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Peak Expiratory Flow Rate Measurement In Children With Bronchial Asthma

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Abstract:
Background: *Contemporary asthma guidelines emphasize patient self-management, wherein peak flow monitoring plays a crucial role. Peak expiratory flow rate (PEFR) is defined as the maximum expiratory flow rate following a forceful inspiration and demonstrates correlation with forced expiratory volume in 1 second (FEV1) (Gupta et al., 2023) Peak flow monitoring, in asthmatic client, aids in establishing the diagnosis, measure the severity of symptoms, evaluate treatment response, and identify asthma exacerbations.*
Materials and Methods: *An exploratory study was conducted on 160 children diagnosed with bronchial asthma attending the out-patient department of a pediatric hospital in Mumbai. The PEFR values in the children were measured, compared with the predicted values based on their height and the percentage of lung function impairment was computed. The values were correlated with selected socio- demographic and environmental factors.*
Results: *The findings provided insight into the demographics and living conditions of the children. The age distribution shows that 44.4% are between 8-10 years, 30.0% are 10-12 years, and 25.6% are 12-15 years old. In terms of gender, 61.9% are male and 38.1% are female. The socio-economic class is predominantly lower middle, with 66.9% of the children falling into this category, while 16.9% are upper lower and 16.3% are upper middle. Regarding their residence, 6.3% live in mansions or bungalows, 39.4% in buildings, 52.5% in chawls, and 1.9% in slums. Most children, 83.8%, have well-ventilated rooms, and 87.5% do not have pets at home. Additionally, 77.5% of the households maintain cleanliness in their house and surroundings. Studyfindings state that PEFR values are directly proportional to the height of children. The lower values of PEFR in asthmatic children reflect the impairment of lung function. The analysis of the association between various factors and peak flow rates revealed that age, gender, socio-economic class, residence, and presence of pets do not significantly associate with PEFR grades, while room ventilation is found to be a significant factor affecting the respiratory health of the children.*
Keywords: *Peak Expiratory Flow Rate, factors, children*

INTRODUCTION
Bronchial asthma is a prevalent chronic respiratory condition affecting millions of children worldwide. According to the World Health Organization (WHO), asthma affects approximately 14% of children globally, with varying prevalence rates across different regions(WHO, 2021).
The Peak Expiratory Flow Rate (PEFR) is expressed in liters/min and represents the highest flow rate achieved when an individual exhales with maximum effort.
Peak expiratory flow (PEF) measurements obtained using a peak flow meter can serve as a significant aid in both the diagnosis and monitoring of asthma. Global Initiative for Asthma (GINA) guidelines recommend the utilization of PEFR monitoring to assess treatment response, identify triggers for symptom exacerbation, and establish a baseline value for action plans (particularly for individuals with poor perception of symptoms). The limitation of airflow observed during exacerbations (measured as PEF or FEV1) is considered a more reliable indicator of exacerbation severity than the degree of symptoms. However, symptoms often serve as sensitive indicators of the onset of an exacerbation, as they typically precede the deterioration in peak flow rate.(Bateman et al., 2008) Large changes in the peak flow rates are a sign of poor asthma control.
Research indicates that children with asthma often experience fluctuations in their PEFR, influenced by a multitude of factors including environmental triggers, medication adherence, and individual physiological characteristics. Furthermore, environmental factors such as exposure to allergens and air pollution have been linked to decreased PEFR, underscoring the need for targeted interventions in high-risk populations.(Kyejo et

al., 2023)

Understanding these factors is essential for optimizing asthma management and improving clinical outcomes in pediatric patients.

Need of the study:

The need for this study arises from the increasing prevalence of bronchial asthma in children, which significantly impacts their quality of life and overall health. Monitoring the peak expiratory flow rate is an inexpensive, straightforward and useful investigation that can be performed on a daily basis by the children or their caregivers. The changes in the peak flow values indicate variations in the respiratory function of patients. Understanding the factors associated with Peak Expiratory Flow Rates (PEFR) is crucial for developing effective management strategies and interventions. By identifying these factors, healthcare providers can better tailor treatments, improve asthma control, and ultimately enhance the respiratory health of the affected children. This study aims to measure the peak flow rates of children with asthma so as to facilitate better clinical practices promoting optimal treatment and positive health outcomes in pediatric asthma patients.

Statement of the study:

"Assessment of Peak Expiratory Flow Rates in children with bronchial asthma".

OBJECTIVES OF THE STUDY:

1. To obtain the peak expiratory flow rates in children with bronchial asthma
2. To compare the actual values with the predicted values of the children.
3. To find out the association of peak flow rates with selected variables.

