

**Original Research Article**

**Utility of Paediatric Respiratory Severity Score in Children Admitted with Respiratory Distress In Intensive Care Unit**

**Dr. Monika Kashyap<sup>1</sup>, Dr. Premila Waikhom<sup>2</sup>, Dr Anshita saboo<sup>3</sup>**

<sup>1</sup>Assistant Professor, Department of Pediatrics, Shri Guru Ram Rai Institute of Medical & Health Sciences (Sgrrimhs), Dehradun, Uttarakhand, India.

<sup>2</sup>Assistant Professor, Department of Pediatrics, Shri Guru Ram Rai Institute of Medical & Health Sciences (Sgrrimhs), Dehradun, Uttarakhand, India.

<sup>3</sup>Postgraduate Resident, Department of Pediatrics, Shri Guru Ram Rai Institute of Medical & Health Sciences (Sgrrimhs), Dehradun, Uttarakhand, India.

**Corresponding Author**

Dr. Monika Kashyap, Assistant Professor, Department of Pediatrics , Shri Guru Ram Rai Institute of Medical & Health Sciences (Sgrrimhs), Dehradun, Uttarakhand, India.

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**ABSTRACT**

**Background**

Acute respiratory infection is a common reason why children under the age of five get sick or die (ARIs). Lower respiratory tract infections (LRIs) are the main cause of death in children. The Pediatric Respiratory Severity Score (PRESS) for Respiratory Tract Infection is a novel and less complex bedside scoring method first development in Yokohama hospital. Hence the aim of the study was to determine the implication of PRESS score in evaluation of children admitted with respiratory distress in PICU.

**Objectives**

To evaluate PRESS as a severity assessment scoring for acute respiratory infections in pediatric patients.

**Methods**

This was a prospective observational study conducted in a tertiary health care center conducted for a duration of 2 year. All the children admitted with respiratory distress having any 2 features such as tachypnoea, use of accessory muscles, use of intercostal and subcostal muscles, grunting, cyanosis, feeding difficulties and wheeze admitted in were included in the study. PRESS scoring system measured five things: breathing rate, wheezing, use of accessory muscles, SpO<sub>2</sub>, and difficulty feeding. Each part was assigned 0 or 1 point, and the total score showed how mild, moderate, or severe the problem was.

**Results**

Total of 344 children were included. Disease was mild in 44 (12.7%), moderate in 188 (54.7%) and severe in 112 (32.5%). There is statistically significant differences present in pH & pCO<sub>2</sub> values in various PRESS scores, but there was no correlation with mechanical ventilation, oxygen supply and PICU stay.

**Conclusion**

Those with higher PRESS score had longer picu stay and need more oxygen therapy or have higher rate of mechanical ventilation. It is a very simple and easy tool to predict severity of acute respiratory infections and can be used as a guide for severity wise treatment of patients.

**Keywords:** PRESS, Respiratory tract infections, Pediatric respiratory severity scoring.

## **INTRODUCTION**

Acute respiratory infection is a common reason why children under the age of five get sick or die (ARIs). Lower respiratory tract infections (LRIs) are the main cause of death in children.<sup>1,2</sup> There were 10.8 million deaths every year. The World Health Organization (WHO) said that in 2005, 1.9 million children under the age of 5 died from acute respiratory infections (ARIs), and another 2 million died from pneumonia.<sup>3</sup> 36% of the WHO's total South East Asia burden comes from India., with an estimated 0.37 cases of clinical pneumonia per child per year.<sup>4</sup> According to the most recent estimate of deaths caused by Acute Lower Respiratory Infections in India (2014), pneumonia killed 369,000 people, which is 28% of all deaths. This makes pneumonia the single most important cause of death in this age group<sup>5</sup> with varying presentation of pediatric respiratory distress a simple and effective uniform approach is the need of the hour to identify the disease severity. There are at present many scoring systems but very few have been scientifically validated. Most of the scoring system are either hard to evaluate and interpret or are just to differentiate between upper and lower respiratory tract infection. Moreover the judgments essentially depend on each clinician's unique experience, which is neither uniform nor equal. To get a good idea of how serious a problem is, it can be very helpful to have a simple scoring system that anyone can use<sup>6-9</sup> to initiate prompt and effective care.

