

Original Research Article

Pediatric respiratory assessment measure score in assessing the severity of acute asthma in children

R. Prasanna, Fayrouz Moidu, Sekar Pasupathy*

Department of Paediatrics, SRM Medical College Hospital and Research Centre, Kattankulathur, Chennai, Tamil Nadu, India

Received: 06 February 2019

Accepted: 08 March 2019

*Correspondence:

Dr. Sekar Pasupathy,

E-mail: dr_prasannaraju@yahoo.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Asthma is a chronic inflammatory disease of the lung airways resulting in episodic airflow obstruction. Management of acute pediatric asthma depends on assessment of asthma severity which is difficult in children due to poor coordination. This study is to evaluate the usefulness of a simple yet effective alternative like Pediatric respiratory assessment measure (PRAM) score in assessing the severity and outcome of an acute exacerbation of wheeze in children and to identify the PRAM score predicting the need for hospitalization.

Methods: A prospective cohort study was done on 127 children for a period of 2 months in 2018, admitted with acute exacerbation of wheeze using PRAM scores at admission and following each treatment modalities. Usefulness of score in assessing severity was evaluated.

Results: Increasing severity was associated with increasing initial PRAM score. Initial mean PRAM score of 11 in severe persistent forms, 7 in moderate persistent, 6.73 in mild persistent and 5.37 in mild intermittent was found. 59.1% of patients had a positive family history. The most common trigger factor according to our study was viral upper respiratory tract infection (50.4%) followed by exposure to dust (13.4%). Patients who were admitted to the Pediatric Intensive Care Unit (PICU) had the maximum number of interventions.

Conclusions: In our study, statistically it was proved that PRAM Score is a tool that can be used across different ages and PRAM Score is a tool that can be used to assess severity of asthma.

Keywords: Asthma, Asthma scores, PRAM score

INTRODUCTION

Asthma is one of the most common chronic diseases in the world. It is a major cause of morbidity and mortality throughout the world and evidence is showing a considerable increase is noticed especially in children in the past 20 years.¹ Atopic sensitization has lead to a steady increase in prevalence of asthma, and also a parallel increase in other allergic disorders like eczema and rhinitis also noted. The prevalence of childhood

asthma reported in India varies from less than 5% to as high as 20%.²

The chronic inflammation is associated with airway hyper responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. The present management guidelines for acute pediatric asthma relies on the objective assessment of severity of asthma generally measured by lung function tests such as peak expiratory flow rate or spirometry. To obtain reliable

peak expiratory flow rate measurement is not feasible in children presenting with acute asthma. Children who required admission were unable to perform spirometry in comparison to those discharged from emergency room.³ But these tests are not practically possible in young and also sick children, specially in preschool-aged children because of poor coordination. Over half of the asthmatics fall under preschool-age, hence around three quarters of these asthmatic children cannot perform standard lung function test in the emergency setting.

Hence in pediatrics, clinical scores can be a simple and also inexpensive tool to assess asthma severity. There are more than 18 different clinical scorings for assessing asthma severity. The pediatric respiratory assessment measure (PRAM) score has been found to be an attractive score for assessing asthma severity and response to treatment⁴ performance in children with acute exacerbation of asthma.

The PRAM is a 12- point clinical scoring that includes scalene muscle contraction, suprasternal retractions, wheezing, air entry, and oxygen saturation. Birken et al, in a study of asthma severity scores in preschool-aged children identified PRAM score as one of the scores with good measurement properties.⁵ Ducharme et al, developed and validated the PRAM score against respiratory resistance and proved this as discriminative and responsive to change.⁴

METHODS

A prospective observational study was done in a tertiary care center for a period of two months after ethical committee approval.

Study population included all children in the age group 1-17 years presenting with acute exacerbation of wheeze to the Emergency room (ER) who were admitted. A total of 127 children was included in the study.

All children enrolled was assessed with PRAM scores at admission and following each treatment administered in the Emergency Room (ER). They were either discharged from ER, or admitted into general ward (GW), high dependency unit (HDU), or pediatric intensive care unit (PICU) depending on the severity.

The treatments administered were nebulization with salbutamol/ipratropium, oral/intravenous steroids, intravenous magnesium sulphate, subcutaneous terbutaline according to the severity of the patient. All the patients were followed up till the outcome, which was recorded. Pulse oximetry was recorded at admission and after each intervention using the same Nellcor type of pulse oximetry. All children were triaged and treated as mild, moderate, severe exacerbation according to Emergency room protocol of our hospital.

