

## Original Research Article

# Assessment of severity of illness on admission using SICK score and evaluation of the risk factors associated with mortality in children admitted in a paediatric urban tertiary care centre in south India

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### ABSTRACT

**Background:** “Signs of inflammation that can kill” (SICK) score is one of the severities scoring systems used for predicting outcome of children at admission. The aim of the present study was to study the clinical and demographic profile of children admitted to Paediatric ward, to assess the usefulness of SICK score in predicting the mortality and evaluate the risk factors in predicting mortality.

**Methods:** SICK scoring was done for 369 children on admission. The outcome was recorded as death or discharge. The associated factors were analysed using SPSS software package analysis. Receiver operating curve was used to arrive at the cut-off point of SICK score for predicting mortality. Quantitative data differences between children who died and children who were discharged from the hospital were analysed using student independent t test. Need for assisted ventilation, presence of shock, age less than 3 years, and SICK score >2 were studied to find their association with mortality. Statistical analysis was done using univariate analysis and those factors that were significantly associated with mortality were subjected multivariate logistic regression analysis.

**Results:** The performance of SICK score was “excellent” in discriminating between death and survival with area under the receiver operating characteristics curve 0.94. Age <3-year presence of shock, need for mechanical ventilation and SICK score >2 showed statistically significant association with mortality as evidenced by multivariate logistic regression model.

**Conclusions:** SICK score performed extremely well in predicting mortality on admission. Age <3 years, SICK score >2, Presence of Shock and need for assisted ventilation showed statistically significant association with mortality.

**Keywords:** SICK score, Mortality, Early intervention, Mechanical ventilation, Shock

### INTRODUCTION

Early identification and proper triage of patients, judicious allocation of resources and personnel, appropriate stratification based on severity of illness is essential for effective management of critical illness which determines the mortality rate in an apex institution.

There are several scoring systems used in PICUs that aim to predict morbidity and mortality. Improvement of care

for critically ill patients is a goal for all countries. Knowledge of the effect of risk factors that may complicate the course of critical illness and the exact causes of death is of paramount importance in determining outcome in a critically ill child. This would not only improve prognostic evaluation of patients, but also indicates what therapy and research should focus on to improve the short term and long-term outcomes of those patients.<sup>1</sup>

Since the mortality is highest in the first 24 hours, assessment of severity of illness on admission and early intervention within the golden hour can bring about a dramatic reduction in mortality. Therefore, the need for a clinical scoring system for predicting mortality on admission is a real necessity. The SICK score is a validated clinical scoring system that can predict mortality on admission.

The main aim of this study is to analyse the clinical and demographic profile of children admitted to paediatric tertiary care centre, assess the usefulness of SICK score in predicting mortality and evaluate the risk factors in predicting mortality.

## METHODS

This study is a hospital based prospective study conducted in The Institute of Child Health and Hospital for Children (ICH&HC), Chennai, Tamil Nadu which is tertiary care centre for children for a duration of one year in the year 2007.

### Methodology

Children who fulfilled the inclusion and exclusion criteria were enrolled in the study. A total of 369 children were studied. The assessment using SICK score was done on arrival prior to initiation of treatment for children admitted through the emergency room and paediatric ward. The data was collected in a predesigned proforma.

**Table 1: Scoring of abnormal clinical variables.**

Variable	Abnormal range
Temperature	>38°C
	<36°C
Heart rate	Infant >160 per minute
	Child >150 per minute
Respiratory rate	Infant >60 per minute
	Child >50 per minute
Systolic blood pressure	Infant <65 mm Hg
	Child <75 mmHg
Spo2	90%
Capillary refill time	≥ 3 seconds
A Alert	Anyone except A
V Responds to voice	
P Responds to pain	
U Unresponsive	

Physical variables of temperature, heart rate, respiratory rate, capillary refill time (CRT), oxygen saturation (pulse oximetry) and sensorium (Using AVPU scale) were recorded at the time of admission as per the SICK scoring system (Table 1).

Normal values were assigned a score of 0 and abnormal values assigned a score of 1. The children were followed up every day till discharge or death. The hospital

discharge status (death/survival) was the primary outcome variable.

