

Evaluation of Utility of a Simple Clinical Scoring System for Diagnosis and Severity Assessment of Asthma in Children

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DOI: <https://doi.org/10.52403/ijhsr.20241027>

ABSTRACT

Introduction: Asthma is a common respiratory problem in children, however, its severity assessment in objective terms is difficult.

Objective: To compare the usefulness of Pulmonary Index Score (PIS) with spirometry.

Methods: A total of 100 children aged 6-17 years with clinical diagnosis of asthma were enrolled after excluding children with congenital or acquired cardiovascular, respiratory problems, juvenile diabetes mellitus and those unable to undertake spirometry. Demographic and clinical evaluation of patients was done. PIS was calculated by evaluating respiratory rate, wheezing and sternocleidomastoid activity.

PIS total scores 0, 1-3, 4-6 and 7-9 were categorized as No, mild, moderate and severe asthma. Pulmonary expiratory flow rates (PEFR) % of predicted values >1, 0.8 to 0.1, 0.6 to 0.8 and <0.6 were categorized as No, mild, moderate and severe asthma. PIS and PEFR diagnoses were compared. Kappa-statistic was used to measure agreement.

Results: Majority of children were aged <13 years (85%) and were boys (60%). Cough (88%), wheezing (70%) and repeated cold (54%) were the most common presenting complaints. A total of 30% each had mild and moderate while 18% had severe asthma as per PIS. On spirometry, asthma was confirmed in 75% children. Mild, moderate and severe asthma was diagnosed in 26%, 33% and 16% children with the help of spirometry. Overall, there was agreement on 76% cases between PEFR and PIS ($\kappa=0.675$; $p<0.001$), The sensitivity and specificity of PIS in detection of moderate/severe asthma was 87.8% and 90.2% respectively.

Conclusion: PIS is a simple and effective evaluation tool for pediatric asthma.

Keywords: Pediatric asthma, Spirometry, Pulmonary Index Score, Pulmonary expiratory flow rate (PEFR).

INTRODUCTION

Asthma is one of the most common chronic diseases in children and adolescents, affecting over 300 million people globally, with prevalence rates ranging from 5-20%

depending on the region. In children, it is more frequent in boys than girls, but this trend reverses during adolescence, likely due to hormonal influences. The prevalence of asthma is higher in urban settings and

low-income populations, driven by environmental exposures like pollution and allergens, and socio-economic factors^{1,2}.

Diagnosing asthma in children and adolescents can be challenging due to the variability of symptoms, which may overlap with other respiratory conditions, such as viral-induced wheezing. Spirometry, often used in diagnosis, may be difficult to perform accurately in younger children³. Furthermore, the episodic nature of asthma and the lack of clear biomarkers for its diagnosis can complicate severity assessments.

Misclassification of asthma severity often occurs, leading to either over- or under treatment, which can impact quality of life⁴. Severity is typically assessed based on symptom frequency and lung function, but these do not always correlate well with underlying airway inflammation. This disparity between clinical symptoms and pathophysiology makes management particularly difficult, especially in the pediatric population⁵.

Diagnostic methods based on clinical evaluation and signs/symptoms have their own significance in early diagnosis and management of asthma in children. However, accuracy of such methods is an issue of concern. The Pulmonary Index Score (PIS) is a clinical tool used to assess asthma severity in children by evaluating respiratory rate, wheezing, retractions, oxygen saturation, and dyspnea. It provides a quick, non-invasive measure of disease severity, aiding in timely management decisions^{6,7}.

Considering the significance of early assessment of asthma and its severity from

the point of view of treatment and management, the present study was proposed to assess the utility of pulmonary index score in assessment of severity of asthma in children and adolescents by comparing it against standard spirometry diagnosis.

MATERIALS & METHODS

This study was carried out at Department of Pediatrics of a leading medical college in North India after obtaining approval from Institutional Ethics committee and getting informed consent from the parents of the a total of 100 participants aged 6-17 years presenting with acute exacerbation of asthma at the Outpatient Department or Emergency ward after excluding children with congenital or acquired cardiovascular disease or congenital defect of respiratory tract, those with pulmonary tuberculosis, any known cardiac disease and/or juvenile diabetes mellitus. Children unable to perform spirometry were also excluded.

