e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(8); 658-660

Original Research Article

A Retrospective Study on the Correlation between BMI and COPD in Middle Aged Males using Computerized Spirometry

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Received: 25-05-2024 / Revised: 23-06-2024 / Accepted: 26-07-2024
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Conflict of interest: Nil

Abstract:

Introduction: Obesity is a condition characterized with an increase in size and amount of fat cells in the body. Obesity is caused by imbalance of energy intake ("Diet") and energy expenditure ("physical activity"). In the present world, there is a major epidemic of Obesity and many obese patients suffer with respiratory symptoms and disease. Obesity can affect the thorax, diaphragm and abdominal muscles, thereby resulting in altered respiratory functions. In this retrospective study, BMI was correlated with COPD (Chronic Obstructive Pulmonary Disease) and the variations in respiratory parameters were noted down.

Objectives: (1) Primary objective: To assess the significance between BMI and COPD. (2) Secondary Objective: To propagate the results among the general public about the correlation between Obesity and COPD.

Methodology: The pulmonary function test data were randomly selected. This is a retrospective study. The data was obtained from the procedure performed for the diagnosis of patient's condition. About 60 spirometric values were used for the study (40 subjects with COPD / 20 subjects with normal PFT values). The criteria for COPD diagnosis was airflow limitation irreversible with bronchodilator or only partially reversible with bronchodilator. The best PFT indicator is low FEV1 / FVC ratio below 70% of predicted values.

Result: The association between pulmonary function test and BMI was done. There is moderately positive correlation between FEV1 and BMI and similarly between FEV1/ FVC % and BMI. Pearson correlation coefficient analysis was done. P – Value <0.05 was considered to be statistically significant.

Conclusion: The purpose of this paper is to determine if there is an association between obesity level and prevalence of COPD. The obesity epidemic poses a new challenge to health professionals caring for patients with chronic respiratory diseases. The impact of obesity on COPD has been much less studied. So there should be an increase in quantity and quality of studies on the association between BMI and COPD in the medical world.

Keywords: COPD (Chronic Obstructive Pulmonary Disease), spirometry, FVC, FEV1, FEV1/ FVC, Obesity.

Introduction

Obesity is defined as excess fat storage in the body that is capable of causing various health problems leading to excess morbidity and mortality.

The GOLD guidelines for stages of COPD:

a) Stage I - Mild (FEV1> 80%)
b) Stage II - Moderate (FEV1 - 50 TO 79%)
c) Stage III - - Severe (FEV1 - 30 TO 49%)
d) Stage IV - Very Severe (FEV1 - < 30%)

More than one billion people around the world are overweight or obese with a BMI of 25 Kg/m2 or more. COPD is currently the fourth leading cause of death in the world.

The diagnosis of COPD should not be based solely on symptoms but should include spirometric confirmation. A low FEV1 / FVC ratio (<70%) is the spirometric signature of airflow obstruction. Patients with COPD typically show a persistent decrease in FEV1 (even after bronchodilators) and FVC together with an FEV1 / FVC ratio less than 70%. Obesity is found to decrease the lung volumes and capacities [4] by decreasing both lung and chest wall compliance. There is also an increase in resistance to outflow of air through the airways. Both static and dynamic lung volumes and capacities are compromised in obesity. Obesity increases susceptibility to respiratory infection and hospitalization rates are higher in obese patients with respiratory disease when compared with healthy weight subjects.

Methodology:

This is a retrospective study. The spirometric values were obtained from respiratory medicine OPD at PSGIMS&R Coimbatore. The period of study was from February 2024 to June 2024. BMI was calculated by using Quetelet's Index [5]. The

formula for this index is Body weight in Kg / (Height in meters)^2.The subject was stratified by BMI ranges are:

Classification: Underweight - <18.5 Kg/m^2

- Normal weight - 18.5 to 24.9 BMI
- Over weight - 25 to 29.9 BMI
- Obesity - > 30 BMI

Classification of Obesity:

- Class I obesity - 30 to 34.9 BMI[6]
- Class II obesity - 35 to 39.9 BMI[6]
- Class III obesity - >40 BMI

There was no clinical risk involved in the study.

Statistics/ Results: This was done by entering the data in Excel and then by using IBM SPSS version 28. Pearson correlation coefficient analysis was done.

Inclusion criteria:

- Obesity (BMI above 30 Kg /m^2)
- 35 to 64 years of age
- sedentary patients
- Male patients

Exclusion Criteria:

- Female patients
- Males below 34 years and above 65 years
- Smokers
- Associated systemic diseases
- Surgery within last 6 months

Result analysis: N = 60

Table 1:

	Age (in Years)	Weigh t (Kg)	Height (m)	BMI = Weight in Kg / (Height) in m^2	FVC (% Predicted)	FEV1 (%Pre-dicted)	FEV1 / FVC %
Mean	53.75	69.66	1.67	24.33	62.78	53.60	73.32%
Std. Deviation	12.134	16.38	0.081	4.47	15.49	19.84	18.11%

The descriptive statistics of age, weight, height, BMI and pulmonary function test parameters are given in the table.

