

Predictive value of Respiratory Index of Severity in Children (RISC) in children with Lower Respiratory Tract Infections

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Abstract

Background: To assess the predictive value of Respiratory Index of Severity in Children (RISC) in children with Lower Respiratory Tract Infections (LRTI). **Method:** This retrospective study included a total of 154 children records aged 1-24 months hospitalized for LRTI. Severity of Pneumonia was assessed using Integrated Management of Neonatal and Childhood Illness (IMNCI) classification. Presenting signs, nutritional status (z-score for weight for age), ability to eat were noted and RISC score was calculated. All the children were followed up till their hospital stay through file records. The outcome was noted as discharge after recovery or death. RISC score >4 was considered as predictor of mortality. Patients leaving against medical advice were excluded from assessment. Chi-square test was used for comparison. Sensitivity, specificity, positive and negative predictive value were calculated. **Results:** Mean age of children was 15.41±7.80 months. Majority (65.6%) were males. As per IMNCI Classification, 35 (22.7%) had severe and 44 (28.7%) had very severe/severe pneumonia. A total of 14 (9.1%) patients had RISC score >4. There were 11 (6.5%) deaths. Both higher IMNCI class and RISC scores were significantly associated with mortality. IMNCI severe/very severe was 100% sensitive and 49.6% specific whereas RISC >4 was 90.9% sensitive and 97% specific in prediction of mortality. **Conclusion:** RISC score had high sensitivity and specificity in prediction of mortality among children hospitalized for LRTI.

Keywords: LRTI, Respiratory Index of Severity in Children (RISC), Pneumonia, Nutritional status.

Introduction

Worldwide nearly 150 million children every year acquire LRTIs and incidentally, 90% of these children come from developing world.^[1] Of these, nearly 12 million children suffer from severe episodes of LRTIs requiring hospital admission.^[2] In developing countries like ours, every child experiences an average of five episodes of respiratory tract infection during a year. Respiratory tract infections account for one-third to half of the pediatric outpatient visits and 20%-30% of the pediatric hospital admissions.^[3] In India, pneumonia, one of the most common LRTI has been shown to be responsible for nearly 369,000 deaths comprising 28% of all deaths in children under five years of age, thus making it to be the most dominant cause of death in this age group.^[4]

Assessment of severity of LRTI is a challenging task, especially in young children who are not able to describe the severity of the disease experienced by them. It is generally based on a skillful evaluation of various clinical, biochemical and radiological factors.^[5-8] The independent predictive value of each of these parameters has a limited value.^[9]

In view of the limited value of independent signs and symptoms, some scoring systems based on a mix of clinical and/or biochemical/radiological parameters have been proposed for assessment of severity and/or prognosis, viz., Respiratory severity score^[10], Pediatric Respiratory Severity Score (PRESS)^[11] and Respiratory Index of Severity in Children (RISC)^[12], having different claims regarding their clinical usefulness. RISC is a relatively newer risk prediction scoring system that employs oxygen saturation, clinical signs (chest indrawing, wheezing), feeding refusal and nutritional status (weight for age z-score) for assessment of respiratory illness severity. It has been developed in a South African population and since its development, has not been validated extensively in different populations. Hence, the present study was planned to validate the usefulness of RISC score in Indian population of LRTI patients aged 6 months-24 months in a retrospective database of a tertiary care centre in North India.

Materials and Methods

This retrospective study was carried out at Department of Pediatrics, Era's Lucknow Medical College and Hospital, Lucknow between January, 2020 to December, 2021 after getting approval from the Institutional Ethics Committee.

A total case files of 154 in ward admitted children aged 1 month to 24 months from clinical file records of two years (2018-2020) with a clinical diagnosis of LRTI were enrolled in the study after excluding the children with HIV, gross congenital anomalies or incomplete records. No prior approach for sample size estimation was done and all the cases fulfilling this eligibility criteria during the study were included in the assessment.

