To Assess the Impairment of Forced Expiratory Lung Functions due to Obesity in Adults

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ABSTRACT

Introduction: Obesity is a chronic condition characterized by an excessive accumulation of fat in human body. Obesity is often associated with many health consequences such as diabetes, hypertension, ischemic heart diseases, obstructive sleep apnoea, stroke, premature death, osteoporosis and respiratory impairments etc. Surprisingly obesity is often neglected though it is associated with such life threatening complications.

Material and Methods: Subjects were randomly selected from clinically healthy MBBS students aged 18-22 years. Height and weight were measured to find out BMI (Body mass index). They were grouped into study group (N-50) having BMI more than 25 kg/m^2 as obese and control group (N-50) having BMI 18.5-22.9 kg/m^2. After fulfilling the inclusion and exclusion criteria, written consent was taken from participants in the study. WC (waist circumference), HC (Hip circumference) and W/H (waist hip ratio) was measured to see the adiposity. The forced expiratory lung function parameters are spirometric parameters viz. FEV_1 (Forced expiratory volume at the end of 1st second), FVC (Forced vital capacity), FEV_1%, FEF(Forced expiratory flow) 25-75%., PEFR(Peak expiratory flow rate), were measured. The instrument software used for measurement of all respiratory parameters was Spirowin version 2.0, manufactured by Genesis Medical systems Pvt. Ltd., Hyderabad. Student "t" test was used to analyze the data.

Result: The results showed obese group presented a significant lower value of FEV_1, FVC, FEV_1%, FEF 25-75%., PEFR as compared to nonobese subjects. This suggests lung function impairment due to damage to the chest mechanics and airways narrowing caused by the obesity.

Key words: –BMI, FEV_1, FVC, FEV_1%, FEF, Obesity, PEFR.

INTRODUCTION

Obesity is defined by WHO in 2000 that "A Medical condition in which excess body fat has accumulated to the extent that it may have adverse effects on health consequences". The term obesity is generally refers to excess deposition of fat in the body. Obesity is rapidly escalating in all age group of world population.[1] In different studies in USA shown that 60% adults and 25% children are suffering from obesity and its related problems.[2] In the developing countries like India also, obesity is started grabbing the population, i.e. 25% adults and 6% children up to 2013.[3]

Obesity is called as a disease of 21st century. It is produced mainly due to changed lifestyle, food and eating habits, lack of regular exercise[4], sedentary habits, overconsumption of high calorie food, diversion of population from agriculture food to industrial food and genetic problems.[5,6] Surprisingly obesity is often neglected though chronic problems like atherosclerosis, hypertension, diabetes, coronary artery diseases and stroke problems are sticking seriously.

By the way of BMI values, obesity is classified. WHO gives reference values for global population depending on BMI. Individuals are classified asunder weight (below 18.5 kg/m^2), normal weight (18.5 kg/m^2 – 24.9 kg/m^2), overweight (25.0 kg/m^2- 29.9 kg/m^2) and Obese (30 kg/m^2 and onwards). In Asian population, complications of obesity are arising in less values of BMI in comparison with European population. So other reference values of BMI are considered by WHO in Asian and Indian population.[7,8] These are normal weight (18.5 kg/m^2 – 22.9 kg/m^2), overweight (23.0 kg/m^2- 24.9 kg/m^2) and Obese (25 kg/m^2 and onwards)

Apart from affecting different systems, obesity shows negative effects on respiratory functions.[9] Different studies have shown that the forced expiratory parameters (FEV_1, FVC, FEV_1%, FEF 25-75%., PEFR) of lung functions are affecting due to obesity. FEV1 is the forced expiratory volume at the end of 1st second of forced vital capacity(FVC). Its value depends on force of expiration achieved by strength of respiratory muscle and condition of the airways in the respiratory tree. These spirometric values are significantly decreases in obesity.[10] This is possibly due to hampering of respiratory mechanics and and narrowing of respiratory passage.[11]

Respiratory functions also affecting due to higher side of body fat deposition. Waist circumference significantly associated with FVC and FEV_1.[12] Some controversial finding was also observed. No change in FEV_1, FVC, FEF 25-75% was shown by obesity.[13] Increased FEV_1, FVC and decreased FEV_1% were shown and increased demand, decreased compliance and increased load on diaphragm shown in the review of obesity.[14] Intestinal bariatric surgery in obese women shows improvement in respiratory function like ERV, VC(Vital capacity), FVC and FEV1 with decrease in obesity

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and weight loss.[15] As there are lots of controversial findings in the present literature, so I have planned to conduct this study.

MATERIAL AND METHODS

The subjects were randomly selected among the mix group of MBBS students between age group of 18 to 22 years. The students were selected from MGM Medical College and Hospital, Aurangabad. Written consent was taken from each subject. Ethical clearance was taken from institutional ethical committee. The study was conducted in the period of December 2015 to November 2016. Anthropometric parameters were measured. These parameters of weight and height were used to calculate the BMI, using formula BMI = Wt in KG/ Ht in m^2. Subjects were grouped in two groups depending on BMI values i. e. Study group (obese) and control group(nonobese).