PRAM score usefulness in assessing the severity of Asthma was analyzed. The data analysis was computed using the SPSS software and p value <0.05 was considered statistically significant.

RESULTS

Age group (1-3 years) represented majority of cases (53%) followed by 3-6 years (27.6%) and then 6 -17 years (20.4%) In our study, moderate persistent asthmatics were maximum number. Initial PRAM scores in patient with different severity of Asthma were studied (Table 1).

Table 1: PRAM scores by severity classification.

Asthma severity	No of patients	PRAM scores	Deviation	Error	P value between groups
Mild intermittent	19	5.37	2.77	0.636	0.003
Mild persistent	26	6.73	2.32	0.456	
Moderate persistent	30	7.00	2.34	0.429	
Severe persistent	3	11.00	1.00	0.577	

It was found that patients with severe persistent asthma had high initial PRAM scores when compared to other groups (Table 2).

From the table its noticed that patients requiring lesser number of interventions and those that respond to the treatments administered on average are either discharged or admitted to general ward (lower observed PRAM score), while those who fail to respond to the ER

treatment (PRAM scores remain high) on average need higher levels of care and are admitted to PICU/HDU.

We used statistical testing and analysis to test if the PRAM Score is an effective tool across the three identified age groups, i.e., does the tool remain unbiased with age of the patient in identifying the severity of asthma (Table 3).An increase in mean values of initial examination PRAM scores is observed.

We (Capitol W) used single factor analysis of Variance (ANOVA) to find out whether the observed differences in the mean values of the three different age groups are statistically significant or not (Table 4 and 5).

From the above Table, P-value is 0.09 which is greater than 0.05 which is interpreted to the null hypothesis that

all means are equal stands. The null hypothesis that the Means of the three groups are the same and the observed increasing trend with age groups is not statistically meaningful. Hence, the PRAM Score is a tool that can be used across different ages.

Table 2: Outcomes of ER management with pram score.

	Count	ER PRAM (Mean)	Stage 1 PRAM (Mean)	Stage 2 PRAM (Mean)	Stage 3 PRAM (Mean)	Stage 4 PRAM (Mean)
Triage	127					
Stages						
Discharged	37	3.86	1.36			
GW	32	5.75	3.72			
HDU	1	8.00	6			
PICU	0					
LAMA	2	7.50	6			
Stage 1	72	4.86	2.62			
Discharged	4	6.25	3.50	0.67		
GW	26	7.31	5.96	4.81		
HDU	1	10	9	6		
PICU	1	12	11	11		
LAMA	2	8	6.50	6		
Stage 2	34	7.44	5.94	4.73		
Discharged	0					
GW	7	9	7.86	6.86	5.57	
HDU	5	8.80	7.60	7.20	5.80	
PICU	5	9.80	9.20	9.20	7.80	
LAMA	0					
Stage 3	17	9.18	8.18	7.65	6.29	
Discharged	0					
GW	3	9	6.67	7	5.67	5.33
HDU	0					
PICU	1	10	10	10	8	7
LAMA	0					
Stage 4	4	9.25	7.50	7.75	6.25	5.75

GW = General Ward, HDU = High Dependency Unit PICU= Pediatric Intensive Care Unit, LAMA = Leaving Against Medical Advice.

Table 3: Distribution of PRAM scores across age groups.

Age group	NO. of patients	Mean initial scores	Standard deviation	Standard error	P value between groups and within groups
1-3 Years	66	5.79	2.804	0.345	
3-6 Years	35	6.63	2.402	0.406	0.089
6-17 Years	26	7.00	2.349	0.461	
Total	127	6.27	2.641	0.234	

Table 4: ANOVA for observed PRAM scores for age groups.

Groups	Count	SUM	Average	Variance
1-3	66	382	5.787879	7.862005
3-6	35	232	6.628571	5.769748
6-17	26	182	7	5.52

Table 5: ANOVA for observed PRAM scores for age groups.

Source of Variation	SS	df	MS	F	P-value	F crit
Between groups	33.69591	2	16.84795	2.471772	0.088587	3.069286
Within groups	845.2017	124	6.816143			

Table 6: Distribution of scores across discharged and admitted groups of patients.