All the patients were thoroughly explored for presenting signs, viz., oxygen saturation, chest indrawing, wheezing, refusal to eat and weight for age z-scores. Based on these presenting clinical signs the severity assignment was done using RISC scores¹².

Oxygen saturation		Weight for age z-score
		$z \leq -3 = 2$ points
$\leq 90\%$	$> 90\%$	$-2 \leq z < -3 = 1$ point
Score 3		$z > -2 = 0$ points
	Chest indrawing (Score 2)	
	Wheezing (Score - 2)	
	Refusal to feed (Score 1)	
Total Maximum score = 6		

The severity assessment of pneumonia was done using Integrated Management of Neonatal and Childhood Illness (IMNCI) into the following three categories¹³:

Non-severe pneumonia

Severe Pneumonia

Very severe Pneumonia

The clinical course of disease was also accessed for clinical outcome in terms of discharge, left against medical advice (LAMA) and death.

Statistical Analysis

Data was analysed using IBM Inc. (USA) Statistical Package for Social Sciences (SPSS) version 21.0 software. Association of IMNCI category and RISC score with clinical outcome was assessed using Chi-square test. Prognostic efficacy of RISC and IMNCI category for outcome mortality was assessed at a predefined cut-off (>4) and its sensitivity, specificity, positive predictive value, negative predictive value and accuracy was assessed. The targeted 'p' value to interpret an association statistically significant was less than 0.05.

Results

Maximum patients ($n=74$; 48.1%) were aged >12 months. There were 16 (10.4%) patients aged <6 months and 64 (41.6%) aged 7-12 months. Mean age of patients was 15.41 ± 7.80 months (median age 12 months). There was a dominance of males ($n=101$; 65.6%). At presentation, 11 (7.1%) had oxygen saturation $<90\%$. Chest indrawing and wheezing was seen in 41 (26.6%) and 43 (27.9%) patients. A total of 72 (56.8%) refused to eat. Only 47 (30.5%) had weight for age in normal range whereas 64 (41.6%) had moderately and 43 (27.9%) were severely underweight. As per IMNCI classification, almost half ($n=75$; 48.7%) had non-severe pneumonia, 35 (22.7%) had severe pneumonia and 44 (28.6%) had very severe/severe pneumonia. Most of the patients ($n=133$; 86.3%) were discharged after recovery. A total of 10 (6.5%) left against medical advice (LAMA) and 11 (6.5%) died (Table 1).

Table No 1: Demographic profile according to age and sex (n=154)

SN	Characteristic	Number of patients	Percentage
1.	Age		
	≤ 6 months	16	10.4
	7-12 months	64	41.6
	>12 months	74	48.1
	Mean age \pm SD (Range) in months	15.41 ± 7.80 (1-24) [Median age = 12 months]	
2.	Sex		
	Male	101	65.6
	Female	53	34.4
3.	Presenting Signs (RISC Components)		
	Oxygen saturation $<90\%$	11	7.1
	Chest indrawing	41	26.6

	Wheezing	43	27.9
	Refusal to eat	72	56.8
	Weight for age z-score		
	Severe	43	27.9
	Moderate	64	41.6
	Normal	47	30.5
4.	Severity of Pneumonia (IMNCI Class)		
	Non-severe/No	75	48.7
	Severe/Pneumonia	35	22.7
	Very severe/Severe	44	28.6
5.	Outcome		
	Discharge	133	86.3
	LAMA	10	6.5
	Expiry	11	6.5

The RISC scores were found to be 0, 1, 2, 3, 4 and 5 in 30 (19.5%), 50 (32.5%), 34 (22.1%), 24 (17.5%), 11 (7.1%) and 5 (3.2%) cases (Fig. 1).