The Pediatric Respiratory Severity Score (PRESS) for Respiratory Tract Infections is a novel and less complex bedside scoring method published on July 10, 2015 by Pediatricians at the Yokohama hospital.<sup>10</sup> This scoring system split respiratory infections into three categories in terms of severity by assessing five factors: respiratory rate, wheezing, auxiliary muscle use, SpO<sub>2</sub>, and feeding difficulties. PRESS score is a simple and rapid process which categorize disease as mild (scoring 0 to 1), moderate (scoring 2 to 3) or severe and thereby helps in initiating prompt treatment. Since PRESS involves simple observations, it requires minimal resources and can be effectively used in peripheral health centers which lack in proper infrastructure. By categorizing the disease severity, sick patients can be promptly referred to higher centers and thereby preventing complications and loss of life.

## **MATERIAL AND METHODS**

This was a prospective observational study conducted in Shri Ruru Ram Rai institute of medical health and sciences (SGRRIMHS) which is a large tertiary health care center located in Dehradun which receives patients from all over the state. The study was conducted for a duration of 2 years from June 2021 to May 2023 in pediatric emergency department. All the children admitted with respiratory distress having any two features such as tachypnoea, use of accessory muscles, use of intercostal and subcostal muscles, grunting, cyanosis, feeding difficulties and wheeze admitted in hospital were included in the study. All children were initially managed in pediatric emergency department, after which a decision was made regarding transfer to ward or PICU as per severity of disease. Children with age <1 month and >18 years, children with known metabolic disorder or congenital heart disease were excluded from the study. Patients presenting to emergency with respiratory distress were enrolled in the study after obtaining informed consent. The goal of the study was made clear to the parents or

guardians before they let their child be examined. Goal was to categorize the severity of respiratory distress in children on the basis of PRESS score into mild, moderate and severe and to determine the association of severity of respiratory distress based on PRESS score with clinical parameters and blood gas parameters.

The study included 344 patients that satisfied with the inclusion criteria. At the time of presentation a brief history was taken and demographic data and immunization schedule was noted followed by immediate PRESS scoring even before initial management was done. Children were categorized into mild, moderate and severe respiratory distress as per PRESS scoring. PRESS was used to measure five things: breathing rate, wheezing, use of accessory muscles, SpO<sub>2</sub>, and difficulty feeding. Each part got 0 or 1 point, and the total score showed how mild, moderate, or severe the problem was. A second PRESS scoring was done 2 hours after initial management after which patients were transferred to ward or PICU as per severity of disease. ABG parameters were recorded at the time of admission and during the course of stay, data on clinical indicators, such as the duration of oxygen therapy, the duration of mechanical ventilation, the duration of stay in the intensive care unit, and the duration of stay in the hospital, were gathered at the time of discharge.

### **Statistical Analysis**

Data was entered into a Microsoft Excel data sheet, and analysis was performed using SPSS v23.

The types of data that were collected were shown using frequencies and proportions. The Chi-square test was employed to determine the significance of qualitative data. Continuous data were shown using the mean and standard deviation.

The paired t test was used to calculate the mean difference between two quantitative variables as a measure of significance. A p value of 0.05 was deemed to be statistically significant after adhering to all the guidelines for statistical testing (the likelihood that the result is true).

### **RESULTS**

A total of 344 patients were analyzed, with 40.1% of the study subjects being below the age of 1 year. There were 140 (40.7%) females and 204 (59.3%) males. Average age was 38.1±36.3 months. Pneumonia was the most common ailment followed by bronchiolitis and asthma. Tachypnea was seen in 300 (87.2%) cases, accessory muscle use was seen in 178 (51.7%), intercostal and subcostal muscle use was seen in 182 (52.9%), cyanosis was seen in 34 (9.9%), grunting was seen in 20 (5.8%), SpO<sub>2</sub><95% was seen in 282 (82%). Feeding difficulties were present in 250 (72.7%) and wheeze was seen in 98 (28.5%) cases. PRESS score was 1 in 44 (12.7%), 2 in 48 (14%), 3 in 140 (40.7%), 4 in 92 (26.7%) and 5 in 20 (5.8%). Disease was mild in 44 (12.7%), moderate in 228 (54.7%) and severe in 112 (32.5%).

Among discharge patients, 42 (22.6%) patients stayed for 1-5 days, 78 (41.9%) patients stayed for 6-10 days, 66 (35.5%) stayed for >10 days. About 124 (66.7%) stayed in ward for 1-5 days, 22 (23.7%) stayed for 6-10 days, 8 (4.3%) stayed for >10 days. Mechanical ventilation was not required in 132 (71%) patients. There is statistically significant difference present in mechanical ventilation, oxygenation, PICU stay and overall hospital stay when correlated with the PRESS score of discharge patients.

