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# A comparative study to determine clinical and spirometric profile among patients of asthma in different body mass index groups

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## Abstract

**Background:** Overweight and obesity is the most common co-morbidity and disease modifier of asthma; it has been associated with increased risk of asthma exacerbations, worse respiratory symptoms and poor asthma control. The objective of study was to determine the relation of body mass index (BMI) with the level of asthma control and to study the clinical presentation and spirometric profile of asthma patients from different BMI groups.

**Materials and methods:** The descriptive prospective study done among confirmed asthmatic patients who were attending the Department of Pulmonary Medicine, outpatient department (OPD) and inpatient department (IPD). The study was demographic, clinical and spirometric parameters in asthmatic patients who were on optimal pharmacotherapy among different BMI categories.

**Results:** Total 144 diagnosed asthma patients were included; the overall mean age of the study group was 34.27 ± 11.7 years and the majority of patients 50 (34.72%) were between 18-27 years of age group. Moderate asthma (FEV1 60-79) was observed to be the most common in all BMI groups. The severe asthma (FEV1 <60) was observed with BMI > 30kg/m$^2$ in asthma patients (p=0.27).

**Conclusions:** The poor control of asthma was significantly frequent in the overweight and obese BMI group, regardless of the findings of no differences in spirometry. Our results suggest that obese individuals with asthma show a higher incidence of one-year follow-up hospitalization due to exacerbation symptoms than non-obese individuals.

**Keywords:** Obesity; asthma; spirometry; hospitalization; body mass index

## Introduction

The prevalence of asthma varies widely among countries and within countries with different geographies and socioeconomic conditions, which is now recognized as a common cause of disability with economic cost and preventable deaths [1-2]. Over-weight and obesity are the most common asthma co-morbidity and a disease modifier of asthma; it has been associated with increased risk for asthma exacerbations, worse respiratory symptoms and poor control [3]. Obese patients with asthma have prominent respiratory symptoms and little eosinophilic airway inflammation [4]. The link between

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the two appears to be multi-factorial and is likely to involve a combination of in utero conditions, genetic factors, co-morbidities, and inflammation secondary to excess adipose tissue [5].

In contrary to general conception, study depicts increased total lean mass is more strongly associated with asthma than fat mass among females [6]. Body mass index (BMI) may reflect vastly differing physiology and metabolic health, which concludes adipose tissue inflammation, is increased in obese individuals with asthma; however, metabolic dysfunction is more important than fat mass for asthma in obesity [7-8]. Obese asthmatics appear to perceive their symptoms as more severe and have a greater prevalence of functional co-morbidity, but lower airway inflammation as assessed by FeNO [9].

Early onset atopic (EOA) and late onset non atopic obese asthma (LONA) seems to be distinct diseases, manifesting different clinical profiles altogether [10]. Children with obesity are at higher risk of asthma and prone to have greater severity and poorer control of their asthma symptoms, more frequent asthma exacerbations, and overall lower asthma-related quality of life [11]. It is generally accepted that obesity is a risk factor for adult asthma. However; not much recent studies correlated different BMI groups among adult asthma individuals.

The objective of the present study was to determine the clinical and spirometric profile of asthmatic patients among different BMI and to determine its association with the level of asthma control and hospitalization rate among the study groups.

## Materials and methods

Descriptive prospective study was conducted in the Department of Pulmonary Medicine, Swaroop Rani Hospital, Motilal Nehru Medical College, Prayag raj from September 2020 to August 2022. After clinical ethical clearance 144 diagnosed asthma [4] patients, after screening consecutive 250 patients attending the Department of Pulmonary Medicine Swaroop Rani Hospital who aged > 18 years of either gender was included in the study. Patients were started with optimal pharmacotherapy according to GINA 2020 followed up for 1 year.

## Study procedure

Diagnosed asthma patients who met inclusion and exclusion criteria were assessed with detailed history and clinical examination, followed by all patients were subjected to a questionnaire for determining the level of asthma symptom control and history of exposure to various types of risk factors for asthma (GINA 2020). Spirometry done after 3 months of optimal pharmacotherapy to note airflow limitation (FEV1) in different BMI groups [12].

## Patient and public involvement

Asthma patients attending the hospital emergency and outpatient department (OPD) and inpatient department (IPD) with written informed consent were enrolled in the study. Patients were not involved in the design, recruitment and intervention assessment of this study.

## Results

Total 144 asthma phenotype patients were included, the overall mean age of the study group was 34.27 ± 11.7 years, and the majority of patients 50 (34.72%) were between 18-27 years of age group. In this study, the overall men/women ratio is 1.46: 1; 85 (59%) patients were males and 58 (41%) were females. The overall mean age in men was 33.73 ± 11.81 years and in women it was 35.46 ± 11.86 years, the overall mean weight is 67.4Kg, and mean BMI 24.62.

