ORIGINAL RESEARCH

A Study of Prevalence of Changes in FEV1 in Asthmatic Patient and Correlation with BMI

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ABSTRACT

Background: To determine the prevalence of obesity in asthmatic patient and to determine correlation of BMI of asthmatic patient with FEV1 (forced expiratory volume in 1 second).

Martial and Methods: We conducted this study on 75 Indian asthmatics with aim is to investigate the role of BMI on asthma severity. Patients who satisfying the predefined inclusion criteria were recruited into the study. All required tests were done including spirometry and calculation of BMI was done. The data obtained was subjected to systematic statistical analysis.

Results: The statistical analysis shows prevalence of obesity in asthmatic patients was higher (37.3%, BMI ≥ 25) than the general population. Most of the overweight and obese asthmatics had history of prior use of ICS therapy. There is statistically significant correlation found between BMI and FEV1, also significant correlation is present in BMI and asthma severity.

Conclusion: Obesity is potentially preventable factor which help in asthma control. Hence, asthma education programs may also include counseling about weight reduction which aims to help those patients who are overweight to improve health status and outcomes.

Key Words: Body Mass Index (BMI), Asthmatic patient, FEV1 (forced expiratory volume in 1 second), GINA Staging.

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INTRODUCTION

The prevalence and incidence of asthma have increased in recent times. Obesity is a predisposing factor for the development of asthma. Various factors have been proposed to explain the link between obesity and asthma such as a common DNA predisposition, developmental changes, altered lung physiology, the presence of a systemic inflammatory process, and an increased prevalence of associated comorbidities. Asthma and obesity are important public health problems. In recent decades, the prevalence of obesity has increased dramatically. Boulet LP in his book elaborated on Asthma and obesity. Added effects of obesity on respiratory symptoms can affect asthma control assessment. It can make asthma more difficult to control and is associated with a reduced beneficial effect of asthma medications. This could be due to a change in asthma phenotype, particularly evidenced as a less eosinophilic type of airway inflammation combined to the added effects of changes in lung mechanics. Weight loss is associated with improvement of asthma and should be an integral part of asthma management. Additional research on how obesity influences the development and clinical expression of asthma, establish the optimal management of asthma in this population and determine how obesity affects long-term asthma outcomes in these patients should be done. The parallel increase in the occurrence of obesity and asthma in the past 2−3 decades has led some researchers to propose a causal relationship between two conditions. Obese patients with asthma demonstrate different asthma phenotypes compared with patients of normal weight. Hence this study in Indian asthmatics was required.

MATERIALS AND METHODS

This was a prospective, cross-sectional study with a sample size of 75 patients. The entire patient's age 18 years and above presenting to pulmonary medicine department, who fulfilled the asthma diagnostic criteria according to Global Initiative for Asthma (GINA), were evaluated in single visit that includes a medical interview, physical examination, BMI, ECG, CXR, and spirometry were enrolled in the study. Patient with obstructive disease other than asthma (emphysema, chronic bronchitis, bronchiectasis), Inhaled/oral steroid intake in preceding 1 month (because it may alter the disease severity), current medications for obesity, severe debilitated disease, patient of associated lung disease e.g. presence of pulmonary infection, primary pulmonary hypertension, active pulmonary tuberculosis, pleural effusion, pulmonary emboli, contraindication or inability to perform required tests, uncooperative patient or unwilling to give informed written consent were excluded. The diagnosis of asthma was confirmed by symptoms of asthma,(wheeze, breathlessness, chest tightness and/or cough) reversible airflow obstruction with improvement of 12% or more and 200 ml in FEV1, if patient was not able to perform Spirometry or there was no reversibility of airflow obstruction then patient was excluded. We calculate BMI as weight in kilograms divided by square of height in meters ($kg/m^{2)}$ and also classified BMI for our study population (Indian Asian population) as obesity in Indian people was different from that of other countries. Several studies in India have suggest that Indian population are at higher risk of obesity related co morbidities at a lower level of BMI that are recommended by WHO. Classification of BMI are as follows; underweight: <18.5, normal weight: 18.5- 22.9 kg/m^2, overweight: 23.0- 24.9 kg/ m^2, pre-obese: 25.0-29.9 kg/m^2, class I obesity 30.0-34.9 Kg/m^2, class II obesity 35.0-39.9 Kg/m^2, and class III obesity ≥40 Kg/m^2.

Statistical Analysis:

The data obtained was subjected to systematic statistical analysis. A master chart was prepared and the total data was divided and distributed appropriately and presented as tables along with graphs by Data compilation, presentation, and Statistical analysis. Statistical analysis was done using SPSS Version 20. Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Statistical test employed for the obtained data in our study were Chi-Square Test: [p-value >0.05 Not significant, p-values <0.05 Significant (significant at 95% confidence level)].

