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# A STUDY ON PEAK EXPIRATORY FLOW RATE: USEFUL TOOL FOR EARLY DETECTION OF AIRWAY OBSTRUCTION

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**ABSTRACT** **Background:** Peak expiratory flow rate (PEFR) is an effort-dependent parameter, emerging from the large airways within about 100-120 msec of the start of forced expiration. It measures the degree of obstruction in the airways. It is thus expected to be a reasonable substitute for spirometry in airflow obstruction screening when spirometer is unavailable **Aims & Objective:** The present study is to detect early detection of airway obstruction by peak expiratory flow rate in adults. **Methods And Materials:** 100 asymptomatic participants of age group 18-40 yrs., 46 females and 54 males were included in the study. A family history for presence/absence of asthmatic symptoms was taken from all subjects. After anthropometric examination, PEFR values were recorded in standing position, using the Mini Wright Peak Flow meter after demonstrating them the right procedure. Three measurements were taken and the highest reading was recorded. **Result:** Thirty-one Percent with family history of airway obstruction showed PEFR values. The mean age of males was 36 ± 2.3 years while that of females was 33.17 ± 2.6 yrs. Average height and weight of males was 170 ± 12 cm & 60 ± 8 kg, respectively while that of females was 155 ± 14 cm and 40 ± 12 kg, respectively. The mean PEFR values in L/min were 340 ± 67 in males and 235 ± 39 in females. **Conclusion:** The results of this study support the vital role of PEFR related to changes in airflow, which eventually can result in early identification of patients with airway obstruction.

**KEYWORDS :** Airway obstruction, Asthma & PEFR.

## INTRODUCTION:

According to guidelines on asthma management, patient education is thought to be essential in the treatment of adult asthma (1- 7). Great emphasis is placed on educating asthmatics to improve asthma knowledge, promote adherence to treatment and improve health outcomes. Limited information to patient education programmes have shown a modest impact on morbidity (8), whereas improvement in asthma control and reduction in the use of healthcare facilities can be attained by programmes that integrate instruction, written self-management plans and regular follow-up (9). The peak expiratory flow rate (PEFR) is a person's maximum speed of expiration. A subjective and effort-dependent parameter emerging from the large airways within about 100-120 msec of the start of forced expiration remaining at its peak for 10 msec, it varies with anthropometric, climatic, geographic and nutritional conditions [10-13]. It is measured with a peak flow meter, which is a simple, portable, hand-held device used to monitor a person's ability to expire out air through the bronchi. It thus gives an idea about the degree of obstruction in the airways. Asthma, one of the most common chronic diseases of childhood, is characterized by recurrent, reversible, airway obstruction occurring usually because of inflammation of the pulmonary airways and bronchial hyper responsiveness with eosinophilic infiltration [14]. Physiologically, abnormal airway hyper-reactivity is documented by decreased bronchial airflow after broncho-provocation with methacholine or histamine. Airway obstruction can also be provoked by cold air, exercise, viral upper respiratory infection, cigarette smoke, and respiratory allergens [15]. The global prevalence of asthma is anticipated to be approximately 4.5 percent [16]. In India, the prevalence of asthma in adults varies from 2.05 to 3.5% (17-30 million patients) [17]. Severe socio-economic burden is experienced by the family of asthmatics [18], the estimated total cost of asthma treatment for the year 2016 is calculated to be approximately 4852.86 crores [19]. Asthma is seen running in families not only because of the genetic inheritance but due to same exposures and environmental conditions shared by them.

Peak flow meter can serve as a useful tool to monitor airway patency particularly in those people who have a family history of bronchial asthma. Asthmatic family, having significantly low PEFR values than its height and age matched peers, can be considered under impending asthma category. Thus, present study was proposed to detect early stages of airway obstruction through PEFR, in asymptomatic school going children and to refer the subjects showing signs of early obstruction, for further pulmonary evaluation.