Age group	No of patients	Mean initial scores	Standard deviation	Standard error	P value within and between groups
Discharged patients					
1-3 yrs	20	3.5	2.090	0.47	0.10
3-6 yrs	11	4	2.366	0.71	
6-17yrs	10	5.4	2.413	0.76	
Total	41	4.1	2.322	0.36	
Admitted patients					
1-3 yrs	43	6.7	2.548	0.39	0.04
3-6 yrs	23	7.8	1.154	0.241	
6-17 yrs	16	8	1.713	0.428	
	82	7.3	2.150	0.237	

Table 7: ANOVA for discharged and admitted patients.

Groups	Count	Sum	Average	Variance
Discharged in ER PRAM score	41	168	4.1	5.39
Admissions in ER PRAM score	82	597	7.28	4.62

Table 8: ANOVA for discharged and admitted patients.

Source of variation	SS	df	MS	F	P-value	F crit
Between groups	276.91	1	276.91	56.78	9.80×10^{-12}	3.92
Within groups	590.16	121	4.88			

The initial PRAM scores (shown in the 3 age groups for convenience) in the discharged and the admitted patients are compared to understand if there are any meaningful inferences that can be made. The basic data set is shown below (Table 6):

The mean initial PRAM scores of discharged patients in all the 3 age groups varied between 3.5 and 5.4 and the average of the entire set of discharged patients (41 patients) is 4.1.

The mean initial scores of admitted patients in all the 3 age groups varied between 6.7 and 8 and the average PRAM score for admitted patients (82 patients) was 7.3.

We run a statistical test to understand whether the observed difference in the initial examination PRAM scores of discharged patients and patients who were admitted are significant. Assuming Null hypothesis that: Mean of discharged group = Mean of admitted group (Table 7 and 8).

P-value is very low (9.8×10^{-12}) which is lesser than 0.05 (the 5% significance level that we have chosen), which is interpreted to the null hypothesis that the Means of the two groups are equal has to be rejected.

The observed F value 24 is greater than F critical and hence again the null hypothesis is invalid. In summary, the null hypothesis that the Means of the two groups, admitted and discharged patients are the same is rejected and the observed difference in PRAM scores on initial examination is statistically meaningful. Thus, the PRAM score is a tool that can be used to assess severity of asthma.

Patient with severe persistent asthma had high initial PRAM scores compared to other group. Maximum number of patients were seen with PRAM score of 6 and 7 (19.2%) in our study.

Those patients that require lesser number of interventions and those that respond to the treatments administered (lower observed PRAM scores) on average are either

discharged or admitted to general ward. While those patients that fail to respond to the ER treatments (PRAM scores remain high and sticky) on average need higher

level of care and are admitted to the HDU/PICU (Table 9).

Table 9: PRAM scores for discharged and admitted patients.

Outcome	No. of patients	Mean initial score	Standard deviation	Standard error
Discharged	41	4.10	2.322	0.363
General ward	68	6.82	2.022	0.245
HDU	7	8.86	0.900	0.340
PICU	7	10.14	1.069	0.404

Table 10: ANOVA for discharged, general ward and PICU/HDU patients.

Groups	Count	Sum	Average	Variance
Discharged in ER PRAM score	41	168	4.10	5.39
Admissions in ER PRAM score	68	474	6.82	4.09
Admission HDU/PICU PRAM score	14	133	9.50	1.35

Table 11: ANOVA for discharged, general ward and PICU/HDU patients.

Source of variation	SS	df	MS	F	P-value	F crit
Between groups	360.08	2	180.04	42.61	0	3.07
Within groups	5026.99	120	4.22			
Total	867.07	122				

Table 12: Comparison of scores after initial bronchodilataion across different outcome groups.

Outcomes	Mean initial score	Standard deviation	P value between groups	Mean scores after treatment	Standard deviation	P values between groups
Discharged	4.09	5.3	0.000	1.5	2.7	0.000
Admitted patients	7.28	4.62		5.7	6.7	

This Table 9 shows that the initial scores varied with severity at presentation to the ER. Patients with severe exacerbation who did not improve with treatment needing PICU care had high score (10.14) when compared to discharged patients who had a less severe exacerbation which improved with treatment (mean score 4.1).

A statistical test to understand whether the observed difference in the initial examination PRAM scores of discharged patients and patients who were admitted are meaningful. The null hypothesis that: Mean of discharged group = Mean of General Ward group = Mean of HDU/PICU group (Table 10 and 11).

