Research Article

Effect of increasing body fat on pattern of pulmonary function: A prospective study

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Received: June 28, 2017; **Accepted:** July 22, 2017

ABSTRACT

Background: Several evidences are available for altered pulmonary function (PF) with increasing body fat as measured by body mass index (BMI). However, consequences of obesity on PF have been reported to vary depending on its severity and pattern. **Objectives:** To study the effect of increasing body fat (measured by BMI) on the pattern of PF. **Materials and Methods:** A total of 120 subjects of either sex were studied having BMI ≥30 kg/m^2 in the Department of Medicine, GR Medical College, Gwalior, from July 2013 to November 2014. Anthropometric and spirometric parameters were measured using a computerized spirometer. Data were analyzed using IBM SPSS version 20 and expressed as either mean ± standard deviation or percentage. **Results:** Out of 120 subjects, most of them belong to age group of 41-60 years (55%), were female (52.5%) and had BMI between 30 and 35 kg/m^2 (73.33%). The most common PF test (PFT) pattern was restrictive (30.83%). Mean forced expiratory volume in 1 s (FEV1%), forced vital capacity (FVC%), and FEV1/FVC ratio among patients with BMI 30-35 (n = 76), was 78.3 ± 16.3, 77.9 ± 14.5, and 105.6 ± 7.8; with BMI 36-40 (n = 21) was 78.5 ± 21.1, 78.5 ± 19.2, and 105.6 ± 8.2; and with BMI 41-45 kg/m^2 (n = 3) was 65.2 ± 18.3, 68.6 ± 16.7, and 99.9 ± 5.7, respectively. **Conclusions:** Increase in BMI leads to increase in abnormal PFT parameters. Early detection can reduce the abnormal PFT values in obese subject.

KEY WORDS: Body Mass Index, Spirometry, Pulmonary Function Test

INTRODUCTION

As per the latest World Health Organization report, 2.8 million people die every year because of obesity. The prevalence of obesity has doubled between 1980 and 2008.[1] Reports of National Family Health Survey (NFHS) in India showed that percentage of overweight or obese people has increased from 11% NFHS-2 to 15% in NFHS-3.[2]

Access this article online	
Website: http://www.ijmsph.com	**Quick** Response code
DOI: 10.5455/ijmsph.2017.0719922072017	

Respiratory function in obese patient is affected by number of ways. In obese people, the presence of adipose tissue around the rib cage and abdomen and in the visceral cavity loads the chest wall and reduces pulmonary functions (PFs).[3] The increased lung and respiratory system resistance in obesity reduces forced vital capacity (FVC).[4]

PF test (PFT) assesses the respiratory system in terms of its function. PFT is affected by number of factors including age, sex, height, and weight (body mass index [BMI]) along with several environmental factors.[5] Increase in BMI which reflects itself as obesity is conceived to be the most common offender who changes lungs, chest wall, and diapharm relation leading to alteration in PF values which is commonly assessed by spirometry.[6]

Limited data are available which compare the effect of increasing body fat on pattern of PFs. Hence, this study was performed to evaluate the PFT parameters in subjects with BMI ≥30 kg/m^2.

MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted on 120 subjects having BMI ≥30 kg/m^2 in Department of Medicine, GR Medical College, Gwalior, Madhya Pradesh, from July 2013 to November 2014.

Institutional Ethics Committee approval and a written informed consent were obtained from each patient before starting the study.

Subjects with age >18 years of age and BMI ≥30 kg/m^2 were included and subjects with acute myocardial infarction, acute respiratory illness including chest injury, acute severe illness, and neuromuscular disorder were excluded from the study.

After thorough history taking and clinical examination, individuals were subjected to routine investigations and spirometry (PFT). Spirometry was performed using UNI-EM spirometer.

All the data were analyzed using IBM SPSS version 20. Data are expressed as mean ± standard deviation.

RESULTS

Mean forced expiratory volume in 1 s (FEV1), FVC%, and FEV1/FVC ratio among patients with BMI 30-35 (n = 76), was 78.3 ± 16.3, 77.9 ± 14.5, and 105.6 ± 7.8; with BMI 36-40 (n = 21) was 78.5 ± 21.1, 78.5 ± 19.2, and 105.6 ± 8.2; and with BMI 41-45 kg/m^2 (n = 3) was 65.2 ± 18.3, 68.6 ± 16.7, and 99.9 ± 5.7, respectively (Tables 1 and 2; Figure 1).

