

## Study of pulmonary function tests in patients with bronchial asthma

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### Abstract

Asthma is a dysfunction of the respiratory system, characterized by wheeze, shortness of breath, late night or early morning cough, tightness in the chest and expiratory wheezing. Along with increased urbanisation, prevalence of asthma is increasing in the developing countries. Pulmonary function tests are done to access the changes in the respiratory system and its function. Our study was conducted to record and compare pulmonary function test parameters like FVC, FEV1, FEV1%, PEFR in patients of bronchial asthma and non asthmatics. 150 individuals (males and females) were selected in the age group of 18years to 35 years. 75 (*study group*) were previously diagnosed cases of asthma, and 75(*control group*) were age matched non asthmatic healthy individuals. Spirometry was then performed and three consecutive readings were recorded and the best among them was taken for each for FVC, FEV1, FEV1%, PEFR. The statistical analysis was done using MS Office Excel 2007 and SPSS 20. *Students' t-tests* were performed. Our study showed decreased lung function parameters in asthma patients as compared to controls. FEV1, FEV1% and PEFR were significantly low in asthmatics.

**Keywords:** Bronchial asthma, Pulmonary function tests.

### Introduction

Asthma is a dysfunction of the respiratory system. It is characterized by variable and recurring airflow obstruction, secondary to mucous production by the respiratory epithelium and spasm of bronchus. Common features of asthma are shortness of breath, coughing, tightness in the chest and expiratory wheezing.<sup>1</sup> Today, there has been an increase in the prevalence of asthma in the developing countries, which is associated with increased urbanization.<sup>2</sup> In asthma, limitation of airflow is mainly a result of broncho-constriction, but airway edema, vascular congestion, and luminal occlusion with exudates may also contribute. The presence of broncho-constriction diminishes the vital capacity. It also reduces the maximal ventilation volume and causes hyperinflation of the lung. During an attack, the breathing capacity is so limited by broncho-spasm that intense dyspnea is present. Treatment with bronchodilator drugs (eg. adrenaline) relieves the symptoms of an acute attack.<sup>10</sup> In asthma, there is a reduction in forced expiratory volume in 1 second (FEV1), FEV1/FVC (forced vital capacity) ratio, and peak expiratory flow rate (PEFR). Bronchial asthma occurs at all ages, half of cases develop before age 10 years and another third occur before age 40.<sup>3</sup> Treatment with bronchodilator drugs relieves the symptoms of an acute attack of asthma. However, long-term deterioration of lung function in asthma patients has been mentioned in various studies. It is stated that chronic airway inflammation can lead to airway remodeling and result in irreversible airway obstruction in due course of time. The consequence of this process could be deterioration in pulmonary function.<sup>4</sup> Spirometer is noninvasive diagnostic instruments for screening and basic testing of lung function. Spirometry offer essential diagnostic insight into the type and extent of pulmonary function impairment.<sup>11</sup> FEV1 is considered to be the "gold standard"

of measuring airways obstruction because its measurement has been well standard and the measurement can be performed repeatedly and reliable reference values are available.<sup>12</sup> This present study was undertaken to record and compare the pulmonary function parameters like FVC, FEV1, FEV1%, PEFR in between patients of bronchial asthma and non-asthmatics.

### Materials and Methods

Our study was conducted in Department of Physiology, Silchar Medical College and Hospital. The period of study was 1 year. This case control study was done after obtaining approval from the Institutional Ethical committee. 150 individuals (males and females) were selected in the study. 75 (*study group*) were previously diagnosed cases of asthma, duration being more than five years who had two acute exacerbation in any given year, from OPD, students, teaching and non-teaching staff, and 75(*control group*) were age matched non asthmatic healthy individuals. The subjects were selected within the age group of 18 years to 35 years.

The pulmonary function tests were carried out by using digital computerised - spirometer (SCHILLER SPIROVIT SP-1). The following parameters were recorded for analysis: FVC- Forced vital capacity  
FEV1- Forced expiratory volume in one second  
FEV1% (FEV1/FVC)-ratio of forced expiratory volume of air expired during the first second of FVC to forced vital capacity expressed as percentage.  
PEFR-Peak expiratory flow rate.

The subject was asked to report to Department by 10 AM and rest for some time in our silent research lab in order to alleviate any anxiety. Spirometry was then performed before 12 noon in order to keep away from changes of the diurnal variation. The procedure was first demonstrated. A nose clip was applied. The subject took deep forceful

inspiration followed by rapid forceful expiration through the mouthpiece. Three consecutive readings were taken for each for FVC, FEV1, FEV1%, PEFR and the best among them was recorded.

**Observation and Results**

The statistical analysis was done using MS Office Excel 2007 and SPSS 20.

Students' t-tests were performed to assess the significance of difference of parameters

The mean ± standard deviation of the variables and p-values were used for comparison.