In the present study among 144 asthma patients, 81(56.25%) were well controlled, 46(31.94%) were partially controlled, and 17(11.8%) had uncontrolled levels of asthma symptoms (Table 1). Out of 73 patients who were in the normal weight BMI group (BMI 18.5-24.99), Maximum number of patients 56(77%) had well controlled Asthma symptoms, 15(20%) patients had partially controlled and 2(3%) patients had uncontrolled Asthma symptoms (Figure 1). By this data it shows that most of asthma patients who were normal weight had controlled symptoms and only a few patients had uncontrolled symptoms.

**Table 1:** Distribution of asthma patients according to different asthma severity controls.

| *Level of Asthma of Control* | *Number of patients(n=144)* | *Percentage* |
|---|---|---|
| Well controlled | 81 | 56.25% |
| Partially controlled | 46 | 31.94% |
| uncontrolled | 17 | 11.8% |

Asthma patients belonged to >35 BMI group, majority of patients 60% were had uncontrolled asthma and 40% patients had partially controlled asthma (Table 2). It concludes that higher BMI was associated with worsening severity and control of asthma symptoms. Obesity and overweight are associated with a poor control of asthma (p=0.001). Daytime symptoms more than twice per week in the past four weeks were the most common symptom and more frequent among overweight and obese asthma patients in comparison to normal and underweight BMI groups.

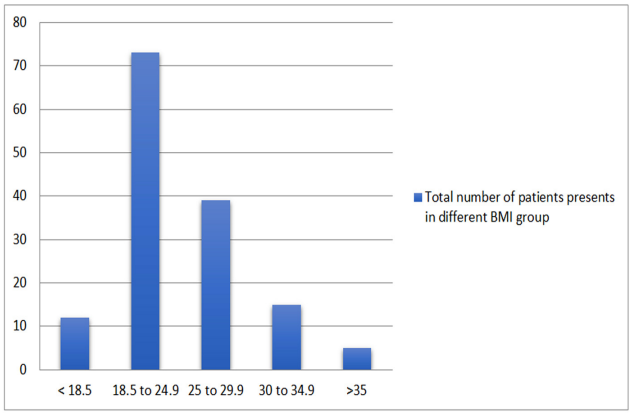


**Figure 1:** Distribution of asthma patients among different BMI groups.

Among the BMI group <18.5, maximum no. of patients (75%) had predicted FEV1 between 60-79%. Normal and overweight BMI group had 68.49% and 66.66% predicted FEV1 between 60-79% respectively. Among BMI group 30-34.99, 46.66% patients had predicted FEV1 <60%, while in BMI group >35, the maximum percentage of patient was equally distributed in FEV1 60-79% and FEV1 <60%. Overweight and obese asthma individuals have significant one year hospitalization rate in comparison to individuals with BMI 18.5 -24.99 and BMI < 18.5 (Table 3). In this study we found that out of 144 patients, 39(27%) patients were complaining night waking symptoms. It was observed that night waking symptoms were more common in obese BMI group.

**Table 2:** Distribution of Levels of asthma control in different BMI groups.

| *BMI groups* | | *Well controlled* | | *Partially controlled* | | *Uncontrolled* | |
|---|---|---|---|---|---|---|---|
| | *Total no. of patients* | *No. of patients* | *% of pts in different BMI group* | *No. of patient* | *% of pts in different BMI group* | *No. of patients* | *% of pts in different BMI group* |
| <18.5 | 12 | 9 | 75% | 2 | 16.66% | 1 | 8.33% |
| 18.5- 24.99 | 73 | 56 | 76.71% | 15 | 20.54% | 2 | 2.7% |
| 25-29.99 | 39 | 13 | 33.33% | 20 | 51.28% | 6 | 15.38% |
| 30-34.99 | 15 | 3 | 20% | 7 | 46.66% | 5 | 33.33% |
| >35 | 5 | 0 | 0 | 2 | 40% | 3 | 60% |

Chi square statistic =47.025, P < 0.001.

**Table 3:** Distribution of patients who needed hospitalization due to acute exacerbation of asthma in the past one year among different BMI groups.

| *BMI groups* | | *Patients with history of ≥1 hospitalization due to exacerbation in last one year* | | *Patients with no history of Hospitalization in last one year* | |
|---|---|---|---|---|---|
| | *Total no. of pts* | *no. of pts* | *% of pts in different BMI group* | *no. of pts* | *% of pts in different BMI group* |
| < 18.5 | 12 | 2 | 16% | 10 | 84% |
| 18.5 -24.99 | 73 | 8 | 10.9% | 65 | 89.1% |
| 25-29.99 | 39 | 12 | 30.7% | 27 | 69.3% |
| 30-34.99 | 15 | 8 | 53% | 7 | 47% |
| > 35 | 5 | 4 | 80% | 1 | 20% |

Chi square statistic = 24.06, P= < 0.001.

