Original article

Pediatric respiratory severity score evaluates disease severity of respiratory tract infection in children

Janjira Thokngaen, Wissaroot Karoonboonyanan

Department of Pediatrics, Bhumibol Adulyadej Hospital.

Background: Acute respiratory infections (ARIs) are commonly found causes of morbidity and mortality in children aged below 5 years old. Pediatric respiratory severity (PRESS) score is a simple severity scoring system. Healthcare providers can apply it as a preliminary patient assessment for proper treatments.

Objective: To evaluate pediatric respiratory severity score as a severity assessment for pediatric patients with acute respiratory infections.

Methods: This is a prospective study from 1st September 2016 to 31st October 2017. The study group includes 120 patients aged 3 months to 14 years old. The use of PRESS score as an assessment tool has 5 parameters: respiratory rate, wheezing, accessory muscle use, peripheral oxygen saturation (SpO_2), and feeding difficulties, and can be classified into 3 groups: mild (score of 0 or 1), moderate (score of 2 or 3), and severe (score of 4 or 5). The primary outcomes are sensitivity, and specificity for hospitalization. The secondary outcomes are sensitivity, specificity of intensive care unit (ICU) admission, mean and standard deviation of the duration of oxygen therapy and nebulized bronchodilator.

Results: The admitted regular patients in moderate and severe group had a sensitivity of 0.94 and a specificity of 0.88, whilst the ICU patients in severe group had a sensitivity of 0.75 and a specificity of 0.66, longer duration for oxygen treatment, and longer duration for nebulized bronchodilator treatment, orderly, and statistically significantly. Furthermore, this system is more reliable than previous respiratory severity score.

Conclusions: PRESS score could predict condition severity and might guide a proper treatment of acute respiratory infection in children.

Keywords: Pediatric severity score, respiratory tract infection, PRESS score.

Acute respiratory infections (ARIs) in children are one of the most common cause of morbidity and mortality in children aged younger than 5 years old.[1, 2] Lower respiratory tract infections (LRIs) are the leading causes of death in children. The death toll reached 10.8 million casualties per year. There were 1.9 million deaths from ARIs and the World Health Organization (WHO) found approximately 2 million children under five died yearly from pneumonia in 2005.[3] In Thailand, the Pediatric Respiratory and Critical Care Medicine Society of Thailand (PRCS) published data which indicate that in 2013 the prevalence of pneumonia was about 45-50 percent of children under 5 years of age with acute respiratory tract infection.[4] Data from a weekly epidemiological surveillance report shows pneumonia in Thailand, published in 2012, during 2003 – 2010, the highest occurrence of pneumonia was in the age group between zero to four years old. In 2010, the age group 0 - 4 years old had the rate of 1,939.49 per 100,000 population.[5] From the pediatric patients record of Bhumibol Adulyadej Hospital, the Royal Thai Air Force, reveals the number of admitted pediatric patients with LRIs in the past 5 years reaches about 200 patients per year.

At multiple community hospitals, it is found that in addition to a doctor, there are operational nurses and trained public health center officers who can provide a basic medical treatment. Additionally, it is also found that some patients living in remote areas, and consequently having difficulties visiting any provincial hospital prefer to receive treatments at

community hospitals or public health centers nearest to their residences.

In community hospitals, there are many pediatric patients with fever, cough, and dyspnea, hence, several cases are found, e.g., some patients have a respiratory failure that requires an immediate treatments and even urgent transfer. Some are with moderate symptoms and not with severe dyspnea, and they require oxygen treatment, nebulization, and need an admission. Some with less severity can be treated with a nebulization and go home, etc. Therefore, these characteristics change their assessment. The assessments practically depend on the individual's experience, which is not standardized nor equal. If there is a simple assessment scoring system, that everyone can utilize, it can be of great used to properly evaluate the severity of the case.[6-9] The patients could be better treated promptly and more appropriately. As a result, it may reduce complications and ultimately the mortality rates.

The Department of Pediatrics, National Hospital of Yokohama, published a research article: Pediatric Respiratory Severity Score (PRESS) for Respiratory Tract Infections in Children in July 10, 2015, showing a new and more simple bedside scoring system.[10] It is for the assessment of a severity of pediatric patients with respiratory infections classified in to three groups: mild (0 - 1), moderate (2 - 3), severe (4 - 5) based on five parameters: respiratory rate, wheezing, accessory muscle use, SpO_2, and feeding difficulties (Table 1).