The tables, results and graphical representations of our study are explained as follows

1. The difference between the mean ± standard deviation for age in non-asthmatic subjects and asthmatic subjects was found to be statistically insignificant (p=0.17).
2. Out of the 150 subjects in the study, 68 (45%) were male subjects and 82 (55%) were female subjects
3. Table showing number and percentage of male and female subjects participated in the study

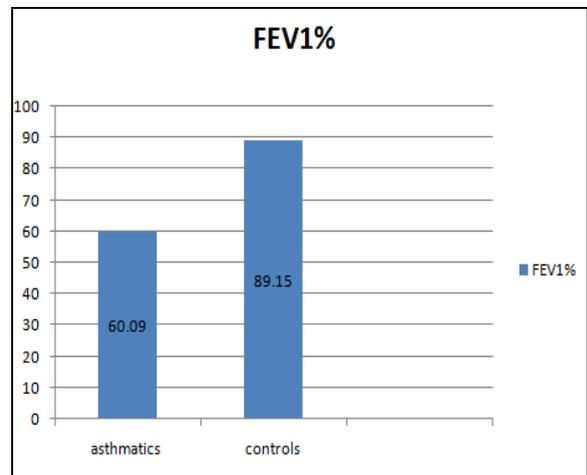
**Table 1**

| Subjects | Number | Percentage |
|----------|--------|------------|
| Males    | 68     | 45%        |
| Females  | 82     | 55%        |

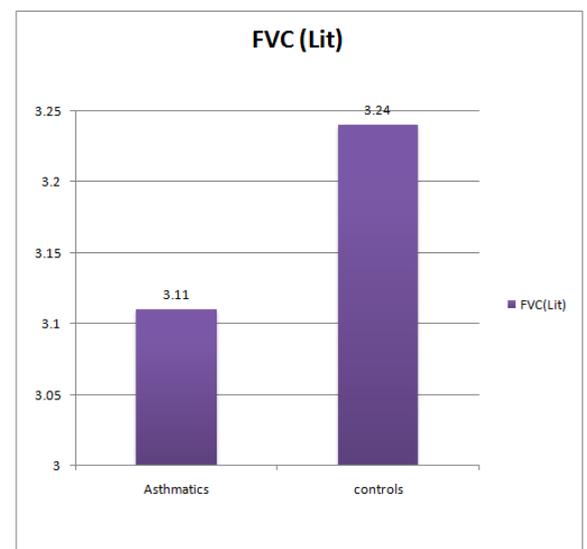
**Table 2**

| Parameters     | Asthmatics  | Controls    | P value |
|----------------|-------------|-------------|---------|
| FEV1 (Lit)     | 1.85± 0.50  | 2.92± 0.93  | <0.01   |
| FEV1: FVC (%)  | 60.09± 5.26 | 89.15± 9.27 | <0.01   |
| FVC (Lit)      | 3.11± 0.79  | 3.24± 0.90  | > 0.05  |
| PEFR (Lit/sec) | 3.03± 0.81  | 6.01± 2.16  | <0.01   |

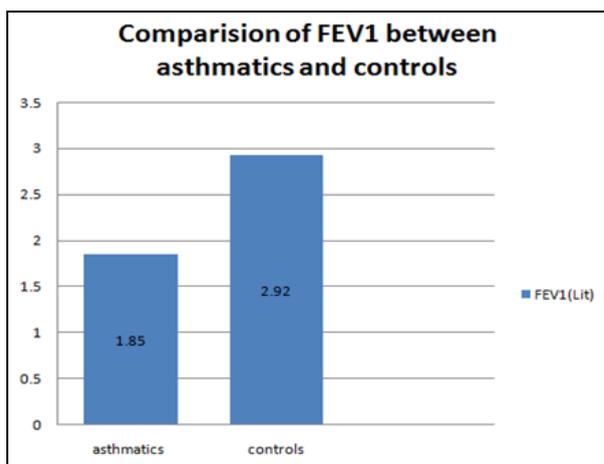
Values expressed as mean and standard deviations  
p-value<0.01-is statistically significant



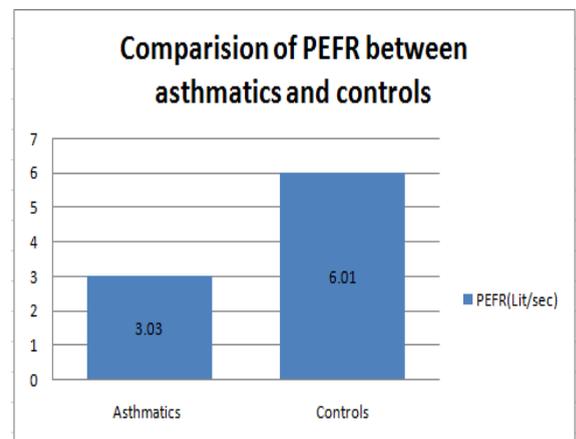
**Fig. 2:** Bar diagram showing the mean FEV1% in asthmatics and controls