P-value is very low (1.04×10^{-14}) which is lesser than 0.05, hence null hypothesis is rejected. The observed F value 26 is greater than F critical and hence again the null hypothesis is invalid. Thus PRAM score is a tool that can be used to assess severity of asthma and we can safely conclude that the tool is effective to differentiate between cases that require a higher level of care as well. We can run the same test after the 1st intervention. Again the

results are similar (P value is 4.3×10^{-15}) and if any further utility can be ascribed, it is that the observed PRAM scores at this stage post the 1st intervention probably have a higher level of significance in discriminating patients that require a higher level of care (HDU/PICU).

This table (Table 12) shows the change in PRAM scores after initial nebulisation. 60% change in scores after initial nebulisation was seen in the discharged group when compared to the 22.3% in the admitted group. The mean scores after treatment in the discharged group was 1.5 when compared to 5.7 in the admitted group who continued to require further treatment.

DISCUSSION

Accurate assessment of the severity of asthma exacerbation is an important guide to initial treatment and to monitor the response to subsequent therapy. Pulmonary function tests can provide reliable and objective information on the severity of airways obstruction but require cooperation and may not be

feasible in young children. Pulmonary function test are difficult to perform at the primary care level. Paediatric asthma scores, consisting of a combination of clinical symptoms and signs, are frequently used to estimate the severity of acute airways obstruction.

Chalut DS et al, validated the PRAM score against respiratory resistance and concluded that this score can be discriminative and responsive to change.⁶ The performance characteristics of PRAM score in children with acute exacerbation of asthma was determined. Van der Windt et al, in a review of literature on clinical asthma scores found 16 different scores.⁷ He analyzed that majority of scores was improvised just on basis of experience in clinical practice. The real assessment of clinical scores should be done based on validity, responsiveness, reliability, item development, inter rater reliability. there is very less literature explaining the definitions and materials.

Kirschner and Guyatt and Guyatt et al, defined responsiveness as the ability to detect a clinically important change over time.^{8,9} Ducharme FM et al, introduced the preschool respiratory assessment measure (PRAM).⁴ The PRAM was developed by relating potentially relevant items, such as wheezing and retractions, to a measure of pulmonary function (respiratory resistance), in children aged 3- 6yrs.

Mean age of children included in our study was 4.079 ± 2.84 which was lower than other comparable studies. In the PRAM study by Ducharme et al, the mean age was 5.8, PASS study by Gorelick et al, mean age was 7.0 and 5.9 and in the MPIS study by Carroll et al, the mean age was 7.6.^{4,10,11}

Male children predominated in our study (58%) which was similar to the PASS study (60%) and the PRAM study (63%) whereas female children predominated in the MPIS study (60%).

Our study had maximum number of children with moderate persistent asthma (38%) which was comparable to the study by Scribano VP et al (51%).¹⁰ The PASS study had more number of children with mild intermittent asthma (66%).

Regarding Meter Dose Inhaler (MDI) use and its compliance, our study showed 62% of asthmatics using MDI with 54% having good compliance. This was similar to the PASS study which had 78% of children using MDI.³

In our study 33% of patients studied were discharged and 67% were admitted. Among the patients admitted, 80% were admitted in the general ward, 10% in HDU and another 10% in PICU. The greater percentage of admitted patients in our study reflects an increased severity of airway obstruction studied. This helps to study the ability of PRAM scores to assess the severity.

The distribution of patients in the ER of PASS study by Gorelick et al ¹⁰, 38% were discharged and 62% were admitted which was similar to our study. Validity of scores across all the age groups:

In our study the PRAM scores in the different outcome groups across the studied as groups was analysed using ANOVA and the p value was found to be statistically not significant implying that no difference in scores in the age groups was observed. The PRAM scores were found to be valid across all age groups (1-17 yrs). The PRAM study by Ducharme FM et al, found a strong association between scores and the admission rate in both preschool (2-6 yrs) and school age (7-17 yrs) children with r value of 0.37 in preschool and 0.43 in school age children.⁴

Predictive validity

In our study percentage of admitted patients with scores of 0-3, 4-7, 8-12 was 8.5%, 43.9%, 47.6% respectively implying that maximum number of admitted patients had score of 8-12. Similarly, the maximum percentage of discharged patients had scores of 0-3. This was statistically analysed using the Pearson Chi square test which showed a Pearson Chi square value of 33.13 with a p value <0.0001. The PRAM scores of different outcome groups were also analysed by ANOVA in our study and found to have significant p values showing the predictive validity of the score.