Duration of PICU stay was more in higher PRESS score. There is statistically significant difference present in duration of PICU stay in various Press score. There is statistically significant differences present in pH & pCO<sub>2</sub> values in various PRESS scores.

ABG parameters (pH and Pco2) were correlating with severity of PRESS score. Patients with moderate and severe PRESS score had primary respiratory acidosis (type 2 respiratory failure). Hence PRESS score is an excellent tool for predicting respiratory acidosis. The table 4 and 5 shows the predictors of the regression equation, reliability (r square) so the reliability is 26% and it is statistically significant.

Respiratory rate	Respiratory rate at rest, on room air*	0 or 1	
Wheezing	High pitch expiratory sound heard by auscultation	0 or 1	
Accessory muscle use	Any visible use of accessory muscles	0 or 1	
Spo2	Oxygen saturation <95% on room air	0 or 1	
Feeding difficulties	Refusing feedings	0 or 1	
Press score	Score 0-1 mild; 2-3 moderate; 4-5 severe	0-5	
Criteria of Tachypnea	Month	Respiratory rate	
	≤12	>60	1
	≤12, <36	>40	1
	≤36, <156	>30	1
	≥156	>20	1
<ul style="list-style-type: none"> <li>Respiratory rate evaluated according to American Heart Association guideline</li> </ul>			
<b>Table 1 Pediatric Respiratory Scoring System</b>			

Criteria for Tachypnea	
Age In Months	Respiratory Rate
0-2 Months	>60/Min
2 Months – 1 Year	>50/Min
1 -5 Years	>40/Min
>5 Years	>30 /Min

**Table 2: WHO guidelines were used to measure the rate of breathing**

Press Score	Frequency	Percent
Score 1	44	12.7
Score 2	48	14
Score 3	140	40.7
Score 4	92	26.7
Score 5	20	5.8

**Table 3: Distribution according to press score**

Parameter	Score 2		Score 3		Score 4		Score 5		F value	P value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
pH	7.4	0.1	7.3	0.2	7.2	0.2	7.2	0.1	14.368	<0.001**
pCO2	36.9	31.4	34.6	12.1	54.1	20.1	57.7	19.8	14.701	<0.001**
pO2	79.4	52.3	85.5	55.5	64.9	50.7	76.8	54.9	1.215	0.305 NS
HCO3-	19.2	4.1	19.7	6.8	22.4	6.6	21.8	7.2	2.586	0.055 NS
Lactate	2.1	2.0	1.6	4.4	2.7	2.3	3.4	3.2	2.644	0.051 NS
Base Excess	-0.2	7.9	0.0	9.9	2.5	9.9	0.4	14.3	.551	0.648 NS

**Table 4: Comparison of Blood gas Parameters with PRESS score**

\*\*-Highly significant (p<0.001), NS – Not significant (p>0.05)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. Change
1	.511 <sup>a</sup>	.261	.225	.4929	.261	7.236	6	123	.000

*Table 5: Regression equation for dependent variable (severity) using other independent variables Model Summary*

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	13.599	2.816		4.828	.000	8.024	19.174
PH	-1.661	.393	-.457	-4.223	.000	-2.439	-.882
pCO2	.002	.002	.099	1.009	.315	-.002	.007
pO2	.001	.001	.077	.980	.329	-.001	.003
HCO3-	.033	.009	.358	3.672	.000	.015	.051
Lactate	.021	.014	.130	1.570	.119	-.006	.048
Base Excess	-.004	.004	-.086	-1.046	.298	-.013	.004

