Correlation of Body Mass Index with Pulmonary Function Tests in North Indian Females

Chetan Kharodi[1], Archana Goel[2], Nidhi Puri[3], Surjit Singh[4]

ABSTRACT

Introduction: Obesity is becoming one of the serious public health problems of modern world with rapidly changing lifestyles involving consumption of high calorie foods with decreased physical activities. Spirometery is the initial screening tool for pulmonary diseases. 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 and methods: This study was done on 300 female subjects in the age group of 18-25 years including 150 from rural area and 150 from urban area of North Indian populations. Various anthropometric measurements (height, weight) were taken. BMI was calculated. Parameters of pulmonary function tests such as FVC, FEV1,FEV1/FVC,FEF25-75%,PEFR were measured by spirometer.

Results: The mean value of BMI in rural and urban population is (23.33±4.75) and (22.55±4.57) respectively. On comparing Pulmonary function parameters of both the population, all the parameters were significantly higher in urban population except FEV1/FVC.

Conclusion: Prevalence of deranged BMI was significantly higher in rural population. Negative correlation found between BMI with Pulmonary function tests in both population except FEV1 and FVC which showed positive correlation in urban 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 a 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] Obesity has reached epidemic proportion in India in 21st century with morbid obesity affecting 5% of country population. In North India obesity is found to be more prevalent in urban population (male 5.5%, females 12.6%) followed by rural population (male 1.6%, female 3.8%).[5] 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 AND METHODS

A cross-sectional study was done on 300 female subjects in the age group of 18-25 years including 150 from rural area and 150 from urban area populations in North India. 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 Chandigarh), 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 were 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.[7,8,9] 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

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rate (FEF 25-75%) andPEFR (Peak expiratory flow rate).

STATISTICAL ANALYSIS

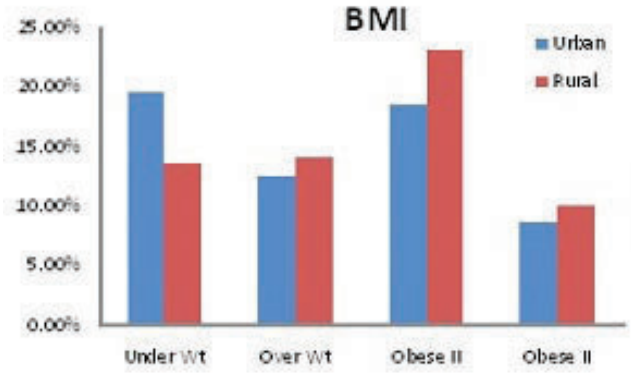
Data was tabulated and statistically analysed by using SPSS version 20. Mean, Standard deviation, Student t-test (p value), Pearson's correlation test (r value) were used to investigate the relationship between the BMI and lung function tests among study groups, respectively. The study was approved from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

RESULTS

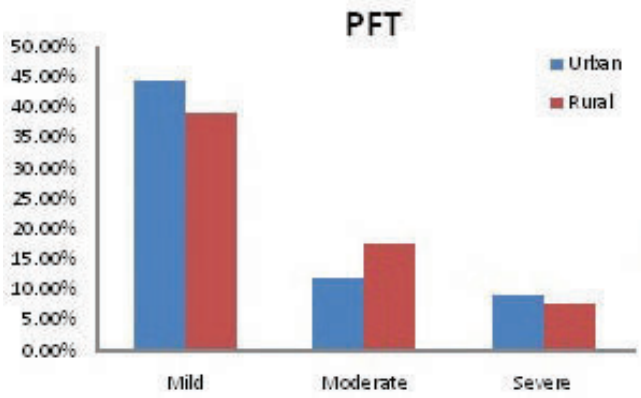
Comparison of mean and standard deviation values of BMI and Pulmonary function test in rural and urban population (Table 1) indicated that all the parameters were higher in urban population except BMI and FEV1/FVC. P value was statistically significant for Height, FVC, FEV1, PEFR and FEF. Prevalence of deranged BMI was higher in obese 1 cases of rural population as shown in Fig 1, while prevalence of deranged pulmonary function tests were found to be maximum in mid restriction in both population as indicated in Fig. 2. On comparing pulmonary function tests among various groups of BMI we found In underweight group, the mean values of pulmonary function tests were higher in urban population as compared to rural population. This differences was not statistically significant (Table 2). In overweight group, the mean value of FEV1 and FEV1/FVC was higher in rural population while PEFR and FEF was higher in urban population. This differences was not statistically significant as shown inTable 2. In obese I and II groups, the mean value of pulmonary function tests were higher in urban population except FEV1/FVC, which was higher in rural population and statistically significant in obese II group. The differences of mean value of FVC and FEV1 was statistically significant in both obese groups (Table 2). In this cross-sectional study, we found negative correlation of body mass index (BMI) with pulmonary function parameters in both the populations, whereas FEV1 and FVC were found to be positive in urban population (Table 3).