Inclusion criteria – Clinically healthy male Medical students do not suffering from any illness, between age group of 18 – 22 years. The subjects those who are obese to their respective age were selected. Normotensive (<140 mm of Hg) supine and sitting, Systolic BP – 110 to 140 mmHg, Diastolic BP -70 to 90 mmHg, were included in the study Sample size taken in both groups were 50-50

Exclusion criteria – The students excluded from study, those who were suffering from any medical illness, anxious apprehensive and uncooperative students and any previous history of disease or hereditary aspect of disease. Subjects having respiratory infections, any other respiratory disease, hypertensive, and having any musculoskeletal deformities were be excluded from study.

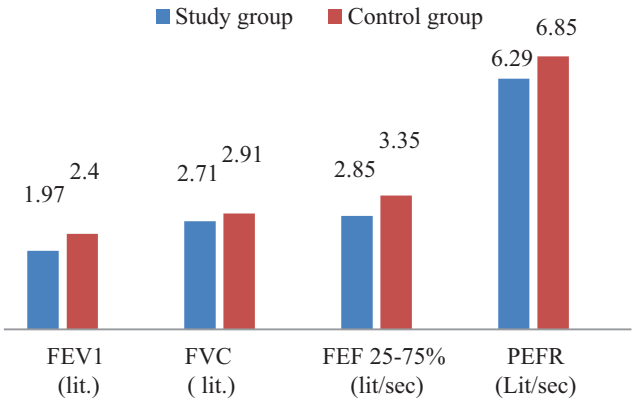
Spirometry - The spirometry tests were conducted using a computerized software instrument Spirovin version 2.0, manufactured by Genesis Medical systems Pvt. Ltd., Hyderabad. All subjects performed spirometry tests, in sitting position, using techniques recommended by the American Thoracic Society (ATS). The spirometry tests were conducted on the subjects in the morning by the investigator. The subjects were instructed properly to take the maximum deep inspiration and then expire out with maximum efforts into the mouthpiece with a nose clip. Tests were repeated for three times. Best reading from three were selected. The validity of the test was verified according to the ATS recommendations. The parameters that were measured by spirometry were as follows: the forced vital capacity (FVC), forced expiratory volume at 1st sec. (FEV_1), peak expiratory flow rate (PEFR), and forced mid expiratory flow (FEF25%–75%). In addition to these measured parameters, the ratio of FEV1 to FVC (FEV1%) was calculated automatically by software system.

STATISTICAL ANALYSIS

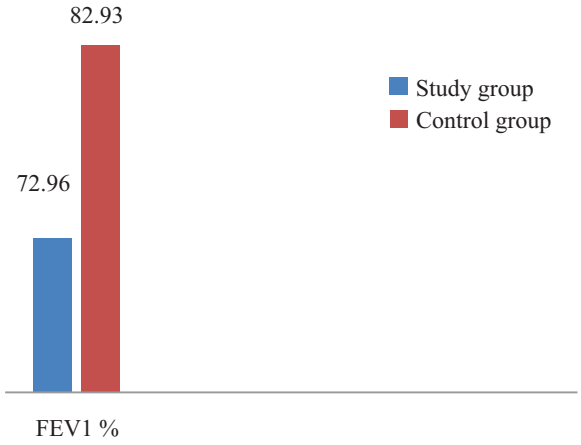
Data of all forced expiratory lung function parameters was collected by the spirometry instrument. The collected data was tabulated and analysed by SPSS statistical software. Students 't' test was used for the results.

Parameters	WHO criteria (BMI kg/ m^2)	Asian criteria (BMI kg/ m^2)
Underweight	Below 18.5	Below 18.5
Normal weight	18.5 – 24.9	18.5 - 22.9
Overweight	25 – 29.9	23.0 – 24.9
Obese	≥ 30	≥ 25

Table-1: Classification of obesity based on BMI



Graph-1: Relations of FEV1, FVC, FEF, PEFR. among groups



Graph-2: Relation of FEV1% (FEV1/FVC) among groups

RESULTS

From table no.2 all anthropometric parameters shown statistically significant difference in both groups except height. The values of FEV_1 was statistically significant i.e. 1.97 (±0.19 lit) in the study group, and with 2.40 lit (±0.15 lit) in the control group ($P > 0.001$). The FVC was 2.71 lit (±0.20 lit) in the study group and with 2.91 lit (+ 0.21 lit) in the control group($P > 0.001$). FEV1% (FEV1/ FVC) is 72.96% (±5.54%) in the study group and 82.93% (± 6.73%) in the control group. P value is less than 0.001. Mid expiratory flow [FEF(25-75% lit/sec)] is 2.85 lit/sec (±0.27 lit / sec) in the study group and 3.35 lit/sec (± 0.20 lit / sec) in the control group. Peak expiratory flow rate with 6.29 lit/sec (±0.71 lit / sec) in the study group, and with 6.85 lit/sec (± 0.35 lit / sec) in the control group. P value is less than 0.001. $P < 0.001$ shows highly significant difference between two means for that Variable. Means all variables significantly differed between Study group and Control group except height.