Based on the review, the PRESS score is easy and simple to assess a patient. As for each parameter has either a score of 0 or 1, where 1 is present, and 0 is otherwise. A summation of these parameters classifies the group of the patient as mild (with score 0 to 1), moderate (with score 2 to 3), and severe (with score 4 to 5). When the classification identifies a condition as severity, this consequently indicates a proper treatment with urgency. Thus, patients can be treated promptly and appropriately.

Methods

The objective of this study is to evaluate PRESS score as a severity assessment for pediatric patient with acute respiratory infections.

A research design follows the prospective study scheme. The duration of this research is from 1st September 2016 to 31st October 2017. The other details to be documented are location, population, criteria of this research. The location for the data is from pediatric outpatient and inpatient clinic, Bhumibol Adulyadej Hospital, the Royal Thai Air Force. The target population for the research is pediatric patient aged between 3 months to 14 years diagnosed with respiratory infections, that includes both outpatients and inpatients.

Table 1. PRESS scoring system.

Score component	Operational definition	Scoring
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
SpO_2	Oxygen saturation <95% on room air	0 or 1
Feeding difficulties	Refusing feedings	0 or 1
	Sum of five components	
PRESS 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

*Respiratory rate evaluated according to American Heart Association guideline.
PRESS: Pediatric Respiratory Severity score, SpO_2: Peripheral oxygen saturation.

A statistical analysis results from a data collection of 120 cases, with primary outcomes as sensitivity and specificity of hospitalization, and secondary outcomes as sensitivity and specificity of ICU (Intensive Care Unit) admission by the receiver operating characteristics (ROC) curve to analysis the area under the curve (AUC) of PRESS score, mean ± SD of duration of oxygen therapy and nebulized bronchodilator. The categorical data were assessed using Chi-square test. The continuous data was expressed as a mean ± standard deviation (SD) with 95% confidence interval (CI) where applicable, and the significant level was set as 0.05 on the SPSS statistical version 24.

Results

In this research, the population size is 120 patients, 61 females (50.8%), and 59 males (49.2%) (Table 2). Average age is 37.2 ± 35.9 months old (mean ± SD). There are 33 upper ARIs diagnosed patients, 27.5%, and another 87 patients, 72.5%, diagnosed as lower ARIs. There are 86 admitted patients (71.6%) those consist of 82 general pediatric admitted patients (68.3%), and 4 ICU admitted patients (3.3%). The rest are 34 non-admitted patients (28.3%). The result shows that 35 mild patients (29.2%), 43 moderate patients (35.8%), and 42 severe patients classified in accordance to PRESS scores severity levels (Figure 1).

Table 2. Characteristics of the patients.

Characteristics		All patients n = 120	%
Age (months)		37.2 ± 35.9	
Gender			
Male		61	50.8
Female		59	49.2
Acute respiratory tract infection			
Upper		33	27.5
Lower		87	72.5
Treatment			
- Hospitalization	General ward	82	68.3
	ICU admission	4	3.3
	Total	86	71.6
- No admission		34	28.3