At enrolment, demographic details and presenting complaints were noted and details of risk factors were explored. Following this clinical assessment of the patients was carried out to assess the pulmonary index. Pulmonary index score (PIS) is a simple clinical evaluation method that takes into account three clinical features, viz., respiratory rate, wheezing and sternocleidomastoid activity in order to assess the asthma in children⁸. The scoring criteria is as follows:

Pulmonary Index Score Criteria

Score	Respiratory rate		Wheezing	Accessory muscle use (Sternocleidomastoid activity)
	<6 years	>6 years		
0	<30	< 20	None	No apparent activity
1	31-45	21-35	Terminal expiration with stethoscope	Questionable increase
2	46-60	36-50	Entire expiration with stethoscope	Questionable apparent
3	>60	>50	Inspiration & Expiration without stethoscope.	Maximal activity

For each clinical feature, scores are accorded from 0 to 3. The aggregated score

is used for diagnosis and severity assessment of asthma as follows:

Total score 0 = No asthma
 1-3 = Mild asthma
 4-6 = Moderate asthma
 7-9 = Severe asthma

evaluation using Wright's Mini Peak Flowmeter. Peak Expiratory Flow rate was (PEFR) was assessed. Assessment of asthma based on PEFR % of predicted normal value was done as follows:

All the patients were then subjected to spirometry for pulmonary function

PEFR % of predicted normal value

≥100	No asthma
≥80% to <100 -	Mild intermittent or persistent asthma
>60-80%	Moderate persistent asthma
≤60%	Severe persistent asthma

Data Analysis: Data was collected on structured proforma and then digitalized using MS-Excel software. Cohen's Kappa-coefficient was calculated to find out agreement between PIS and PEFR diagnosis. Sensitivity, specificity, positive and negative predictive values of PIS were assessed against PEFR.

RESULT

Maximum (44%) of children were aged between 10-13 years. Majority (85%) were aged between 6 and 13 years. There was a dominance of boys (60%). Cough (88%), wheezing (70%) and repeated cold (54%)

were the most common presenting complaints. Majority (55%) had history of early top feeding and family history of asthma (59%). There were 23 children having exposure to parental smoking. PI scores ranged from 0 to 9 with a mean of 3.55±2.80. Pulmonary index scores diagnosed asthma in 78% children. A total of 30% each had mild and moderate while 18% had severe asthma as per PIS. On spirometry, asthma was confirmed in 75% children. Mild, moderate and severe asthma was diagnosed in 26%, 33% and 16% children with the help of spirometry (Table 1).

Table 1: General Profile and Characteristics of Study Population (n=100)

SN	Characteristic	No./%
1.	Age	
	6-9 Years	41
	10-13 Years	44
	14-17 Years	15
2.	Boys/Girls	60:40
3.	Presenting complaints	
	Cough	88
	Chest tightness	23
	Repeated cold	54
	Breathlessness	33
	Wheeze	70
	Fever	7
4.	History of early top feeding	55
5.	Family history of asthma	59
6.	Exposure to parental smoking	23
7.	Urban: Rural	76:24
8.	Mean PIS±SD (Range)	3.55±2.80 (0-9)
9.	PIS Diagnosis	
	No asthma	22
	Mild	30
	Moderate	30

	Severe Asthma	18
10.	PEFR Diagnosis	
	No asthma	25
	Mild	26
	Moderate	33
	Severe Asthma	16

Agreement of PIS diagnosis with PEFR diagnosis was seen for 12/25 (48%) cases diagnosed as no asthma, 22/26 (84.6%) mild, 27/33 (81.8%) moderate and 15/16

(93.8%) severe asthma cases. The level of agreement between PIS and PEFR diagnosis was excellent ($\kappa=0.675$; $p<0.001$) (Table 2).