RESULTS

In this study we found that the prevalence of obesity in asthmatics was higher (37.3%, BMI ≥ 25) than the general population. In these study odds of an obese individual having severe asthma was 1.86 times more than nonobese (OR 1.86). Out of 75 patients, 33.3% patients were in moderate persistent and then intermittent stage 26.7%. There is a significant association between BMI and gender of asthmatics (p-value <0.05), this suggest that females were more associated with obesity than males in this study population. Most of the male

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cases were overweight and most of the females were pre-obese. There was significant association found (p-value<0.05) between BMI and FEV1, also significant association was found between BMI and severity of asthma (p-value<0.05).
In our study, when looking upon asthma patient in various groups of asthma severity namely Intermittent, mild persistent, moderate persistent and severe asthma, there is no statistical significant correlation (p-value>0.05) found between BMI and severity of asthma. However when combining intermittent and mild persistent asthma patients in one group and moderate and severe asthma patients in other group, there is statistically significant correlation (p-value<0.05) found between BMI and severity of asthma.

Table 1: Showing Study Population According to BMI

BMI	Number of Patients	Percent
< 18.5 (Underweight)	6	8
	29	38.7
23 - 24.9 (Overweight)	12	16
25 - 29.9 (PreObese)	13	17.3
30 - 34.9 (Class I Obesity)	11	14.7
35 - 39.9 (Class II Obesity)	4	5.3
≥40 (Class III Obesity)	0	0
Total	75	100

Table 2: Showing Study Population According to FEV1

FEV1	Number of Patients	Percent
<60%	12	16
60- 80%	25	33.3
> 80%	38	50.7
Total	75	100

Table 3: Association of the BMI of Asthmatics with Age

	BMI (kg/m2)					
AGE	<18.5(Underweight)	18.5-22.9 (Normal weight)	23-24.99 (Overweight)	25-29.9 (Pre-Obese)	30-34.9 (Class I Obesity)	35-39.9 (Class II Obesity)
18 to 30 years (n=25)	3	14	3	4	0	1
31 to 45 years (n=34)	3	11	6	6	6	2
46 to 60 years (n=12)	0	3	3	2	4	0
Above 60 Years (n=4)	0	1	0	1	1	1
Total (75)	6	29	12	13	11	4

Table 4: Showing Association of BMI of Asthmatics with Gender

	BMI (Kg/M^2)					
Gender	**<18.5 (Underweight Ht)**	**18.5-22.9 (Normal Weight)**	**23-24.99 (Overweight)**	**25-29.9 (Pre-Obese)**	**30-34.9 (Class I Obesity)**	**35-39.9 (Class II Obesity)**
Female (N=37)	4	16	2	5	6	4
Male (N=38)	2	13	10	8	5	0
Total (N=75)	6	29	12	13	11	4

Table 5 (A): Showing Association of BMI with FEV1

Variable	**BMI (kg/m^2)**					
FEV1	**<18.5(Underweight)**	**18.5-22.9 (Normal weight)**	**23-24.99 (Overweight)**	**25-29.9 (Pre-Obese)**	**30-34.9 (Class I Obesity)**	**35-39.9 (Class II Obesity)**
<60% (n=12)	2	3	1	2	3	1
60- 80% (n=25)	0	8	3	6	6	2
>80% (n=38)	4	18	8	5	2	1
Total (N=75)	6	29	12	13	11	4

Table 5 (B): Showing Association of BMI with FEV1

Variable	**BMI**	
FEV1	Underweight Normal	Overweight + Preobese + Obese
<80%	13	24
> 80%	22	16

Table 6 (A): Showing Association of BMI with GINA Staging

Variable	**BMI (kg/m^2)**					
GINA STAGING	**<18.5(Underweight)**	**18.5-22.9 (Normal weight)**	**23-24.99 (Overweight)**	**25-29.9 (Pre-Obese)**	**30-34.9 (Class I Obesity)**	**35-39.9 (Class II Obesity)**
Intermitten t (n=20)	4	7	4	3	1	1
Mild persistent (n=18)	0	11	4	2	1	0
Moderate persistent (n=25)	0	8	3	6	6	2
Severe persistent (n=12)	2	3	1	2	3	1

Total (N=75)	6	29	12	13	11	4

Table 6 (B): Showing Association of BMI with GINA Staging

Variables	**BMI**	
GINA Staging	Underweight + Normal	Overweight + Preobese + Obese
Intermittent + mild persistent	22	16
Moderate persistent + Severe persistent	13	24

DISCUSSION

Lung function is a strong predictor of overall mortality in asthma and chronic obstructive pulmonary disease (COPD). FEV_1 is considered to be the "gold standard," whereas peak expiratory flow (PEF) is mostly used in absence of FEV_1 measurements.