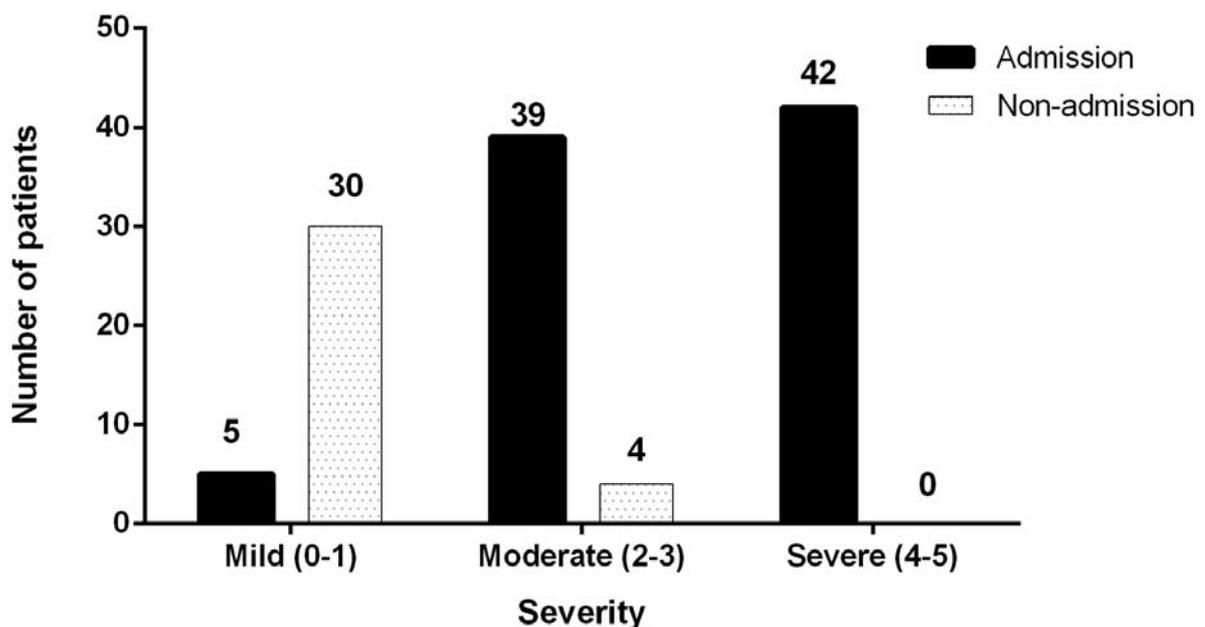ICU: intensive care unit

Figure 1. Numbers of admission classified according to their severity.

The statistic results of admitted patient treatment show the area under curve of admitted patient treatment is 0.97 (95%CI: 0.95 - 0.99) with a cutoff point of 1.5 (scores >1.5 predicting admission), giving a sensitivity of 0.94 and a specificity of 0.88 (Figure 2). As for ICU patients, the area under curve of this group is 0.81 (95%CI: 0.64 - 0.98) with a cutoff point of 2.5 (scores >2.5 predicting ICU admission), giving a sensitivity of 1.00 and a specificity of 0.46, and with a cutoff point of 3.5 (scores >3.5 predicting ICU admission), giving a sensitivity of 0.75 and a specificity of 0.66 (Figure 2).

The duration of oxygen therapy results classified from the severity are 0.23 ± 0.73 days (mean $\pm$ SD) for mild, 1.60 ± 1.69 days for moderate, and 3.00 ± 2.83 days for severe level. This shows a statistically significant difference (Figure 3). Moreover, the nebulized bronchodilator results also show significant differences between each group: 0.66 ± 1.63 days for mild, 3.79 ± 2.56 days for moderate, and 5.64 ± 3.16 days for severe group (Figure 4). Of note there is no mortality occurred from this research.
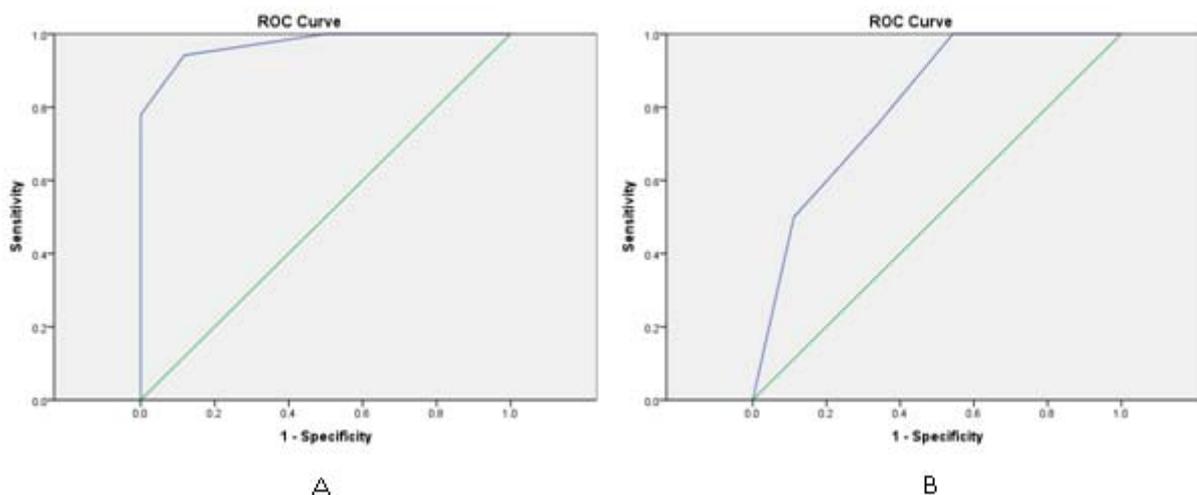