Table 1: Different parameters among study cohort

Parameters	*n* (%)
Age (years)	
20-40	46 (38.33)
41-60	66 (55)
61-80	8 (6.66)
Gender	
Male	57 (47.5)
Female	63 (52.5)
BMI (kg/m^2)	
30-35	88 (73.33)
36-40	27 (22.5)
41-45	5 (4.16)
Pattern of PFT	
Mixed	31 (25.83)
Restrictive	37 (30.83)
Normal	52 (43.33)

PFT: Pulmonary function test, BMI: Body mass index

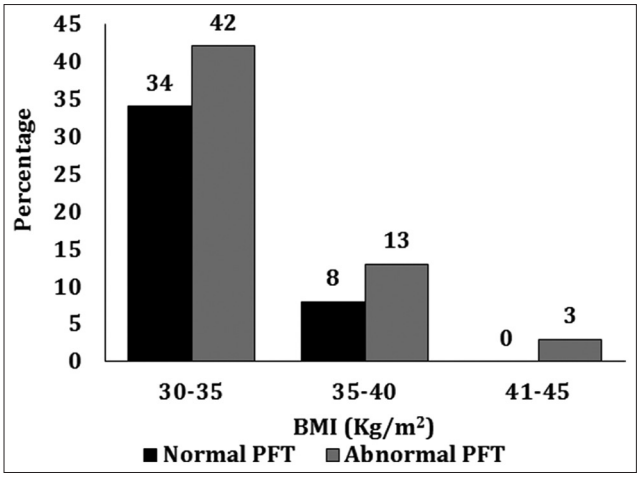

Figure 1: Correlation of body mass index with pulmonary function test. BMI: Body mass index (kg/m^2), PFT: Pulmonary function test

DISCUSSION

Obesity is an increasingly global problem. This study demonstrated the relationship of PF with BMI in a group of 120 subjects. The study showed decreased lung function in obese group as the BMI increased which strengthen the finding from previous studies. The main finding of this study is that increase in BMI leads to increase in abnormal PFT parameters mainly restrictive pattern.

Obesity is a common cause of reduced FVC since it interferes with diaphragm and chest wall mobility. PFT is a useful procedure for assessing and monitoring respiratory diseases. The previous trials have showed that PF is influenced by BMI and waist hip ratio.[7,8] FVC and FEV1 were decreased in this study which is in accordance with the Schoenberg et al. where they reported that increase in BMI was associated with decrease in PF.[9] It was also reported that FVC and FEV1 were decreased, while FEV1/FVC was increased with increasing BMI which is similar to the reports of the previous studies.[10] Reduced FVC and FEV1 and increased FEV1/FVC ratio suggest restrictive pattern in this study which is similar to the reports by previous workers which suggested restrictive ventilator defects in obese subjects.[11] It is quite evident from the data that with increasing BMI; there was an increase in abnormal PFT pattern which is again strengthen by the findings of Ahmad and Morgan.[11] Negative relation has been reported between increased BMI or obesity and PF with decrement in conventionally measured PF parameters.[12] In this study, we noticed that abnormality in the pattern of PF parameters were increased with increasing BMI which is

Table 2: Different patterns comparing with risk factors

Parameters	Mixed (*n*=31)	Normal (*n*=52)	Restrictive (*n*=37)	Total (*n*=120)
Age (years)				
<30	5 (35.71)	4 (28.57)	5 (35.71)	14 (100)
31-40	11 (34.37)	13 (40.62)	8 (25)	32 (100)
41-50	9 (20.93)	18 (41.86)	16 (37.20)	43 (100)
51-60	5 (21.73)	12 (52.17)	6 (26.08)	23 (100)
61-70	2 (33.33)	2 (33.33)	2 (33.33)	6 (100)
71-80	0 (0)	2 (50)	2 (50)	4 (100)
Gender				
Male	12 (19.04)	30 (47.61)	21 (33.33)	63 (100)
Female	30 (38.96)	30 (38.96)	17 (22.07)	77 (100)
BMI (kg/m^2)				
30-35	23 (25.27)	41 (45.05)	27 (29.67)	91 (100)
36-40	7 (29.17)	9 (37.5)	8 (33.33)	24 (100)
41-45	2 (40)	0 (0)	3 (60)	5 (100)

Data are expressed as number of subjects (percentage), BMI: Body mass index

contrasting with the findings of Naimark and Cherniack who showed that in comparison to normal subjects, in obese patients' total respiratory compliance was significantly reduced,[13] whereas study from Bengaluru by Sudhir and Chandrashekara on 150 subjects reported an increase in FVC with increasing BMI.[14] Study from Hyderabad by Devershetty et al. who studied 30 women with BMI >30 kg/m^2 reported that they did not found any significant difference between FEV1 and FVC between obese and normal subjects; whereas in present study, both the parameters were reduced.[10] Li et al. studied 48 subjects and reported that severely obese subjects with BMI more than 45 kg/m^2 showed a reduced FVC and FEV1 values when compared with age matched control group. In this study also subjects with BMI ≥30 kg/m^2 were reported a decreased FVC and FEV1 values but their ratio was increased.[15] Lad et al. also reported an negative correlation between BMI and FVC while studying overweight subject, which is in agreement with the present study results.[16]

The sample size of this study was small; a large randomized clinical trial is required to strengthen this study findings.

CONCLUSION

This study data showed obesity as one of the greatest public health problems. It was found that obesity can change the PFT parameters assessed using spirometry. Higher the BMI more will be the chances of altered PFT. The most common pattern observed was restrictive one. An early assessment of obesity using BMI estimation could decrease the chances of abnormal PFT.

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How to cite this article: Singh JP, Nagvanshi S. Effect of increasing body fat on pattern of pulmonary function: A prospective study. Int J Med Sci Public Health 2017;6(9):1417-1420.

Source of Support: Nil, **Conflict of Interest:** None declared.