## AIMS AND OBJECTIVE:

The present study was to detect early detection of airway obstruction by peak expiratory flow rate in adults.

## MATERIAL AND METHODS:

After obtaining the approval from the ethical committee of the institute, the study was conducted in Madhubani Medical College, Madhubani, Bihar from August 2022 to April 2023. Prior permission and informed written consent were obtained on a consent form, after clearly explaining them the purpose of the study. Hundred participants, of age group 18-40 years were recruited for the study; of which 46 were females and 54 boys. Anthropometric parameters were measured. For all subjects, age was calculated to the nearest completed year. Weight (in kg) was measured without shoes and with light clothing, on a standard calibrated bathroom scale. Height (in cm) was measured with a standard portable stadiometer.

A personal and family history for presence/absence of asthmatic symptoms like shortness of breath, wheezing, cough, heaviness of chest and night time exacerbations of symptoms and/or any prolonged medication was taken from all subjects. The patients with any of these symptoms were not included in the study. However, such symptoms in any other family member suggested a positive family history. In those who gave a positive family history of asthma, the relation with the asthmatic family member, was also recorded. PEFR values were then recorded in standing position, using the Mini Wright Peak Flow meter. The maneuver was explained and demonstrated to them before the actual recording. Each was asked to take a deep breath and then blow into the peak flow meter as hard and as quickly as possible. The peak flow meter was horizontally held and a tight seal was maintained between the lips and the mouthpiece. The marker was returned to zero after every measurement. A few normal breaths were taken and then the process was repeated two more times. Every patient was encouraged to blow harder each time. Three measurements were taken and the highest reading was recorded on case record forms. Disposable mouthpieces were used for the subjects.

PEFR values were classified into 3 regions as described below:

- Eighty to 100 percent of the usual or normal peak flow readings indicated no airway narrowing.
- Fifty to 79 percent of the usual or normal peak flow readings were considered as mild airway narrowing.
- Less than 50 percent of the usual or normal peak flow readings indicated moderate/severe narrowing.

**Inclusion criteria:**

Inclusion criteria were as follows: 18- 40 years of age with voluntary participation in the study. Each patient satisfied the American Thoracic Society (ATS) definition of asthma, with symptoms of episodic wheezing, cough and shortness of breath responding to bronchodilators, and reversible airflow obstruction documented on at least one previous pulmonary function study .

**Exclusion criteria:**

Exclusion criteria were; any thoracic skeletal abnormality *e.g.* kyphosis, scoliosis, history of pulmonary surgery, malnutrition, acute respiratory infection or any medication with bronchodilators. Those with present or past history of smoking, pulmonary tuberculosis, COPD, bronchiectasis or any other respiratory diseases were also excluded from the study.

**Statistical Analysis:**

Fisher's exact test was done to calculate the two tailed 'P' value, Odd's ratio and relative risk. On applying Fisher's exact test, the two tailed 'P' value was 0.0155 considered to be significant.

## RESULTS:

The study was performed on 100 asymptomatic of age group 18-40 years, 46 females and 54 males. The mean age of males was 36 ± 2.3 years while that of females was 33.17 ± 2.6 yrs. Average height and weight of males was 170 ± 12 cm & 60 ± 8 kg, respectively while that of females was 155 ± 14 cm and 40 ± 12 kg, respectively. The mean PEFR values in L/min were 340 ± 67 in males and 235 ± 39 in females. Descriptive analysis of PEFR was performed to calculate mean and standard deviation. PEFR value was the dependent variable while age, sex, height, and weight were the independent variables. The predicted value so obtained was compared with the observed values of PEFR. We found that the observed PEFR value of 76 patients was above 80% of the predicted value (no obstruction in airways) while 24 patients had observed PEFR values below 80% of the predicted value (suggestive of narrowing of airways). Of these, 11 had PEFR values more than 75% of the predicted value; 8 had values between 65%-75% of the predicted values and 5 had PEFR values below 65% of the predicted value. The lowest observed PEFR was 56.2% of the predicted value. Thirteen percent (13%) gave a family history of asthma. Four out of 13 showed family history of airway obstruction showed PEFR values below 80% of the predicted value. On the other hand, five of them who were not having any family history of asthma, also showed values below 80% of the predicted value. Surprisingly, the participants with lowest PEFR value 56.2% of the predicted value had no family history of airway obstruction.