Table 2: Correlation

		BMI Weight in Kg / (Height) in m^2	FVC (% Predicted)	FEV1 (%Pre-dicted)	FEV1 / FVC %
FVC (% Predicted)	Pearson Correlation	0.024	1	**0.756****	**0.499****
	Sig. (2-tailed)	0.852		**<0.001**	**<0.001**
FEV1 (%Pre-dicted)	Pearson Correlation	**0.362****	**0.756****	1	**0.755****
	Sig. (2-tailed)	**0.004**	**<0.001**		**<0.001**
FEV1 / FVC %	Pearson Correlation	**0.513****	**0.499****	**0.755****	1
	Sig. (2-tailed)	**<0.001**	**<0.001**	**<0.001**	
**. Correlation is significant at the 0.01 level (2-tailed).					

The association between pulmonary function test and BMI was done using Pearson's correlation coefficient and r value was estimated. P value of <0.05 is considered to be statistically significant. There is moderate positive correlation between FEV1 (% Predicted) and BMI with p value 0.004. Similarly there is moderate positive correlation between FEV1/FVC % and BMI with p value <0.001. This shows that as BMI increases, FEV1 % and FEV1/FVC % also increases.

Discussion

There is a dearth of information on the alteration of PFT parameters across gender and BMI. So this study was done for retrospective analysis of correlation between COPD and Obesity in middle aged males using computerized spirometry. The overall impact of obesity on lung function is multi factorial, related to mechanical and inflammatory aspects of obesity. With increasing BMI, FRC [7] (functional Residual Capacity) and ERV (Expiratory Residual Volume) gets decreased exponentially. So there is an increase in work of breathing. About [4] studies have shown that increase in respiratory rate per minute occurred in obese subjects. Severe Obesity8 alters Spirometric values by impairing diaphragmatic and thoracic muscle dynamics. BMI's main weakness is limited specificity since it does not distinguish between fat mass and lean (muscle) mass.

Obesity Paradox: COPD patients with BMI of <21.5Kg/m2 had a higher risk of death. [9]

Low BMI is associated with worse outcomes and overweight / obesity has a protective effect and decreases mortality - so called "obesity paradox". Early intervention in subjects with low BMI may reduce the incidence of COPD. BMI is associated with rate of lung function decline in COPD [10]. But over weight and obese subjects had the lowest rate of lung function decline in people with COPD. Obesity can be a risk factor for developing COPD

[11]. Excess fat in obesity [12] decreases total compliance, increases pulmonary resistance and decreases respiratory muscle strength. Abdominal and thoracic fat mass are likely to reduce vital capacity by limiting the room for lung expansion during inspiration, in turn leading to expiratory air flow limitation. Identification and modification of risk factors like continued smoking, emphysema severity and frequency of acute exacerbation is a goal of COPD management. Smoking is number one risk factor for development of COPD. In the developing world, indoor use of biomass fuels such as charcoal and wood for cooking is a major cause for COPD among never - smokers.

The three explanations for correlation between obesity level and COPD in both men and women are:

1. Obesity causes chest wall compression and impairs diaphragmatic movements and lowered chest wall compliance.
2. Inflammation associated with obesity causes or exacerbates COPD
3. The symptoms of COPD result in decreased mobility (sedentary life style) and decreased energy expenditure that concomitantly increases BMI. Increased inflammation leads to airway remodelling (including progressive narrowing of small airways due to fibrosis), increased mucous production due to more goblet cells and alveolar wall destruction.

Statistics: (Prevalence of obesity in India and in the world)

In world obesity atlas 2022, 9.8% of women and 5.4% of men were found to be obese globally. Global estimate suggest that over 2.3 billion children and adults are overweight out of which 400 million are obese. It also predicts that one billion people globally (1 in 5 women and 1 in 7 men) will be living with obesity by 2030. In India in 2022, 70 million (7 crores) adults were living with obesity- 44 million (4.4 crores) women and 26 million (2.6 crores) men. The obesity prevalence in India in 2022 (based on zonal variation) is 11.8% to 31.3% / central obesity - 16.9% to 36.3%.

Conclusion

Increases in BMI over time provoked greater decreases in FVC than in FEV1; therefore, the ratios of FEV1 /FVC increased as BMI increased because both FVC and FEV 1decreased. The purpose of this paper is to determine if there is an association between obesity level and prevalence of COPD. The obesity epidemic poses a new challenge to health professionals caring for patients with chronic respiratory diseases. The impact of obesity on COPD has been much less studied. World obesity day is observed on March 24 every year. A major limitation is the nature of the collected data, which could only determine association, not causation. An important challenge will be to find efficacious weight-loss strategies for obese patients with chronic respiratory diseases. The usual recommendation to increase physical activity is difficult for these patients to implement, since they are prone to a sedentary lifestyle imposed by shortness of breath. Further studies are therefore necessary to address the rapidly growing problem of obesity in chronic respiratory diseases.

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