DISCUSSION

Obesity is one of the major health hazards across the world. It can lead to various clinical complications such as diabetes, vascular diseases, osteoarthritis, etc. But less emphasis has been given on the effect of obesity on respiratory system.[10] In this study an attempt was made to find out whether there is an increased risk of respiratory problems in overweight and



Graph-1: Prevalence of deranged BMI



Graph-2: Prevalence of deranged pulmonary function tests

Parameter	Rural (n=150) (Mean±SD)	Urban (n=150) (Mean±SD)	p value
Weight(kg)	55.49±12.09	55.68±11.89	0.87
Height(cm)	1.54±0.064	1.57±0.068	0.0001*
BMI(kg/m^2)	23.06±4.83	22.22±4.41	0.1168
FVC	2.38±0.41	2.65±0.50	0.0001*
FEV1	2.19±0.37	2.42±0.47	0.0001*
FEV1/FVC	91.16±4.93	90.81±6.61	0.6036
PEFR	5.51±0.93	5.93±1.23	0.0010*
FEF	4.16±0.89	4.35±1.03	0.0005*

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

Parameter	Under Weight		Over Weight		Obese 1		Obese 2	
	R(n= 22)	U(n= 27)	R(n=16)	U(n=19)	R(n=29)	U (n=25)	R(n=19)	U(n=12)
FVC	2.28±0.36	2.47±0.47	2.44±0.52	2.44±0.65	2.25±0.34	2.53±0.53*	2.24±0.48	2.77±0.30*
FEV1	2.11±0.35	2.32±0.43	2.21±0.41	2.15±0.63	2.05±0.28	2.28±0.52*	2.06±0.46	2.49±0.24*
FEV1/FVC	88.89±8.27	90.93±3.58	85.68±3.71	84.12±11.30	88.23±4.19	86.36±7.81	87.47±3.74	83.38±4.50*
PEFR	5.64±0.74	5.72±1.07	5.00±0.98	5.03±1.62	5.23±0.88	5.48±1.52	5.31±1.31	5.85±0.72
FEF	4.21±0.78	4.38±0.89	3.69±0.45	3.77±1.23	3.69±0.87	3.91±1.16	3.84±1.13	4.13±0.65

Table-2: Pulmonary function tests among various groups of BMI

BMI	FEV1	FEV1/FVC	PEFR	FEF	FVC
Rural	-0.103	-0.078	-0.099	-0.111	-0.077
Urban	0.0186	-0.240	-0.0589	-0.131	0.104

Table-3: Pearson correlation coefficient's of BMI with pulmonary function tests in both population

obese individuals. Pulmonary function tests are generally related to body size and age, where height is a proxy for chest size, and age reflects maturity.[11] Because of this reason every individual has different range of normal values. This study was formulated to see any increase in the BMI will lead to decrease in pulmonary functions. Results of this study were similar with the study done in Andhra Pradesh, where a positive correlation of BMI with FVC and FEV1 was observed.[12] It may be because of fat accumulation around ribs, abdomen and diaphragm which causes restricted movements of ribs, reducing lung volume and decreasing respiratory compliance.[10]

Our study revealed significant decrease in pulmonary function tests in overweight and obese females who do not have any known obstructive airway disease. All the parameters of pulmonary function tests were negatively correlated with Body mass index (BMI) in rural population. (Table 3) 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.

Therefore, it can be said that obesity has significant impact on respiratory problems. Excess of abdominal fat may restrict the diaphragmatic movement which leads to a decrease in pulmonary function. This study suggested significant impairment of pulmonary functions in overweight and obese population due to limited expansion of thoracic cavity which leads to possibility of small airway diseases. The lung functions might be improved by weight loss.

CONCLUSION

Findings of the present study concluded that there was significant difference ($p<0.0001$) in height of urban and rural population. Prevalence of deranged BMI in study population was significantly higher in rural population. Prevalence of deranged pulmonary function tests were found to be maximum in mid restriction in both population. Negative correlation was found between BMI and PFT in both population except FVC and FEV1 which showed positive correlation in urban population.

List of abbreviations

BMI – Body mass index
PFT – Pulmonary function test
FVC - Forced vital capacity
FEV1 - Forced expiratory volume in 1 sec
FEF - Forced expiratory flow rate
PEFR - Peak expiratory flow rate and interpretation of data

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