Over all, in our study 34(23.6%) patients had a history of hospitalization in the last one year due to acute exacerbation of asthma (Table 3). Out of which, majority of patients (Figure 2) belonged to the overweight and obese BMI groups [30.7% of BMI 25-29.99, 53% of BMI of 30-34.99 and 80% of BMI > 35]. It is observed that all patients whose BMI > 35 frequently used reliever medication for controlling symptoms and 66.6% of patients among BMI 30-34.99 group (Table 4). The severity of asthma was identified based on FEV1, and its correlation with BMI was studied; moderate asthma (FEV1 60-79) was observed to be the most common in all BMI groups. Out of 144 patients, 16 (11.1%) patients had FEV1 > 80% of predicted value, 93(64.5%) patients had FEV1 between 60-79% and 35 (24.3%) patients had FEV1 <60% of the predicted value (Table 5). The increasing trend of severe asthma (FEV1 <60) was observed with increasing BMI of asthma patients (Figure 3), but the comparison of asthma severity according to BMI levels and using chi-square test, there was no significant difference in different groups (p=0.274).

Among total 144 patients, maximum number 73 (50.69%) were included in normal BMI group, 12(8.33%) of them in underweight group, 39 (27.08%) in overweight group, 15 (10.41%) in BMI 30-34.99 and 5 (3.47%) in BMI > 35.

Observed that the majority of underweight normal weight asthma patients were symptomatically well controlled.

Overall, 34 patients had a history of hospitalization in late one year due to acute exacerbation of asthma symptoms. Table 3 shows that majority of patients among BMI 25-29.99(30.7%), BMI 30-34.9(53%) and BMI > 35 (60%) were hospitalized in last one year due to of Asthma symptoms in comparison to BMI 18.5 -24.99 and BMI < 18.5.

**Table 4:** Distribution asthma patients who needed reliever medication more than twice / week, in past 4 weeks among different BMI groups:

| *BMI Groups* | *Total number of patients in different BMI groups(n)* | *Reliever needed for symptoms more than twice/week, in past 4 weeks.* | | *Patients who not used reliever medication more than twice /week* | |
|---|---|---|---|---|---|
| | | *Number of pts* | *% of pts in different BMI group* | *Number of pts* | *% of pts in different BMI group* |
| < 18.5 | 12 | 2 | 16.6% | 10 | 83.4% |
| 18.5 – 24.99 | 73 | 16 | 21.9% | 57 | 78.1% |
| 25- 29.99 | 39 | 18 | 46.15% | 21 | 53.85% |
| 30- 34.99 | 15 | 10 | 66.66% | 5 | 33.33% |
| >35 | 5 | 5 | 100% | 0 | 0 |

P= 0.00047.

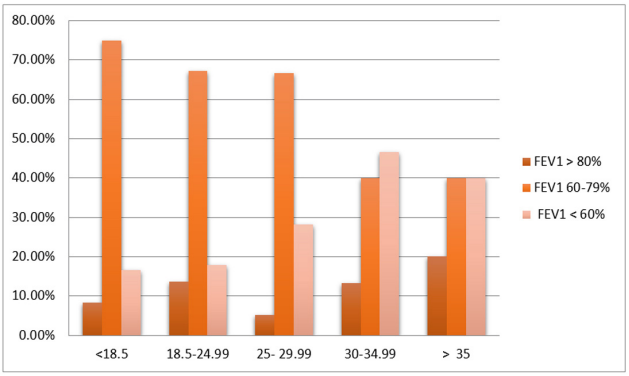


**Figure 2:** Severity of Asthma according to FEV1 value in different BMI group.

Spirometry of total 144 patients showed 16 (11.1%) had FEV1 > 80% of the predicted value, 93(64.5%) patients had FEV1 between 60-79% of the predicted values and 35 (24.3%) patients had FEV1 <60% of predicted value. Chi square statistic = 9.866, P= 0.274

**Table 5:** Mean spirometry indices in diagnosed asthma patients according to BMI levels.

| *BMI group* | *FEV1(%) mean ± SD* | *FVC (%) mean ± SD* | *FEV1/FVC (%)* |
|---|---|---|---|
| <18.5 | 68.5 ± 10.36 | 79.8 ± 8.66 | 85.58 ±13.48 |
| 18.5- 24.99 | 68 ± 10.79 | 79 ± 8.34 | 84 ± 9.5 |
| 25- 29.99 | 63.53 ± 10.79 | 76.51 ± 8.34 | 82.32±11.31 |
| 30-34.99 | 59.26 ± 10.83 | 73 ± 8.31 | 79.33± 9.55 |
| >35 | 59.2 ± 10.89 | 75.2 ± 8.33 | 76 ± 9.44 |

Obese and overweight asthma individuals had less FEV1 and FVC predicted values; however, statistically not significant.