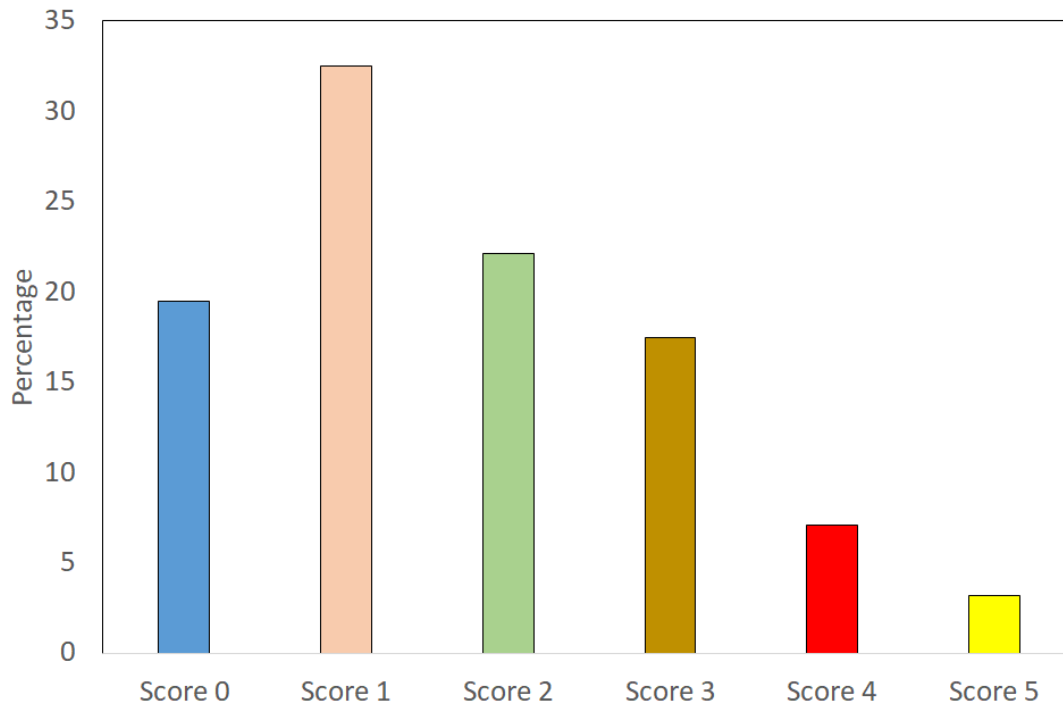


Figure 1: Distribution of cases according to RISC Scores (n=154)

A statistically significant association of IMNCI category and RISC scores was seen with in-hospital mortality ($p < 0.05$) (Table 2).

Table No. 2 Association of Hematological, Radiological and RISC scores with outcome Expiry (n=144)

SN	Variable	Expiry (n=11)	Discharged after recovery (n=133)	Statistical significance
1.	IMNCI Category			
	Non-severe	0	66 (49.6%)	$\chi^2=11.151$;

	Severe Pneumonia	6 (54.5%)	28 (21.1%)	p=0.004
	Very severe pneumonia	5 (45.5%)	39 (29.3%)	
2.	RISC Score			
	0	0	29 (21.8%)	$\chi^2=90.785$; p < 0.001
	1	0	47 (35.3%)	
	2	0	32 (24.1%)	
	3	1 (9.1%)	21 (15.8%)	
	4	6 (54.5%)	3 (2.3%)	
	5	4 (36.4%)	1 (0.8%)	

IMNCI severe/very severe category was 100% sensitive and 49.6% specific in prediction of in-hospital mortality. However, its positive predictive value was only 14.1% whereas its negative predictive value was 100%. IMNCI was 53.5% accurate in prediction of in-hospital mortality. On the other hand,

RISC score >4 was found to be 90.9% sensitive and 97% specific in prediction of in-hospital mortality. It had positive and negative predictive values of 71.4% and 99.2%. RISC score >4 was 96.5% accurate in prediction of in-hospital mortality (Table 3).