**Fig. 3:** Bar diagram showing the mean FVC (Lit) in asthmatics and controls



**Fig. 1:** Bar diagram showing the mean FEV1 (Litres) in asthmatics and controls



**Fig. 4:** Bar diagram showing the mean PEFR (Lit/sec) in asthmatics and controls

The mean± standard deviation of FEV1 for asthmatics and non-asthmatics is 1.85± 0.50 liter and 2.92± 0.93 liter respectively. The difference is statistically significant ( $p<0.01$ ). The mean± standard deviation of FEV1% (FEV1/FVC) for asthmatics is 60.09± 5.26% and for non-asthmatics is 89.15± 9.27%. The value is less in asthmatics difference is statistically significant ( $p<0.01$ ). The mean± standard deviation of FVC for asthmatics is 3.11± 0.79 liter and for non-asthmatics is 3.24± 0.90 liter. The value is less in asthmatics but not significant ( $p>0.05$ ).

The mean± standard deviation of PEFR (Lit/sec) for asthmatics is 3.03± 0.81 and that for non-asthmatics 6.01± 2.16. The value is less in asthmatics and the difference is statistically significant ( $p<0.01$ ). This shows that FVC, FEV1, FEV1%, PEFR were lower in asthmatics as compared to the controls. FEV1, FEV1% and PEFR were showing significant difference, whereas FVC did not show any significant difference between the two groups. Present findings may show that *asthma* being a *chronic inflammatory disease* has ongoing tissue injury and repair which may result in irreversible fibrotic changes in the airways leading to *decline in lung functions*.

## Discussion

The present study was done to compare the pulmonary function parameters FVC, FEV1, FEV1% and PEFR between asthmatics and non-asthmatics. Asthma has been an exponentially growing problem since time unknown and yet till today many people are still suffering from this obstructive lung disease. All ages are equally at risk and etiology is variable and multiple. Studies done previously to see the pulmonary function changes in the people having bronchial asthma show variable results. In this study it is seen that all the lung function parameters namely –FVC, FEV1, FEV1%, PEFR are lower in asthmatics as compared to the controls. The mean± standard deviation of FVC is 3.24± 0.90 lit in the controls and 3.11± 0.79 lit in the asthmatics. The mean± standard deviation of FEV1 and FEV1% is 2.92± 0.93lit and 89.15± 9.27% in controls and 1.85± 0.50 lit and 60.09± 5.26% in the people having asthma respectively. The mean± standard deviation of PEFR in controls is found to be 6.01± 2.16 lit/sec and it is 3.03± 0.81lit/sec in asthmatics. The difference of FEV1, PEFR and FEV1% between the asthmatics and non-asthmatics is statistically significant. However the difference in FVC between the two groups is not significant. Our findings are similar to the findings of Kumar M et al in 2005, and Bhattad S S et al in 2013. Kumar M et al<sup>5</sup> in 2005, in their study also found that FEV1, FEV1%, PEFR were significantly lower in asthmatics than the non-asthmatics. In the study by Bhattad S S et al,<sup>6</sup> in 2013, it was found that in asthmatic children when compared with healthy children, there was no significant difference in percent predicted values of FVC between the two groups, but percent predicted values of FEV1 and FEV1/FVC ratio in percent were decreased significantly in asthmatic children as compared with healthy children. Lutfi M F<sup>7</sup> in 2012, also demonstrated that spirometric measurements were

significantly lower in asthmatic patients as compared with the control groups. Prabhat K D<sup>13</sup> et al in 1990, in their study with 50 asthmatic patients and 20 healthy age matched and sex matched controls, also found significant reduction in lung function in asthmatic subjects. These findings are similar to this study observation. Madan D et al<sup>14</sup> in 2010 found that all the pulmonary parameters like FVC, FEV1, FEV1/FVC in asthmatic patients showed significantly less observed values than the normal predicted values. The difference in the mean values of all the lung function parameters of bronchial asthma patients were lower in comparison to healthy controls with statistically significant differences in almost all the age groups studied. However our findings were different from the results of the study done by Srivastava A et al in 1995<sup>8</sup> where FVC, FEV1, FEV1/FVC although were reduced in asthmatics in comparison with controls, but the difference was not statistically significant. Devi P T et al<sup>9</sup> in 2012, in their study with 54 asthmatics and 30 controls found that FVC, FEV1, PEFR, FEF 25-75% were significantly lower in asthmatics as compared to the controls. The principal mechanism in the pathogenesis of asthma is chronic airway inflammation, which generally can lead to airway remodeling and in the long term resulting in irreversible airway obstruction and long term deterioration in pulmonary function.

## Summary and Conclusion

FEV1, FEV1% and PEFR were significantly lower in the asthmatics than the non-asthmatics. However the FVC in asthmatics was lower but not significant. However to prevent the long term deterioration of lung function in asthmatics, their early diagnosis and prompt treatment seems to be helpful.

**Conflict of Interest:** None.

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