## Discussion

The prevalence of asthma varies widely among countries; the estimated national burden of asthma in India is about 6% of children and 2% of adults, however a large number of patients still consider asthma as a stigma and therefore conceal the disease [4, 13]. Atopy is associated with lower lung function in normal BMI asthmatics but not in overweight/obese asthmatics, supporting the role of nonallergic mechanisms in disease burden in paediatric obesity-related asthma [14]. Obesity increases the risk of both gastro-oesophageal reflux disease (GERD) and sleep disordered breathing (SDB), which offer insight into the possible effects on the obesity/asthma relationship. Asthma and obesity interact which often associated with worsening of asthma control, more frequent exacerbations, and a poor quality of life [15].

It is also now recognized that asthma may not be a single disease but a group of heterogeneous phenotypes with different aetiologies and prognosis [16]. Our study revealed that above 18 years asthma patients with a mean age of 34.27 ± 11.7 years. Overall men and women ratio was 1.46:1. Attaran et al [17] reported 54.7% were males in their study but in contrary other study [18, 22] found the majority of subjects were women (58%) in their study. Asthma related healthcare use and mortality

are higher in adults [19] and In-addition, multi-centre longitudinal study suggests that early-onset asthma and wheezing may contribute to an increased incidence of developing obesity in later childhood [20].

Our study aimed at the spirometry profile of asthma patients from different BMI groups and to determine the relation of obesity with the level of asthma control. In the present study among 144 asthma patients 81(56.25%) were well controlled, 46(31.94%) were partially controlled, and 17(11.8%) had uncontrolled levels of asthma symptoms. Majority of partially controlled and uncontrolled patients were overweight and obese individuals. Among BMI 30-34.99 group, maximum patients 47% had partially controlled and 33% had uncontrolled in comparison to 20% patients had well controlled. Similarly, in agreement with our results, indicating that obese subjects have more severe asthma than non-obese subjects, Taylor et al [21] and Maalej et al [22] found a significant association between the increase of BMI and the worsening of asthma severity.

Obesity has been correlated with worse asthma control, as well as more frequent and severe exacerbations. Studies suggested that obesity in children hospitalized for asthma is associated with more severe asthma exacerbations, extended length of hospital stay, and increased utilization of PICU level care [23]. Over all in our study 34(23.6%) patients had history of Hospitalization in last one year due to acute exacerbation of Asthma. Out of which, the majority of patients were overweight and obese BMI groups of individuals. Obesity correlated with worse asthma control, as well as more frequent and severe exacerbations. This correlation is strengthened by the apparent effect of weight loss and bariatric surgery on better control and fewer exacerbations and hospitalizations [3, 24].

Obesity significantly reduces functional residual capacity (FRC) and expiratory reserve volume (ERV); however, it has very little effect on residual volume (RV) and total lung capacity (TLC). Obese subjects have markedly increased gastric and oesophageal pressures causing dramatically reduced FRC and ERV, which increases work of breathing [25] In addition, increase in BMI is associated with faster FEV1 and FVC decline among overweight and obese adults with asthma in comparison with their normal weight counterparts [26]. In this study, moderate asthma (FEV1 60-79) was observed to be the most common in all BMI groups. The increasing trend of severe asthma (FEV1 <60) was observed with increasing BMI of asthma patients, however, the comparison of asthma severity according to BMI levels was not significant difference in different groups (p=0.274).

Obesity-related biomarkers showed that IL-6 and adiponectin are potential biological mediators linking obesity and asthma [27]. Obese asthmatics have a higher likelihood of using all classes of asthma medications and higher ICS doses, despite lower $FEV_1$ and similar $FEV_1$/FVC in obese *versus* healthy-weight asthmatics [28]. In the present study, the number of asthma patients who needed reliever medications to control respiratory symptoms was increasing with BMI. It was observed that all patients whose BMI > 35 frequently used reliever medication for controlling symptoms and 66.6% of patients among BMI 30-34.99 group.

## Conclusion

The poor control of asthma significantly frequent in the overweight and obese BMI group. We found that the prevalence of obesity increases with worsening of asthma severity and it was observed that overweight and obese asthma patients needed more reliever medications in comparison to normal weight BMI group patients. However, our study did not show a significant correlation between BMI and $FEV_1$. Further work is needed to clarify the precise mechanisms. In the meantime, the clinician should counsel for dietary modifications and weight loss for their overweight and obese patients with asthma.

## Conflicts of interest

Authors declare no conflicts of interest.

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