Table 2: Correlation between PIS and PEFR Diagnosis

PIS Diagnosis	PEFR Diagnosis			
	No asthma	Mild asthma	Moderate asthma	Severe asthma
No asthma	12	4	5	1
Mild asthma	8	22	0	0
Moderate asthma	3	0	27	0
Severe asthma	2	0	1	15

$\kappa=0.675$; $p<0.001$

On evaluating the efficacy of PIS in detection of moderate/severe asthma a total of 43 cases were true positive, 5 were false positive, 6 were false negative and 46 were true negative. Correspondingly, the sensitivity, specificity, positive and negative

predictive values of PIS were recorded as 87.8%, 90.2%, 89.6% and 88.5% respectively. PIS was 89% accuracy in differentiating moderate/severe asthma from mild/no asthma (Table 3)

Table 3: Diagnostic Efficacy of PIS in detection of moderate/severe asthma

PIS Diagnosis		PEFR Diagnosis		
		Moderate/severe asthma	No/Mild asthma	
Moderate/ severe asthma		43	5	
No/ mild asthma		6	46	
Sens	Spec	PPV	NPV	Accuracy
87.8	90.2	89.6	88.5	89.0

DISCUSSION

In the present study clinical evaluation based pulmonary index showed an overall agreement with spirometry on 76% cases. However, when this efficacy was evaluated in terms of its efficiency to discriminate moderate/severe asthma from mild/no asthma, this agreement level was 89%. PIS, as a simple clinical evaluation tool was found to be 87.8% sensitive and 90.2% specific in detection of moderate/severe asthma. For overall diagnosis of asthma in general it was 86.7% sensitive but only 48% specific. Thus, for overall diagnosis of asthma it was highly sensitive whereas for

diagnosis of moderate/severe asthma, PIS was highly sensitive as well as specific. Pulmonary Index Score (PIS) is a useful and well-validated score for assessment of pediatric asthma in different populations^{9,10}. In the present study, it was found to be more useful in identification of moderate/severe asthma. The findings of the present study are in agreement with the observations of Hsu *et al.*¹⁰ who found it to be 85% sensitive and 75% specific for diagnosis of non-mild cases and 88% sensitive and 77% specific for detection of severe asthma cases. These are close to 87.8% sensitivity and 90.2% specificity for detection of non-mild cases in

the present study. As such, the usefulness of this scale is of significance from the point of view of detection of non-mild (moderate/severe) asthma cases. Its usefulness for prediction of hospitalization in acute pediatric asthma exacerbations has also been documented by Paniagua *et al.*¹¹ in their study. The advantage of this scoring system lies in its simplicity and objectivity. Over the years, objective scoring systems based on PIS have also been proposed and been found to be useful in clinical decision making. In a recent evaluation, modified PIS that incorporates three additional clinical parameters *viz.* oxygen saturation, heart rate and inspiratory-to-expiratory flow ratio has also been found to be useful in evaluation of asthma severity, treatment planning and prognosis in children^{12,13,14}. In the present study, we found that the basic PIS too was a useful method of evaluation of pediatric asthma and has a helpful role in clinical decision making. Being a simple to use clinical evaluation method it has high utility in low-resource settings and in younger children who are not comfortable for confirmatory diagnostic methods like spirometry.

One of the limitations of the study was its cross-sectional nature owing to which the usefulness of PIS in management and prognosis of outcome could not be done. Further studies on a larger sample size with longitudinal design are recommended to assess the efficacy of PIS in management and prognosis of clinical course and outcome of pediatric asthma patients are recommended

CONCLUSION

Pulmonary index score is a useful simple to use clinical evaluation method for diagnosis and severity assessment of asthma in children.

Declaration by Authors

Ethical Approval: Ethical clearance was obtained from the institute as the present study was conducted as a part of dissertation

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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- How to cite this article: Bindiya Verma, Sachin Verma, Sudipti Yadav, Keerti Katiyar, Vandana Verma. Evaluation of utility of a simple clinical scoring system for diagnosis and severity assessment of asthma in children. *Int J Health Sci Res.* 2024; 14(10):262-267. DOI: <https://doi.org/10.52403/ijhsr.20241027>