### Inclusion criteria

We have included all children aged 1 month to 12 years

### Exclusion criteria

We have excluded all children who 1) below the age of one month, 2) patients leaving the hospital against medical advice 3) patients admitted in the surgical side and 4) patients dying in the emergency room

### Statistical analysis

We used SPSS software package for statistical analysis. Quantitative data differences between children who died and children who were discharged from the hospital were analysed using student independent t-test. Receiver operating curve was used to arrive at the cut-off point of SICK score for predicting mortality. Need for assisted ventilation, presence of Shock, age less than 3 years and SICK score >2 were studied to find out their association with mortality. Statistical analysis was done using both univariate and multivariate analysis. Factors that seemed to significantly contribute to mortality after univariate analysis were further analysed using logistic regression multivariate model.

## RESULTS

Children between the ages 1 month to 12 years were included in the study. The average age of the children in the study is 39.7±4.01 months and the average age of the children who died is 20 months as against 40 months who were discharged. (Figure 1) Based on this, age <3 years was further analysed to find its association with mortality. Age less than 3 years showed statistically significant association with mortality, Mean difference with 95% confidence interval=20.89 (4-37), (P=0.01) (Table 2).

**Table 2: Age and mortality.**

Status	N	Mean	SD	t-test
Age in Months	Death	24	20.3	25
	Discharged	345	41.1	40.682
				t=3.76
				P=0.01

### Sex distribution

In this study of 369 children, 225 were males and 144 were females. Sex of the children did not show any statistical significance with mortality (Figure 2).

### Sick score vs mortality

Out of 369 children studied 24 died. The mortality in the study is 6.5%. Mortality risk was found to be increasing

with increase in the SICK score. There was no death in patients with 0 score. The mortality increased with increase in the SICK score. (Figure 3). Mortality

increased with increase in the number of abnormal variables. The linear trend of increase in mortality with increasing score was significant( $p=0.001$ ).

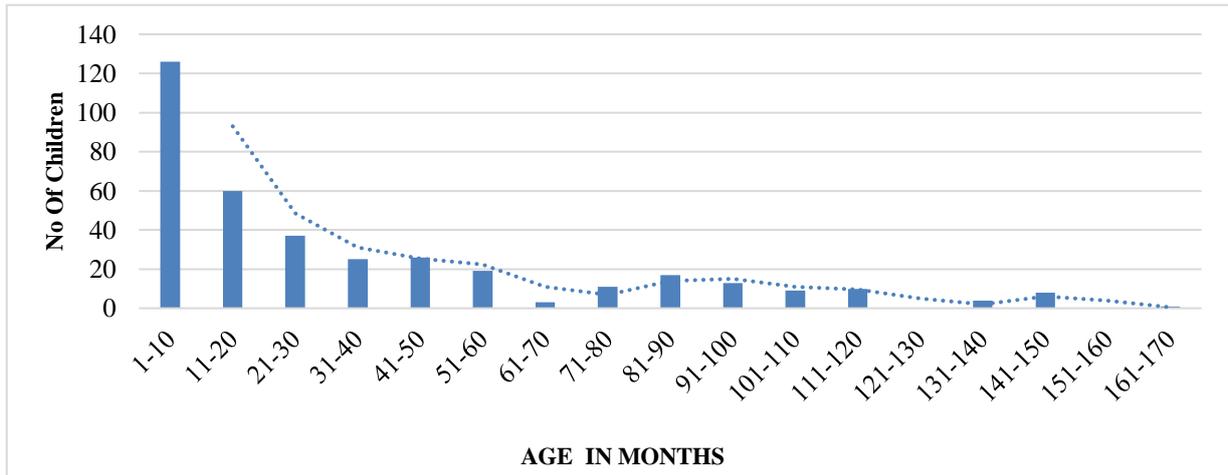


Figure 1: Age distribution.