Table 3: Prognostic efficacy of IMNCI Pneumonia severity and RISC score for outcome

		Expired		Alive		Total			
IMNCI Severity									
Severe/Very Severe		11		67		78			
Non-severe		0		66		66			
		11		133		144			
Sensitivity		Specificity		PPV		NPV		Accuracy	
100		49.6		14.1		100		53.5	
RISC Score									
≥4		10		4		14			
<4		1		129		130			
		11		133		144			
Sensitivity		Specificity		PPV		NPV		Accuracy	
90.9		97.0		71.4		99.2		96.5	

Discussion

In the present study, in-hospital mortality rate among children hospitalized for LRTI was recorded as 6.5%.

We also found that though both IMNCI severity as well as RISC scores were significantly associated with in-hospital

mortality yet RISC score had a better sensitivity and specificity combination (90.9% and 97%) as compared to IMNCI category (100% and 49.6%).

As far as in-hospital mortality rates are concerned, compared to the present study, Chhina et al.^[14] in their study on 100 LRTI cases reported only 1 mortality. In the study by Kumar et al.^[15], the reported mortality rate was 3%. Both these studies had much lower mortality rate than in the present study. Some other studies reported mortality rate below 3%.^[5,12,16] On the other hand, Mirkarimi et al.^[17] however, reported mortality rate of 11.6% which is higher than the present study. In another study from India, mortality rate was reported to be as high as 29%¹⁸. The differences in mortality in different studies may be owing to differences in criteria of hospitalization and severity of disease. In the present study majority of children had severe/very severe pneumonia (50.4%) but a substantial number of patients had non-severe pneumonia thus the mortality rates were in between the two extremes of very low mortality.^[5,12,14-16] and those reporting very high mortality.^[17,18]

There are some other severity assessment criteria that are more objective and use a scoring system to determine the severity of LRTI. These include CURB-65, Respiratory Severity Score, Pediatric Respiratory Severity Score and Modified TAL score.^[11,19-21] However, there is an ongoing urge to have more simple to calculate and accurate scoring systems that could help in severity

assessment of LRTI. RISC score is a simple scoring system based on clinical parameters like oxygen saturation, chest indrawing, wheezing, refusal to eat and z-scores of weight for age as the components in non-HIV children.

In the present study, RISC score showed high predictive value for prediction of mortality. It had a higher discriminant value as compared to IMNCI classification. As far as low discriminant value of IMNCI classification is concerned, it may be owing to its diagnostic rather than prognostic nature. It is primarily a guideline for identification of “danger signs” for children at risk of severe illness requiring

hospitalization.^[22] Incidentally, in our study, a large proportion of children with IMNCI non-severe category required hospitalization. IMNCI thus is a more sensitive but not a highly specific predictor of mortality. On the other hand, RISC has been reported to be a good predictor of severity as well as LRTI related mortality in hospitalized children. In the validation study of RISC, a score >3 showed a high prognostic value for poor outcomes, especially mortality.^[12] Abdallah Abd El Megied et al.^[23] too in their study found RISC score to be 85.7% sensitive and 89.5% specific in prediction of mortality in children hospitalized for community

acquired pneumonia. The findings of the present study endorse the

value of RISC as a sensitive as well as specific predictor of in-hospital mortality in children hospitalized for LRTI. Verma et al.^[18] in their study reported the sensitivity and specificity of RISC score at a cut-off >3 as 85.9% and 77.7% respectively. Although, workers like Tewary et al.^[16] and Kumar et al.^[24] could not evaluate the efficacy of RISC scores for prediction of mortality as they had mortality rate <1%, however, they also found it to be highly sensitive and specific for prediction of prolonged duration of hospital stay and other poor outcomes like ventilation need. In effect, RISC scores, employing simple clinical features show the potential of prediction of clinical course and adverse outcomes effectively. Unfortunately, despite its development around one decade back, RISC score still remains to be one of the less frequently used predictive scores clinically, further studies to potentiate its clinical value are recommended in order to assess its applicability in different populations and environments.

Conclusions

RISC is a highly sensitive and specific scoring system for prediction of mortality in children hospitalized for LRTI.

Conflict of Interest

The authors declare no conflict of interest.

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