Hansen EF et al studied peak flow as predictor of overall mortality in asthma and chronic obstructive pulmonary disease. They compared the predictive power of PEF and FEV_1, measured after maximal bronchodilation. After controlling for age, smoking, sex, and body mass index, authors found best PEF to be at least equal to best FEV_1 as predictor of overall mortality in subjects with COPD. The predictive power of best PEF was in part maintained after controlling for best FEV_1. In asthma, best FEV_1 seemed to be a better predictor of mortality than best PEF. Despite close correlation to FEV_1, PEF apparently provides independent prognostic information in patients with COPD. This may be due to PEF and FEV_1 reflecting different components of COPD, i.e., chronic bronchitis, small airways disease, and emphysema. Furthermore, extrapulmonary components such as muscle mass and general "vigour" probably affect PEF to a greater extent than they affect FEV_1.Authors examined if best PEF provides additional prognostic information in subjects with asthma or COPD, even after controlling for best FEV_1, age, smoking, sex, and body mass index (BMI).Chae EJ et al did airway measurement for airway remodeling defined by post-bronchodilator FEV1/FVC in asthma by using inspiration-expiration computed tomography. WT%, WT, BA ratio, and AC on inspiration and expiration CT are good indices for measuring airway remodeling defined by post-bronchodilator FEV1/FVC in stable asthma patients treated with inhaled corticosteroids.

Juel CT et al saw that asthma is more prevalent in obese, compared with normal weight, subjects. They reviewed current knowledge of the impact of obesity on asthma severity, asthma control, and response to therapy. Many studies have shown that overweight and obesity is associated with more severe asthma and impaired quality of life. Studies of the impact of a high body mass index on response to asthma therapy have, however, revealed conflicting results. Most studies show that overweight and obesity is associated with less favorable response to asthma therapy, with regard to symptoms, level of FEV_1, fraction of exhaled nitric oxide, and airway responsiveness. In conclusion, overweight and obesity is associated with poorer asthma control and, very importantly, overall poorer response to asthma therapy, compared with normal weight individuals.

Özbey Ü et al studied the effects of obesity on pulmonary function in adults with asthma. While the effects of obesity on asthma are unclear, an increased body mass index (BMI) is known to enhance the symptoms and severity of asthma and to impair asthma control. The present study evaluates the effects of nutritional habits and obesity on pulmonary function and asthma control in individuals with asthma. The anthropometric measurements and macro–micro nutrient consumption records of the patients in both groups were obtained, and the two groups were compared in terms of pulmonary function and asthma control test (ACT) scores. The total energy and carbohydrate intake was higher in the obese respondents, while their total protein intake was lower when compared to the normal weight respondents ($P < 0.05$), and a significant positive correlation was found between the omega 3 intake and ACT scores of the respondents ($P < 0.05$).Pulmonary functions and ACT scores decrease with increasing BMI, WC, and WHR. Obese respondents with asthma should be referred to diet clinics to improve their asthma symptoms. Accurate interpretation of spirometry performed on obese patients requires an understanding of the effect of obesity severity and distribution on lung volumes and airway size. In mild obesity, results of spirometry might be normal or might suggest a restrictive process, with a symmetric reduction in FEV_1 and forced vital capacity (FVC). Beuther DA et al observed a disproportionate reduction in FVC with obesity, demonstrating that body mass index (in kilograms per square meter) is significantly associated with the FEV_1/FVC ratio ($P < .01$). The most sensitive indicator of obesity is a low expiratory reserve volume (ERV) and functional residual capacity. Restriction is seen in more severe obesity, with reductions in TLC and FVC. There are conflicting data on whether diffusing capacity is normal or increased in obesity, but this study showed that although PaO_2 increased approximately 6% after surgery ($P < .001$), there was no significant change in diffusing capacity.

Fuhlbrigge AL et al inferrered that asthma is a complex syndrome. Although correlations exist between the various parameters used in clinical assessment, no single parameter can accurately classify all individuals. Assessment of multiple parameters including physiologic measures, symptoms, and activity limitation are necessary to categorize asthma clinical status accurately. In addition, the role biomarkers play in the assessment of disease status is an area of increasing interest. Several validated multidimensional measures for assessing asthma control are now available. Each of these measures includes the parameters of symptoms, activity limitation, and rescue medication use, yet they vary on inclusion of other important components such as physiologic measures and biomarkers.

In our study, when looking upon FEV1 in various groups FEV1 <60%, FEV1 60%-80% and FEV1 >80% there is no statistical significance correlation (p-value>0.05) between BMI and FEV1. However when considering FEV1 into 2 groups FEV1 ≤80% and FEV1>80% there is statistically significant correlation (p-value<0.05) found between BMI and FEV1. There are different views on the relation of obesity and FEV1. Some studies suggest that obesity is associated with a reduction in ERV (Expiratory Reserve Volume), residual volume, and functional residual capacity and that was reversed by weight loss. Obesity also causes a drop of both FEV1 and FVC with a preserved FEV1/FVC ratio. However, previous studies yielded conflicting data on whether obesity affects spirometric finding in asthmatic subjects. In another words, the Odds of getting severe persistent asthma in obese individuals was 1.86 times more than those of nonobese asthmatics. That is there were higher odds (OR 1.86) of getting severe persistent asthma.

CONCLUSION

We found higher prevalence of obesity in asthmatic patients, and also severity of asthma increased with increasing obesity. Obesity is potentially preventable factor which help in asthma control. Hence, asthma education programs may also include counseling about weight reduction which aims to help those patients who are overweight to improve health status and outcomes.It is recommend that a follow-up study is required in which obese asthmatics are reassess for severity of asthma after reduction of weight.

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