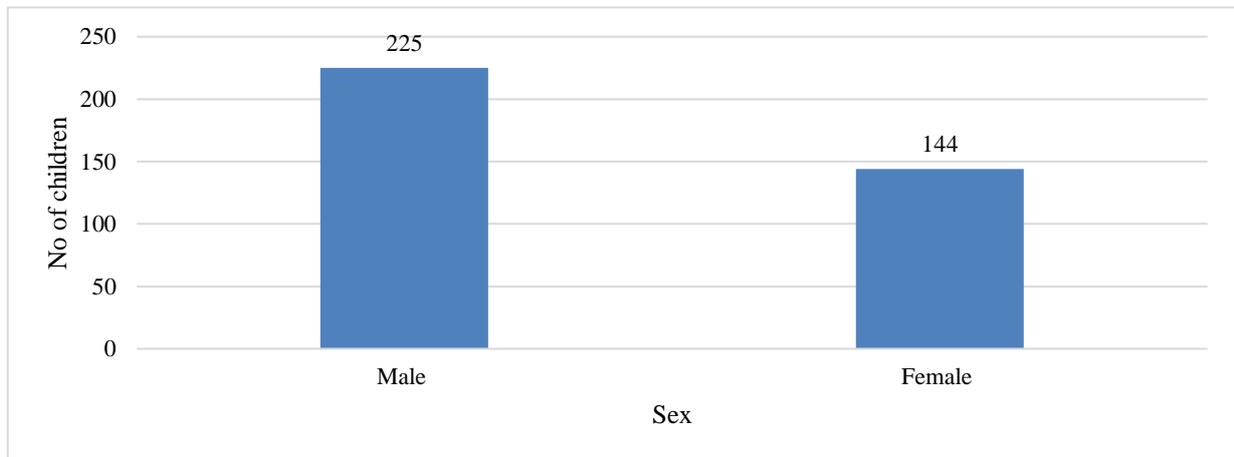


Figure 2: Sex distribution.

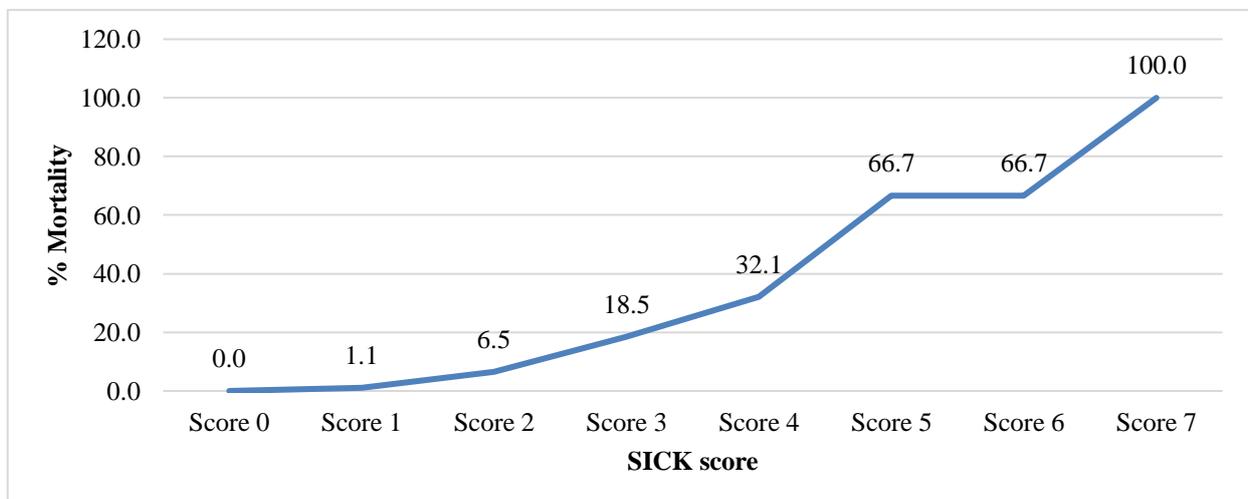
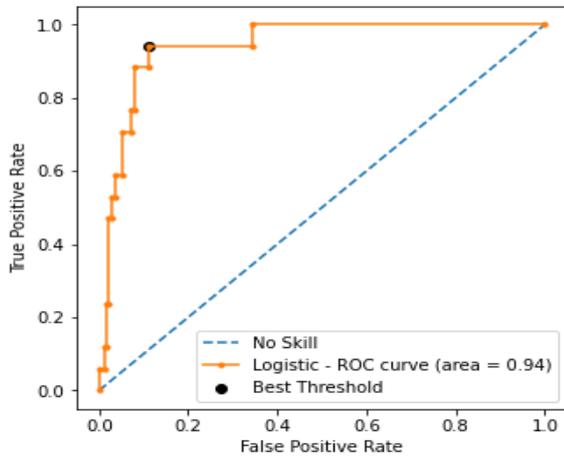


Figure 3: Sick score vs mortality.