PEF < 80% of predicted was more effective in the detection of airflow obstruction was confirmed by the lower limit of normal of forced expiratory volume in 1 second/forced vital capacity, Global Initiative for Chronic Obstructive Lung Disease (GOLD), and GOLD plus symptom, with a sensitivity of 78.7%, 76.8%, 85.3% and a specificity of 81.9%, 83.8%, 81.4%, respectively.

**Fig: PEFR**

## DISCUSSION:

We estimated PEFR in asymptomatic, with an aim to detect whether with positive family history of asthma are at an increased risk of developing asthma later in life. Since PEF testing has good screening properties to detect airway obstruction, we can identify children with airway obstruction in the pre-clinical asymptomatic stage and preventive measures can be instituted before the frank development of disease. Various studies have been done on PEFR in the past. In 2002, Rajesh Sharma *et al.* studied PEFR in a rural group, from Ajmer district of Rajasthan state and compared the values with those available from Northern India [20]. Lee HS and others suggested PEFR to be a useful additional tool to the respiratory questionnaire and spirometry in asthma cases, as it measures airway variability [21-23].

A few studies have attempted to compare the PEFR values of highlander and lowlander populations and found a significant rise in PEFR among high-altitude residents [24]. A number of studies have distinctly substantiated the effect of various anthropometric parameters like age, height, and weight on lung function [25-27]. In 2013, Manjunath CB *et al.* felt that since the reference values of PEFR were affected by regional, environmental and anthropometric factors. In 2013, Mishra *et al.* also found that height correlates better with PEFR in males and weight correlates better with PEFR in females [29]. Paramesh H. found that PEFR values correlated best with height; there was no difference in sexes, religion and urban/rural [30]. Various researchers have concluded that the highest correlation of PEFR occurs with height and they constructed nomograms relating PEFR to height [31-33]. Since most of the studies have proved that height is the most effective variable affecting PEFR, we used a prediction equation based on height, given by Swami Nathan *et al.*, for predicting the PEFR values of our group of subjects. The results of our study suggest that with positive history of asthma are more prone to develop airway obstruction. In our study 33% of family history of airway obstruction showed PEFR values lower than their matched peers. Our study is supported by Burke *et al*. who assessed the predictive value of family history as an indicator of risk for asthma. It is a well-known fact that asthma runs in families. Evidences suggest that this high familial association occurs not only because they share genetic makeup, but also the same environmental factors play an important role in asthma etiology. The association of a positive family history of asthma along with a decreased PEFR to identify at increased risk could provide a basis for targeted prevention efforts.

The results of this study support the pivotal role of PEFR aimed at providing data related to changes in airflow, which eventually can result in early identification with airway obstruction, timely intervention and medication to improve symptom control. When asthma symptoms are controlled, patients are less restricted in their ability to participate in various activities and experience less emotional distress. With the alleviation of asthma symptoms, Quality of Life (QOL) scores will improve [34, 35].

## CONCLUSION:

The PEFR, which is regarded as an early determinant of airway obstruction even in asymptomatic states, is a very simple procedure that does not require any specialized, sophisticated instrument or assistance; it could be performed routinely, may be biannually, in schools as a screening procedure to detect early airway narrowing with a positive family history of asthma. Use of peak expiratory flow rate as a measurement of ventilatory function test is an ancient. This simple test, measured by mini-Wright peak flow meter, is very useful in diagnosis, management, follow up of bronchial asthma and predict the status of ventilator lung function.

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