Predictive validity in the Ducharme et al study of PRAM score found a strong association between rate of admission and PRAM score ($r = 0.4$, $P < 0.0001$).⁴ The association was stronger with scores after initial bronchodilatation. Arnold DH et al, study showed statistical significant improvement in PRAM score after 1st (2.1 points; 95% CI -2.3, -1.9; $P < 0.0001$) and 2nd (-1.0 point; 95% CI -1.3, -0.7; $P < 0.0001$) nebulisation with bronchodilators.¹²

In our study discharged patients had a 60% change in scores after initial bronchodilatation in comparison to 22.3% in admitted patients. The change in scores was maximum in the discharged group reflecting the ability of the scores to respond to change (improvement). Our results were similar to the results of the PASS study where Gorelick et al, found a 51-79% change in scores in the discharged patients in comparison to 25-32% in the admitted patients.¹⁰

The Robidas et al, study found a 26.7% increase in PRAM scores and 26.9% increase in PASS scores after initial bronchodilatation.¹³ Our study showed similar results with a 29.8% increase in PRAM scores. The PRAM scores showed both discriminative and responsive properties.

Predictive validity for PICU admission: In our study a score of 8.5 and above had 100% sensitivity and 85% specificity for PICU admission. In the MPIS study by

Carroll CL et al, a score of 12 was identified as a cut off for PICU admission.¹¹

CONCLUSION

PRAM is a useful score for assessing the severity and response to treatment in children with severe airway obstruction. PRAM score is a simple, objective, easy to use score with many important and desirable properties like validity, responsiveness and discrimination that have not been previously validated in some of the asthma severity scores. PRAM scores were found to have good performance characteristics across all age groups. PRAM score of 6 predicted the need for hospitalization and score of 9 predicted the need for PICU care according to the results of our study.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

- Guglani L, Lodha R, Kabra SK. Epidemiology, Risk Factors and Natural History of Asthma. In Kabra SK, Lodha R, eds. Essential Pediatric Pulmonology. 1st ed. Delhi; Noble Vision; 2006:123-143.
- Ducharme FM, Davis GM. Measurement of respiratory resistance in the emergency department: feasibility in young children with acute asthma. Chest. 1997;111:1519-25.
- Gorelick MH, Stevens MW, Schultz T, Scribano PV. Difficulty in obtaining peak expiratory flow measurements in children with acute asthma. Pedia Emerg Care. 2004 Jan 1;20(1):22-6.
- Ducharme FM, Chalut D, Plotnick L, Savdie C, Kudirka D, Zhang X, et al. The Pediatric Respiratory Assessment Measure: a valid clinical score for assessing acute asthma severity from toddlers to teenagers. J Pediatr. 2008 Apr;152(4):476-80.
- Birken CS, Parkin PC, Macarthur C. Asthma severity scores for preschoolers displayed weakness in reliability, validity, and responsiveness. J Clin Epidemiol. 2004;57:1177-81.
- Chalut DS, Ducharme FM, Davis GM. The preschool respiratory assessment measure (PRAM): A responsive index of acute asthma severity. J Pediatrics. 2000;137:762-8.
- Van der Windt DA. Promises and pitfalls in the evaluation of paediatric Asthma scores. J Paediatrics 2000;1374:744-6.
- Kirshner B, Guyatt G. A methodological framework for assessing health indices. J Chronic Dis. 1985;38(1):27-36.
- Guyatt GH, Kirshner B, Jaeschke R. Measuring health status: what are the necessary measurement properties? J Clin Epidemiol. 1992;45(12):1341-5.
- Gorelick MH, Stevens MW, Schultz TR, Scribano PV. Performance of a novel clinical score, the Paediatric Asthma Severity Score (PASS) in the evaluation of acute asthma. Acad Emerg Med. 2004;11:10-8.
- Carroll CL, Sekaran AK, Lerer TJ, Schramm CM. A modified pulmonary index score with predictive value for pediatric asthma exacerbations. Ann Allergy Asthma Immunol. 2005 Mar;94(3):355-9.
- Arnold DH, Gebretsadik T, Hartert TV. Spirometry and PRAM severity score changes during pediatric acute asthma exacerbation treatment in a pediatric emergency department. J Asthma. 2013 Mar 1;50(2):204-8.
- Robidas, Gouin S, Gravel J, Guimont C, Chaput G, Chalut D, Amre D. Prospective evaluation of two clinical scores for acute asthma in children 18 months to 7 years of age. Acad Emerg Med. 2010;17(6):598-603.

Cite this article as: Prasanna R, Moidu F, Pasupathy S. Pediatric respiratory assessment measure score in assessing the severity of acute asthma in children. Int J Contemp Pediatr 2019;6:1211-7.