**Receiver operating curve**

In our study, the area under the ROC curve is 0.94, that is the scores based on regression could predict mortality in 94% subjects correctly. Further a score of 2.5 showed maximum discrimination with a sensitivity of 87.5% and specificity of 87.2%. The SICK score is considered to be “excellent” at predicting mortality based on the area under the curve (Figure 4).



**Figure 4: Receiver operating curve (ROC curve).**

**Clinical diagnosis and mortality**

Respiratory diseases were the major cause of admission followed by neurological conditions. Mortality was highest in patients presenting with sepsis followed by cardiac ailments. Diabetes, Addison’s disease, drug reactions and anaphylaxis were included in others category (Table 3).

**Table 3: Clinical diagnosis and mortality.**

System	Discharged	Died	Total
Cardiac (C)	37	8	44
Gastrointestinal (G)	20	0	20
Haematologic (H)	11	0	11
Infectious (I)	53	0	53
Neurological (N)	66	4	70
Others (O)	14	0	14
Poisoning/ accidents (P)	12	1	13
Respiratory (R)	96	1	97
Sepsis (S)	7	9	16
Renal (U)	29	1	30
<b>Total</b>	<b>345</b>	<b>24</b>	<b>369</b>

**Presence of shock and mortality**

Out of the 369 children 73 children presented with shock. Presence of shock was significantly associated with mortality (Table 4).

**Table 4: Presence of shock and mortality.**

	Discharged		Mortality	
	N	%	N	%
<b>Presence of shock (P value 0.001)</b>	51	69.86	22	30.14

**Need for assisted ventilation and mortality**

In this study, 18 children required assisted ventilation which is a risk factor for poor outcome.

The statistical analysis showed clearly that there was a significant correlation with need for assisted ventilation and mortality (Table 5).

**Table 5: Need for assisted ventilation and mortality.**

	Discharged		Mortality	
	N	%	N	%
<b>Assisted ventilation (P value 0.001)</b>	4	22	14	78

**Children with SICK score ≤2 and those with score >2**

Based on experience with the previous studies, cut-off for the SICK score which delineates the higher mortality risk from the lower mortality risk was calculated as 2 and analysis was done for those who had score more than 2 and those who had 2 and below, which showed a p value of 0.001 which was statistically significant.

Those who have a score of less than 2 had a mortality risk of 0.98% and those who crossed it had 32.3% mortality risk (Table 6).

**Table 6: SICK score >2 and mortality.**

Sick score	Status			
	Discharged		Death	
	N	%	N	%
≤2	301	99.02	3	0.98
>2	44	67.70	21	32.30

$\chi^2=86.39$  P=0.001 OR95% CI;48(13–211)

Risk factors that were found to contribute significantly to mortality by univariate analysis were further analysed using logistic regression multivariate model. Age <3 years, presence of shock, need for assisted ventilation and children with SICK score >2 showed statistical significance with mortality.

**Univariate analysis**

Age less than 3 years, presence of shock, need for assisted ventilation and SICK score >2 was subjected to univariate analysis. All had a significant p value.

Need for assisted ventilation had the highest odds ratio than the other two. Patients who needed assisted ventilation had 119 times higher mortality risk than children who did not need it.

Children who presented with shock had 63 times higher mortality risk than children who did not present with shock.

Children with SICK score >2 had 48 times higher mortality risk than children who had a SICK score ≤2. The mortality risk was 6 times higher in children less than 3 years of age (Table 7).

**Table 7: Univariate analysis.**

	Odds ratio	95% CI	P value
Age <3 years	6.4	1.5-40	0.005
Shock present	63	14-403	0.001
Assisted ventilation	119	29-535	0.001
SICK score >2	48	13-211	0.001

### Multivariate analysis

Risk factors that were found to contribute significantly to mortality by univariate analysis were further analysed using logistic regression multivariate model.