Figure 2. Receiver operating characteristic curve of hospitalization (A), and ICU admission (B).
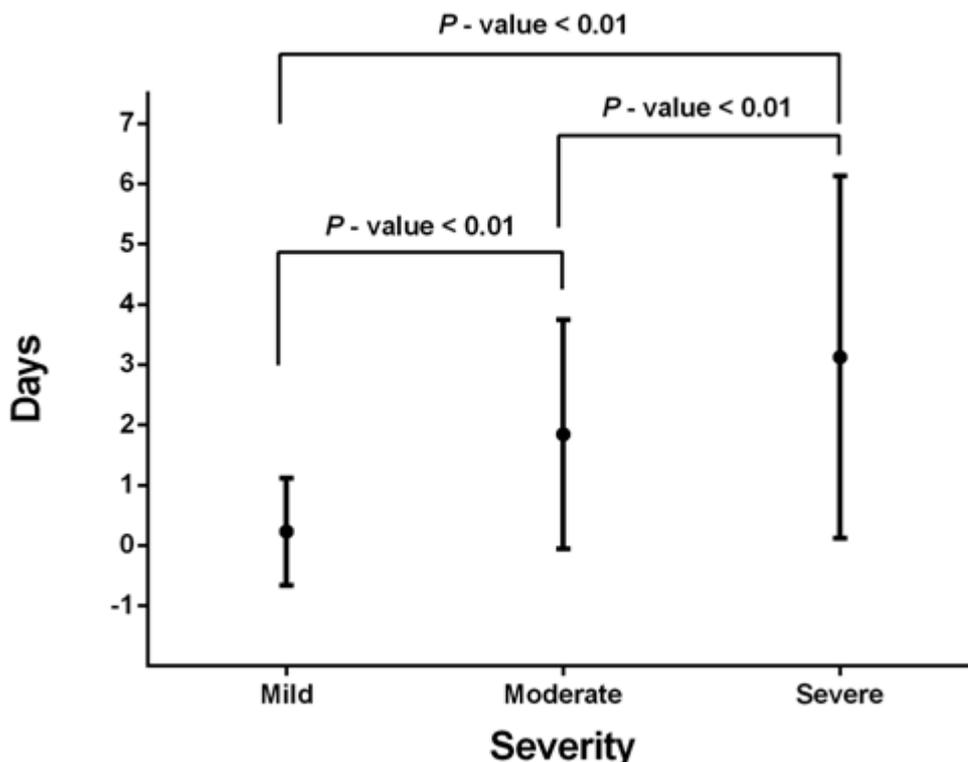

