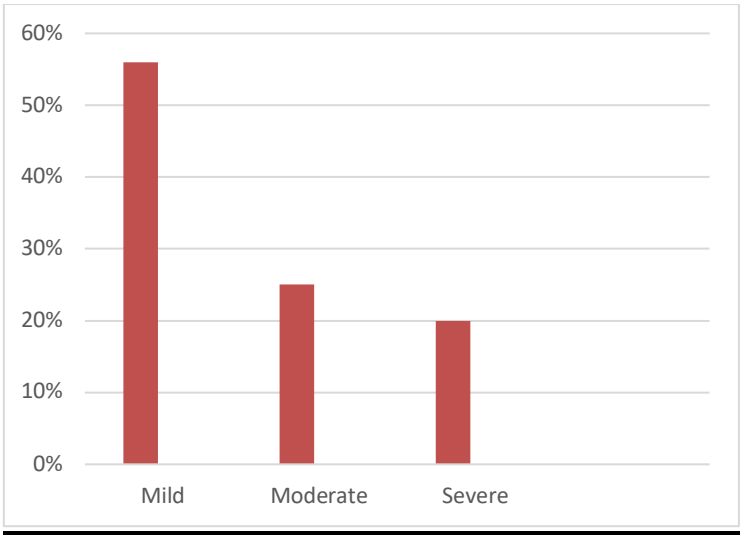

Figure 2: Prevalence of deranged pulmonary function tests in rural population

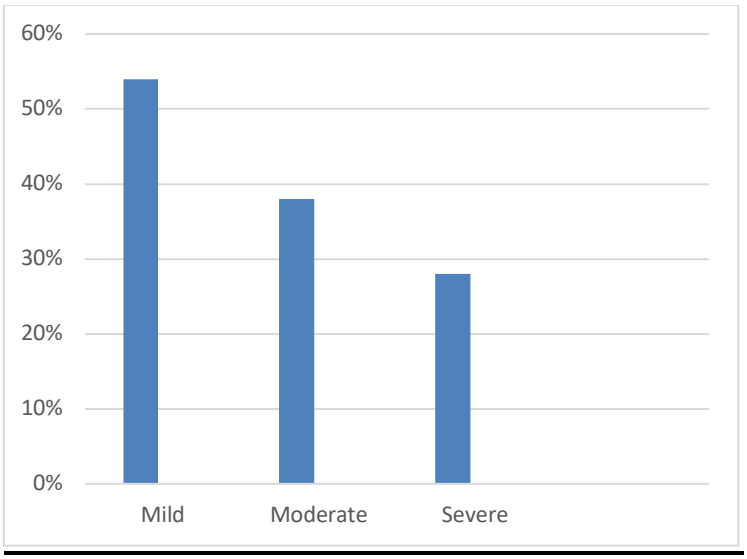

Figure 3: Prevalence of deranged pulmonary function tests in urban population

Table 2: Pulmonary function tests among various groups of BMI

Parameter	Under Weight		Over Weight		Obese 1		Obese 2	
	U (n=20)	R (n=34)	U (n=36)	R (n=32)	U (n=34)	R (n=27)	U (n=10)	R (n=7)
FVC (l)	2.31± 0.84	2.43± 0.63	2.49± 0.64	2.62± 0.78	2.31± 0.42	2.35± 0.56	2.29± 0.54	2.30± 0.32
FEV1 (l)	2.13± 0.48	2.28± 0.51	2.14± 0.54	2.21± 0.73	2.04± 0.32	2.06± 0.35	2.00± 0.50	2.01± 0.23
FEV1/FVC (%)	89.03± 8.66	91.32± 3.63	85.64± 3.77	84.25± 5.48	88.30± 4.22	86.43± 7.80	86.83± 3.89	85.48± 4.54
PEFR (l/m)	6.79± 0.63	6.82± 1.06	5.35± 0.89	5.87± 1.74	5.25± 0.91	5.54± 1.67	5.20± 1.36	5.36± 0.68
FEF (l)	4.39± 0.89	4.73± 0.92	3.48± 0.53	4.21± 1.36	3.28± 0.85	3.80± 1.19	3.10± 1.17	3.67± 0.70

U=urban R=rural

Discussion

The severity of PFT defects is based on the FEV percentage predicted value. The American Thoracic Society classification is as follows;

Mild (FEV percentage predicted greater than 70%)

Moderate (FEV percentage predicted 60% to 69%)

Severe (FEV percentage predicted less than 50%)

Some studies have shown a significant reduction in spirometry parameters with obesity while others have not shown any effect [12-14]. Turan and co-workers have shown in a comparative study on obese and non-obese that although there was no statistically significant difference in FEV1, FVC, or FEV1/FVC, a significant reduction in peak expiratory flow rate (PEFR) and FEF 25-75% was found in overweight and obese individuals [12].

In general, BMI is considered a measure of obesity and it cannot distinguish fat and lean body mass [15]. It is an index of nutritional status and its relationship with body composition is controversial. Waist circumference provides a simple measure of central fatness and it may have a direct effect on the chest wall properties. Waist Circumference mirrors body shape, while BMI provides an estimate of body mass and volume [16]. As previously shown, obesity is not a good parameter to evaluate body fat distribution when measured by BMI [17-18].

Another study showed a positive relationship between FVC, FEV1 and underweight, while FEV1and BMI was negatively interrelated with normal weight people. In overweight males FVC, FEV1 were negatively associated with BMI. FVC and FEV1 was positively connected with BMI/body fat percentage in underweight females, while there was a significant positive association between BMI and FVC in normal weight females, correlation was also positive in overweight females [19].

An earlier study also reported that IC was positively associated with obesity [20]. As vital capacities is equal to IRV + ERV + VT (L); The mean values of VC were significantly higher in obese than in all other groups. In another study VC was reported to have a negative relationship with BMI [21].An earlier study did not report any relation of VC with normal weight and obesity [22].

The present findings were not supported by the study done by Piyali et al. [13] The possible cause of the difference between two studies may be age factor and mild COPD for both sexes in their study [23,24].

Conclusion

Prevalence of deranged BMI was significantly higher in urban population. Negative correlation found between BMI with Pulmonary function tests in both population except FEV1 and FVC which showed positive correlation in rural population.

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