Materials and Methods A quantitative approach was adopted to determine the peak expiratory flow rates in children with bronchial asthma using a peak flow meter. This study was conducted in the outpatient department of a renowned pediatric hospital in Mumbai. The population included all the children attending the outpatient department of the asthma clinic. A sample size of 160 children in the age group of 8 to 15 years was selected using non probability convenience sampling. A semi structured and validated questionnaire was used to collect the demographic and socio-economic data of children. The peak flow rates were assessed using the PEFR meter, a device used to measure lung capacity that has been calibrated using the EU scale in accordance with the internationally accepted European Union standards. The height was measured using the stadiometer. The predicted normal values of PEFR were calculated using the formula recommended by Indian Pediatrics (Balasubramanian et al., 2002)

$$PEFR = (Ht - 100) \times 5 + 100$$

Where Ht = Standing height in cm)

The children were asked to expire forcefully into the PEFR meter after a demonstration by the investigator. Three readings were obtained and the best value was compared with the predicted value to derive the percentage. Those children who had values ranging between 80 to 100 percent of the predicted, proclaimed effective management and control of asthma symptoms. Values from 50 to 80 percent of the predicted value serves as a cautionary signal, suggesting the potential for an asthma episode that may necessitate the use of quick-relief medications or other treatments whereas values less than 50 percent of predicted value pose a risk of an emergency.

Data analysis: Data were analyzed using descriptive and inferential statistics. Sociodemographic data were computed using frequency percentages, and association with selected variables were calculated using chi-square.

RESULTS

I. Socio-demographic data of children:

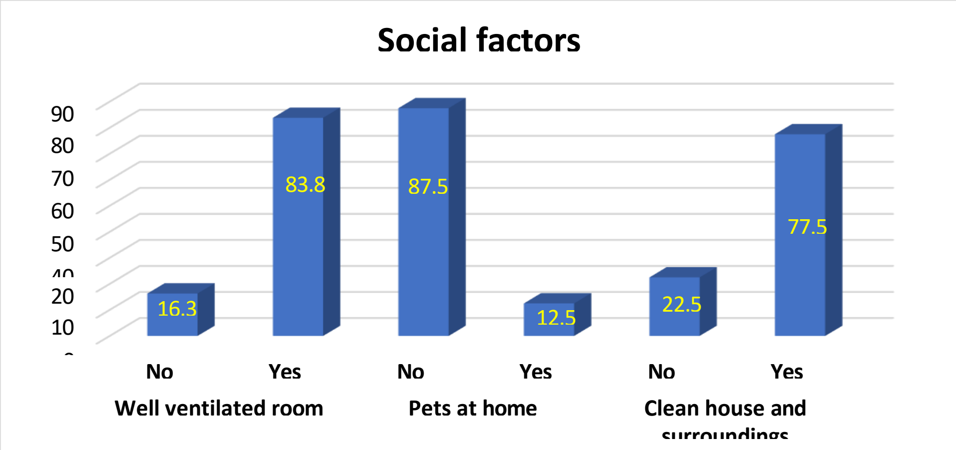
Table 1: Distribution of Children According to Age, Gender, and Standard (N = 160)

Characteristic	Category	Frequency (f)	Percentage (%)
Age of the child	8–10 years	71	44.4
	10–12 years	48	30.0
	12–15 years	41	25.6
Gender	Male	99	61.9

	Female	61	38.1
Standard (Class)	2	13	8.1
	3	30	18.8
	4	29	18.1
	5	29	18.1
	6	16	10.0
	7	15	9.4
	8	16	10.0
	9	12	7.5

Table 2: Distribution of Children According to Socio-economic Class and Residence (N = 160)

Characteristic	Category	Frequency (f)	Percentage (%)
Socio-economic Class	Lower Middle	107	66.9
	Upper Lower	27	16.9
	Upper Middle	26	16.3
Residence	Mansion/Bungalow	10	6.3
	Building	63	39.4
	Chawl	84	52.5
	Slum	3	1.9



II. Comparison of the actual PEFR with predicted PEFR in relation to height of children

Table 3: Comparison of Predicted and Actual PEFR Based on Height (N = 160)

HEIGHT (IN CM)	FREQUENCY (N)	MEAN OF PREDICTED PEFR	MEANOF ACTUAL PEFR
121–130	26	241.53	178.29
131–140	76	280.06	202.89
141–150	49	324.18	247.95
151–160	9	362.20	272.70

The above table presents data on Peak Expiratory Flow Rate (PEFR) in asthmatic children, categorized by height range. It can be inferred that PEFR increases with height. Both the predicted and actual PEFR values show an increasing trend as height increases. Taller children generally have better lung function.