Figure 3. Duration of oxygen therapy results classified from the severity.
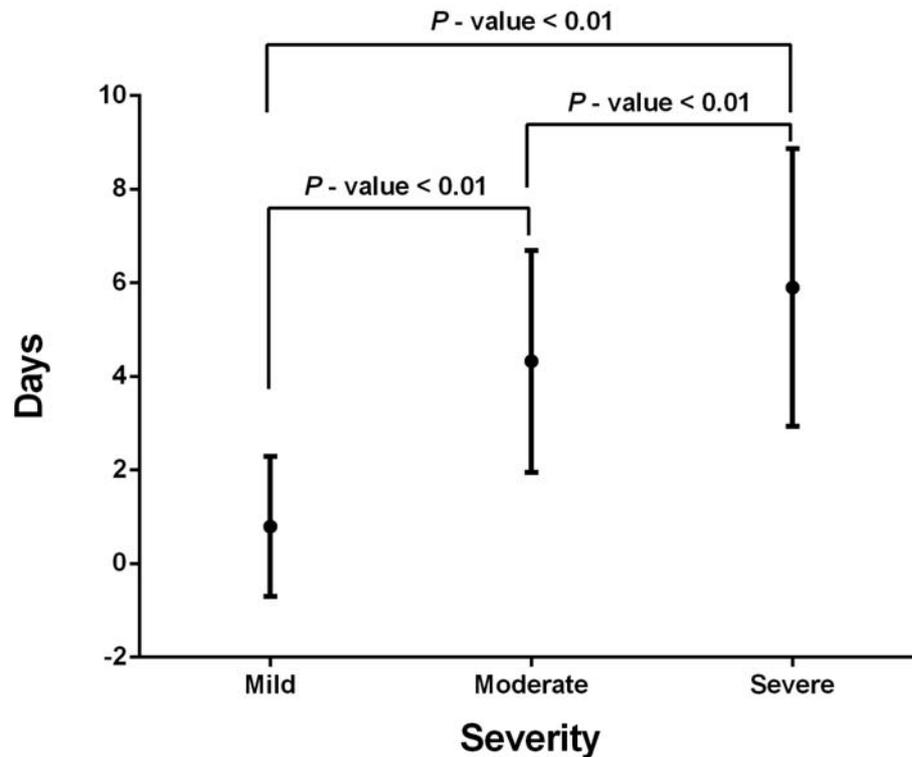
Figure 4. Duration of nebulized bronchodilator results classified from the severity.

Discussion

In community hospitals, there are several child patients with fever, cough, and dyspnea. Some patients have a respiratory failure condition that requires an immediate treatment, and an urgent referral. Some other patients may not be excessively tired, but still need to be treated with an oxygen therapy, a nebulized bronchodilator, and admission. As for those with less severe case, a simple nebulizer treatment without any admission is sufficient.

PRESS scores are a severity assessment to categorize patient with respiratory infections into 3 groups: mild (0 - 1), moderate (2 - 3), and severe (4 - 5) based on five parameters: respiratory rate, wheezing, accessory muscle use, SpO_2, and feeding difficulties.

According to this study, the admitted regular patients in moderate, and severe group results have a sensitivity of 0.94 and a specificity of 0.88, statistical significances, whilst the ICU patients in severe group result has a sensitivity of 0.75 and a specificity of 0.66, statistical significance. This shows a proportion between PRESS score and the predictability of admission of regular ward, and ICU. If the cutoff point is at >2.5, which includes both moderate (Score 3), and severe (Score 4 - 5) groups, the sensitivity and

the specificity become 1.00, and 0.46, respectively. It may yield an over treatment condition for ICU admission that covers all severe condition patients, which is suitable for a hospital with sufficient ICU capacity. However, if the cutoff point is at >3.5, which includes only a severe (Score 4 - 5) group, it yields 0.75 sensitivity, and 0.66 specificity. That exclude 25% of severe condition patient number. This is suitable for a hospital that has less ICU capacity.

Additionally, severe patients statistically significantly require a longer oxygen therapy, and a nebulized bronchodilator than the mild, and moderate, respectively. Similar to a PRESS score study of the Department of Pediatrics, National Hospital of Yokohama, which shows that the rates of hospitalization for moderate, and severe patient were higher than the mild cases, and the severe group required a longer duration of oxygen treatment than others. Furthermore, this system is more reliable than the respiratory distress assessment Instrument (RDAI), and the Children's Hospital of Wisconsin Respiratory Score (CHWAS). The area under the curve for the CHWRS was 0.68 with a cutoff point of 7.5 (scores >7.5 predicting admission), giving a sensitivity of 0.65 and a specificity of 0.65. The area under the curve for the RDAI was 0.51.[11]

As there is no guideline of treatment for participant doctors, it raises a concern about inconsistencies of receiving treatment among patients that could be effect on the following such as rate of general ward or PICU admission, time to start and finish oxygen therapy and nebulized bronchodilators. Hence this may reduce the result reliability. The recommendation outlook is to regulate a treatment guideline to improve result reliability.

Conclusion

In addition to its simplicity and ease of use, PRESS score can predict severity of acute respiratory infections and could guide a proper treatment for pediatric patients.

Conflict of interest

None of the authors has any potential conflict of interest to disclose.

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