Age <3 years, presence of shock, need for assisted ventilation and children with SICK score >2 showed statistical significance with mortality (Table 8).

The multivariate analysis revealed that the mortality risk was 6 times higher in children less than 3 years of age, 25 times higher in children with shock, 20 times higher in children requiring assisted ventilation and 20 times higher in children with a SICK score >2.

Though all the above factors had significant association with mortality, the association of SICK score >2 and need for assisted ventilation and mortality was statistically more significant as they had a narrow 95% confidence interval.

**Table 8: Multiple logistic regression analysis.**

	Odds ratio	95% CI	P value
Age <3 years	6.987	1.123-43.468	0.03
Shock present	25.021	5.155-121.451	0.001
Assisted ventilation	20.563	5.382-78.560	0.001
SICK score >2	20.79	5.25-82.35	0.001

## DISCUSSION

Scoring systems that can be applied at primary level will help in early identification of critical illness so that

prompt intervention can reduce mortality. The data required for calculating SICK score is simple, easily applicable, on-invasive scoring system devoid of laboratory investigations which is similar to the observation by Tibby et al and also the SICK score is done on admission which is similar to PIM2 score which is done within 1 hour of PICU admission, resulting in early identification of severity of illness for necessary intervention.<sup>2,3</sup>

The mortality increased with increase in the SICK score and with increase in the number of abnormal variables in our study. This is similar to the observation by studies by Costa et al using Paediatric risk of mortality score and Martha et al based on the comparison of PRISM and PIM score, supporting the conclusion that higher score is correlated with increased rate of death.<sup>4,5</sup>

With SICK score <1 mortality was 0%, which gradually increased to 100% with a SICK score less than or equal to 7 which is similar to the observation by Kumar et al.<sup>6</sup>

In this study, that the discrimination power of SICK score between death and survival was good with the area under the ROC curve was 0.94. further a SICK score of 2.5% showed maximum discrimination with a sensitivity of 87.5% and specificity of 87.2%. this is similar to the observation by Kumar et al and Gupta et al.<sup>6,7</sup>

Regarding the admission diagnosis, respiratory problems were the highest which is similar to the study by Typpo et al found that the most frequent causes of admission respiratory causes.<sup>8</sup>

In our study out of the 369 children 73 children presented with shock and the presence of Shock was significantly associated with mortality similar to the observation by Jayanthi et al.<sup>9</sup>

A critically ill child means a child who is in a clinical state that may result in respiratory or cardiac arrest or severe neurological complications that may be primary cardiovascular or respiratory or secondary to neurologic, infectious, or metabolic disorder or serious injury. Infection is the most common, and septic shock is a catastrophic immune system reaction that produces organ failure.<sup>1</sup>

The Children who had a critical illness diagnosis had an increased risk of mortality than those who had not. This difference could be because patient with critical illness have a low reserve of physiological function. this finding was consistent with other studies.<sup>10,11</sup>

Children who had respiratory failure, who were mechanically ventilated had increased mortality than those who were not mechanically ventilated. this finding is similar to the observation from other studies.<sup>12-14</sup> Age less than 3 years, presence of shock, need for assisted ventilation and SICK score >2 was subjected to univariate

analysis. All had a significant p value. Need for assisted ventilation had the highest odds ratio than the other two.

Risk factors that were found to contribute significantly to mortality by univariate analysis were further analysed using logistic regression multivariate model. Age<3 years, presence of shock, need for assisted ventilation and children with SICK score>2 showed statistical significance with mortality

The multivariate analysis revealed that the mortality risk was 6 times higher in children less than 3 years of age, 25 times higher in children with shock, 20 times higher in children requiring assisted ventilation and 20 times higher in children with a SICK score>2. Though all the above factors had significant association with mortality, the association of SICK score>2 and need for assisted ventilation and mortality was statistically more significant as they had a narrow 95% confidence interval.

## CONCLUSION

SICK score performed extremely well in predicting mortality on admission in a tertiary Paediatric care centre in Chennai. Predicting mortality on admission paves way for intervention in the Golden hour thereby can drastically reduce mortality. Age<3 years, SICK score>2, presence of shock and need for assisted ventilation showed statistically significant association with mortality.

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