Across all height groups, the mean actual PEFR is consistently lower than the predicted PEFR. This suggests that asthmatic children have reduced lung function compared to expected values for their height.

Table 4: Distribution of Children According to their Peak Flow Rate Grading (N = 160)

Percentage	Grade of Airflow	Frequency	Percentage

Range		(f)	(%)
Above 80%	Normal	43	27.5
50% – 80%	Reduced	116	71.8
Below 50%	Markedly Reduced	1	0.6

The above table presents the distribution of children according to their peak flow rate grading. The children having 50-80% of the predicted PEFR had highest representation with 71.87% of the total. This category represents children who exhibit some level of respiratory impairment or restriction. Although these children are not experiencing severe symptoms, the lower flow rates necessitate regular monitoring.
A quarter of the sample (27.5%) exhibited peak flows in the range above 80% which suggests that a significant proportion of the children in this study have healthy respiratory function. The least represented, with only one subject, which is 0.625% of the total indicates a critical level of respiratory impairment. The findings thus highlight the importance of early intervention and continuous monitoring among the children with asthma.

III. Association of the Peak Flow Rates with selected demographic variables Table 5: Association Between Peak Flow Rates and Selected Variables (N = 160)

Characteristic	Category	Peak Flow Grading: Normal (f)	Peak Flow Grading: Reduced (f)	χ^2 (Chi-square)	*p* value
Age of the child (years)	8–10	14	57	4.029	0.133
	10–12	17	31		
	12–15	13	28		
Gender	Male	28	71	0.080	0.778
	Female	16	45		
Socio-economic	Lower Middle	32	75	1.236	0.539
class					
	Upper Lower	7	20		
	Upper Middle	5	21		
Type of residence	Mansion/Bungalow	2	8	2.062	0.560
	Building	16	47		
	Chawl	26	58		
	Slum	0	3		
Well-ventilated room	No	3	23	3.967	0.046*
	Yes	41	93		
Pets at home	No	38	102	0.072	0.789
	Yes	6	14		

$p < 0.05$ is considered statistically significant.

AGE OF THE CHILD:
The relationship between the child's age and their peak flow rate grading was analyzed using a Chi-square test. The p-value obtained was 0.133, which is greater than the conventional significance level of 0.05. This suggests that age does not have a statistically significant impact on the peak flow rate categories.

GENDER:
The Chi-square test was also conducted to assess whether there was a significant association between gender (Male vs. Female) and peak flow rate. The p-value was 0.778, which is much higher than 0.05, indicating that gender does not significantly influence the peak flow rate.

SOCIO-ECONOMIC CLASS:

The association between socio-economic class (Lower Middle, Upper Lower, Upper Middle) and peak flow rate was examined. The Chi-square test yielded a p-value of 0.539, which suggests there is no significant relationship between socio-economic class and the peak flow rate.

RESIDENCE:

The residence variable was assessed to determine whether the type of housing (Mansion/Bungalow, Building, Chawl, Slum) influences peak flow rate. The resulting p-value of 0.56 indicates that residence type does not have a statistically significant effect on the peak flow rate.

ROOM VENTILATION:

In contrast, the presence of room ventilation was found to be statistically significant with a p- value of 0.046, which is below the threshold of 0.05. This indicates a significant association between room ventilation and the peak flow rates. Children living in well-ventilated rooms are more likely to have better lung function compared to those living in poorly ventilated rooms. Presence of Pets at Home: With regards to the presence of pets at home, the p-value of 0.789 suggests that having pets at home does not significantly influence the peak flow rate. The distribution of children across the categories of peak flow grades is similar for those with and without pets, indicating that pets at home do not significantly affect the lung function.

SUMMARY:

The study thus infers that children with asthma demonstrate lower peak flow rates as compared to the predicted normal values based on their height.Age, gender, socio-economic class, residence, and pets at home do not show a statistically significant association with the peak flow rate zones, based on their respective p-values (all greater than 0.05). Room ventilation was the only variable found to have a statistically significant relationship with the peak flow rate, suggesting that children living in well- ventilated rooms tend to have better peak flow rates.In conclusion, the findings of this study underscore the importance of monitoring asthma- related indicators within the identified range. The data suggests that individuals experiencing symptoms within this cautionary signal should be proactive in managing their condition, potentially utilizing quick-relief medications or seeking alternative treatments. By recognizing these warning signs early, patients can better prevent exacerbations and maintain optimal respiratory health. Continued research and awareness are essential to enhance asthma management strategies and improve patient outcomes.

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