*Table 6: Coefficients*

a Predictors: (Constant), Base Excess, pCO2, pO2, HCO3 Lactate, PH

**DISCUSSION**

There are several paediatric patients at community hospitals who have fever, coughing, and dyspnea. Childhood respiratory tract infections can quickly cause respiratory distress and, in rare cases, severe dyspnea that necessitates additional testing and hospitalisation. Some individuals need an urgent referral and prompt treatment for a condition called respiratory failure. In the current study, we assessed whether a straight forward grading system based on respiratory symptoms was useful at determining whether patients required additional testing or hospitalization. To prevent the situation from getting worse, such exams and therapy could be started right away with the help of an objective assessment of the respiratory symptoms right at the bedside. In the current study demographic data of the study subjects revealed that 138 (40.1%) children were <1 year age, with a strong male preponderance. Nayani K et al<sup>11</sup> found 69.6% males and 30.4% females in their study. The scientists explained that intrauterine hormonal regulation differ in both sexes causing male fetuses of the same gestational age to have greater alveoli and surface area but female lungs develop their surfactant synthesis earlier than males'.<sup>12</sup> causing increased airflow and lower resistance, which appears to prevent the early closure of female alveoli and narrow airways. In our study Disease was mild in 4 (1.2%), moderate in 228 (66.3%) and severe in 112 (32.5%).

Ashraf N, et al.<sup>13</sup> performed a similar study and found that 14.5% of the cases were mild, 45.3% were moderate, and 40.2% were severe. Studies by Feldman AS et al<sup>6</sup> also came to the same conclusions. The less number of mild cases are attributed to the fact that our pediatric residents are posted in various rural centers across the state and thereby using PRESS scoring, mild cases were not referred regularly. Children with a severe PRESS score went to the hospital more often than those with a mild PRESS score. In a study by Miyaji Y. et al,<sup>10</sup> the rate of hospitalization was much higher for moderate and severe cases than for mild cases (p0.001). In our study, there is a statistically significant difference present in duration of PICU stay in various Press score necessitating higher duration of stay in those with Press score 4-5.

It was observed that PICU admissions were more in cases of severe PRESS scores. Similar results were observed in study done by Thokngaen J et al.<sup>14</sup> The PICU admission as indicated by the higher PRESS scores suggests utility value in triaging the children in ER. Also, in the future, researchers could look at how well low PRESS predicts successful outpatient care and how well high PRESS predicts children who need early aggressive inpatient care. This study found that the hospitalized regular patients in the moderate and severe categories had a statistically significant sensitivity of 0.94 and specificity of 0.88. It was statistically significant that the ICU patients in the severe group had a sensitivity of 0.75 and a specificity of 0.66. This demonstrates a correlation between PRESS scores and the likelihood that a patient would be admitted to the ICU or a regular ward. Oxygen therapy and PRESS score have significant statistical correlation. With higher PRESS scores requirement of oxygen therapy and requirement of mechanical ventilation has statistically significant difference. Our findings were contrasting with Miyaji et al,<sup>10</sup> who reported that more oxygen therapy was required in severe cases compared to mild and moderate cases ( $3.7 \pm 1.8$  vs  $0.2 \pm 0.8$  vs  $1.5 \pm 1.8$ ).<sup>6</sup> This shows higher PRESS score denotes severe respiratory dysfunction thus requiring a prolonged respiratory support in the form of mechanical ventilation or oxygen therapy. In a study by Miyaji Y. et al,<sup>10</sup> the length of oxygen therapy for severe cases was much longer than that required for other cases ( $p < 0.001$ ). The PRESS score thus helps in predicting longer hospital stay, oxygen therapy and requirement of longer mechanical ventilation and can be conveyed to attendants. Similar results were obtained in a study by Thokngaen J. et al.<sup>14</sup> patients with severe asthma required nebulized bronchodilators and oxygen treatment for a longer period of time than those with mild or moderate asthma. As per overall final outcome, 93 (54.1%) got discharged, 38 (22.1%) expired, 32 (18.6%) went LAMA and 9 (5.3%) were referred. Similar results were reported by Miyaji et al<sup>10</sup> and Ashraf N et al.<sup>13</sup> On plotting a regression graph with dependent variable set as severity. There is statistically significant differences present in pH & pCO<sub>2</sub> values in various PRESS scores. ABG parameters (pH and Pco<sub>2</sub>) were correlating with severity of PRESS score. Patients with moderate and severe PRESS score had primary respiratory acidosis (type 2 respiratory failure). Hence PRESS score is an excellent tool for predicting respiratory acidosis.

Thus these clinical scoring system may be useful and applicable in hospital settings for triage and assessment of respiratory status by clinician at the initial examination.

## CONCLUSION

In the present study, we observed that PRESS score correlated well with various parameters on the arterial blood gas analysis. It correlated well with the duration of ICU and hospital stay, need for oxygen or mechanical ventilation. It is a very simple and easy tool to predict severity of acute respiratory infections and can be used as a guide for severity wise treatment of patients.

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