Variable	Group	Mean	Std. Deviation	t	Sig. (2-tailed)
Ht (cm)	Study	172.20	6.49	0.302	0.764
	Control	171.80	6.77		
Wt (Kg)	Study	83.24	5.95	13.897	p<0.001
	Control	64.44	7.49		
BMI (kg/sq.m)	Study	28.24	2.03	18.446	p<0.001
	Control	21.46	1.62		
WC (cm)	Study	37.74	3.53	12.232	p<0.001
	Control	30.66	2.08		
HC (cm)	Study	42.76	3.35	11.193	p<0.001
	Control	36.74	1.80		
WC/HC ratio	Study	0.88	0.04	5.951	p<0.001
	Control	0.83	0.04		
FEV1 (Lit)	Study	1.97	0.19	-12.713	p<0.001
	Control	2.40	0.15		
FVC (Lit)	Study	2.71	0.20	-5.038	p<0.001
	Control	2.91	0.21		
FEV1% (FEV1/FVC)	Study	72.96	5.54	-8.084	p<0.001
	Control	82.93	6.73		
FEF (25-75% lit/sec)	Study	2.85	0.27	-10.432	p<0.001
	Control	3.35	0.20		
PEFR (Lit/Sec)	Study	6.29	0.71	-5.006	p<0.001

Table-2: Independent Sample t test

DISCUSSION

In the anthropometric parameters we found significant difference in the BMI. In the result the BMI of case (study) group mean is 28.03 with deviation of ±2.03. This is the obese group according to the BMI cut-off for Asian and Indian population as given in literature of WHO.[6,7] It is compared with control group having mean BMI of 21.46 with standard deviation of ±1.62. Correlation of BMI and respiratory parameters is strongly observed in our study.

FEV_1 reflects the compliance as well as airway resistance. It shows statistically significant –ve relation with BMI in our findings. It is affected in obesity by two ways. One by decreasing the compliance due to deposition of fat in chest and lungs and second, deposition of fat in lungs narrows the respiratory passage and increases the airway resistance. These obstructions dominantly reflects forceful and fast attempts during expiration. Our finding is supported by previous researchers Rajab Ali. K et al[11], D. Canoy et al[16]

In the present study the forced expiratory parameters like FVC and FEV_1% shows relation with compliance, which has contribution of both lung and chest wall compliance. These parameters shown significant –ve relation with BMI in our study. The findings were similar like most of the previous studies of R.meyza et al[17], D. V. Muralidhara et al[18], Sharlin B. Christian et al.[19] Obesity affects the compliance. It is probably due to deposition of fat on chest decreases elasticity of chest. Abdominal deposition of fat restricts the descent movement of diaphragm decreases the expansibility of lungs. It leads to decrement in these spirometry parameters. In one study Umesh Pralhadrao Lad et al[20] it is shown that FVC and FEV_1 has +ve relation with BMI. In the study of G Liyanage et. al. (21) no significant difference was detected in spirometry parameters between obese/overweight and normal weight school children.

FEF 25 -75% is the mid expiratory flow. It is the middle portion of forced expiration in the spirometry loop. It is the marker of small airway resistance. It is measured in lit/min. In our findings the FEF 25 -75% is significantly reduced in obese. It shows –ve relationship with BMI. It narrows due to fat deposition and increases the small airway resistance, specifically in the smaller bronchioles. This produces asthma like condition on obesity. Lots of pervious researchers K P Fung et al[22], Ergun C et al[23], etc also found same –ve trend of FEF 25 -75% in obesity. In one study showed that there is no significant association between BMI and FEF25%, FEF50%, FEF75%.[24]

The PEFR lit/min is the amount of air forcefully expired out after deep inspiration per unit time (by somewhat explosive type of expiration). This is very good indicator of bronchial tree condition. It is promoted as indicator of bronchial hyper responsiveness. It is taken as broncho provocation testing. In our finding results shows significant –ve correlation of PEFR with BMI. It is similar like that of previous many findings Mohamad Al Ghobin et al[13], Jayanti Mishra et al[25], Laxmikant J Borse et al[26], Ramya K et al.[27] It may be due to decreased compliance and increased resistance in the chest region due to deposition of fat. And increased resistance in respiratory passage due to narrowing of passage by fat deposition. The technique of PEFR by Mini Wright's peak flow meter is well accepted in monitoring and treatment of asthma.

CONCLUSION

In our study there was a statistically significant – ve association was found between BMI and forced expiratory lung function parameters in the obese group. It clearly shows obesity hampers the forced expiratory lung functions in the adults.

Additional studies with more subjects and with different age groups are required to verify the results.

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