

# Toward developing a scoring system for dengue fever in children



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## ABSTRACT

**Background:** Dengue is a rapidly increasing global public health problem especially in tropical countries. Dengue is a benign and self-limiting febrile illness in the majority of children but in some children, it can progress to severe dengue (SD) resulting in shock, hemorrhage, and death. **Aims and Objectives:** The aims of this study were to develop a scoring system to predict dengue infection severity. **Materials and Methods:** This prospective and observational study was conducted on all children admitted with dengue fever at a tertiary teaching institute in India. Daily scoring was done for pulse rate, respiratory rate, blood pressure, hematocrit, platelet count (scores 1–3), and systemic complications (0 if absent, 3 if present). Then, highest score recorded during the hospitalization period was taken for statistical analysis. **Results:** A total of 194 cases were classified into probable dengue (PD) 134 (69.1%), dengue with warning signs (DWS) 41 (21.1%), and SD 19 (9.8%) as per the WHO 2009 classification. Mean age of presentation was 11.5 years. The most common presenting symptoms were fever (97.9%), vomiting (73.1%) and signs noticed were flushing (63.4%), hepatomegaly (34.5%), and periorbital puffiness (27.3%). Among 134 children with PD, 116 (86.5%) had dengue severity score 5–6, with only 18 (13.5%) had score 7–13, whereas all 60 (100%) children with DWS and SD had score 7–13, none of them had score <7. Hence, a severity score of >7 identified all children with DWS and SD with overestimation in 13.5% children with PD. **Conclusion:** Daily dengue severity score of >7 indicates the high probability of DWS and SD. However, this scoring system should be validated by similar studies in different settings before we can apply in routine clinical practice.

**Key words:** Dengue fever; Severe dengue; Dengue severity score

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## INTRODUCTION

Dengue fever is the most prevalent human arboviral infection and a major public health concern in tropical and subtropical countries with epidemic outbreaks.<sup>1,2</sup> An estimated 50 million dengue infections occur worldwide annually with 500,000 people requiring hospitalization. Very large proportions (approximately 90%) of them are children aged <5 years.<sup>3</sup> The south-east Asia region is one of the regions at highest risk of dengue fever/dengue hemorrhagic fever accounting for 52% of global risk.<sup>4</sup> Dengue has a wide spectrum of clinical presentations, often with unpredictable clinical evolution and outcome.

While most patients recover following a self-limiting non-severe clinical course, a small proportion progress to severe disease, mostly characterized by profound shock, severe hemorrhage, multi-organ dysfunction, and death. Early detection and appropriate treatment of children progressing from non-severe to severe disease is essential to reduce the mortality. Correct prognostication may avoid such severe complications. Without proper treatment, the case fatality rate in severe dengue (SD) is more than 20% and with timely intervention, it can be reduced to <1%.<sup>3</sup>

The scoring systems, such as the pediatric logistic organ dysfunction score and the disseminated intravascular

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coagulation score, were used to forecast mortality in DSS. Most of the prediction systems in the past focused on clinical outcomes of the disease. There are few studies that focused directly on dengue infection severity.<sup>5,6</sup> The aim of the present study was to develop a simple clinical risk scoring system to predict dengue infection severity, based on patient clinical parameters, and routine laboratory investigations.

### Aims and objectives

The aims of this study were to develop a scoring system to predict dengue infection severity.

## MATERIALS AND METHODS

This observational study was conducted on children admitted to pediatric ward and PICU at ESIC Medical College and Postgraduate Institute of Medical Sciences and Research, Bengaluru, India, from September 2018 to August 2019. All children, aged 1 month–18 years, admitted with clinical features/laboratory parameters suggestive of dengue fever as per the WHO criteria were included in the study. Children with comorbidities such as cerebral palsy, chronic kidney disease, coinfections such as enteric fever, and malaria were excluded from the study. The study was approved by the Institutional Ethical Committee and written consent was taken from all the parents before enrolment. A thorough history was obtained and a general and systemic examination done. Relevant investigations such as CBC, LFT, PT, INR, APTT, RFT, serum electrolytes, and dengue serology were done for all cases and ultrasound chest and abdomen and chest X-ray were done wherever indicated. Then, scoring was done daily (as per scoring chart Table 1) for pulse rate, respiratory rate, blood pressure, hematocrit, and platelet count (scores 1–3). Systemic complications such as CNS, respiratory, hepatic, cardiac, and renal were scored (0 if absent, 3 if present). The highest score recorded during the hospitalization period was taken for statistical analysis.

### Sample size

The sample size for the present study of diagnostic accuracy has been calculated by considering at least 60% diagnostic accuracy of the proposed procedure. The sample size has been calculated to be 210 cases with 0.05 as marginal error at 5% level of significance assuming two-tailed hypotheses. Hence, we have decided to enroll 200 suspected cases.

### Statistical analysis

Data were analyzed using appropriate descriptive and inferential statistics. The categorical type of data was expressed in terms of frequencies and percentages, whereas

**Table 1: Severity scoring system for dengue fever**

Score	1	2	3
Platelet count	>1,00,000	10,000–1,00,000	<10,000
Blood pressure	>5 <sup>th</sup> centile	≤5 <sup>th</sup> centile	
Pulse rate	Normal	Tachycardia <sup>a</sup>	
Respiratory rate	Normal	Tachypnea <sup>b</sup>	
Hematocrit	<40	≥40	
Systemic complications			For each system involvement <sup>c</sup>

<sup>a</sup>1–12 months>160/min, 1–3 years>150/min, 4–6 years>120/min, 7–12 years>110/min, >12 years>100/min (PALS), <sup>b</sup>1–12 months>50/min, 1–5 years>40/min, >5 years>20/min (WHO), <sup>c</sup>CNS-encephalitis, RS-Acute Respiratory Distress Syndrome, CVS-Echo evidence of myocardial dysfunction, Hepatic-AST/ALT>1000 IU, and Renal-AKI

the numeric continuous data as mean±SD. Relative risk was calculated to find out the association of severity score with dengue severity. For all statistical evaluation, P<0.05 was considered as statistically significant.

## RESULTS

The total number of cases were 194, out of which 134 (69.07%) were probable dengue (PD), 41 (21.13%) were dengue with warning signs (DWS), and 19 (9.79%) SD as per the WHO 2009 classification. There were 116 (59.8%) males and 78 (40.2%) females in present study. The majority of the cases 101 (52.1%) were in the age group of 11–18 years followed by 53 (27.3%) cases in the age group of 6–10 years (Table 2).

The mean age of presentation was 11.5 years. The most common presenting symptoms were fever (97.9%), vomiting (73.1%), myalgia (60.3%), and pain abdomen (56.1%). Melena was seen in 9.2%, epistaxis in 6.1%, and hematemesis in 3.6% cases (Table 3).

The most common signs noticed were flushing (63.4%), followed by hepatomegaly (34.5%), periorbital puffiness (27.3%), ptechieae (15.9%), abdominal distension (8.2%), and hypotension (3.1%) (Table 4).

Mean hematocrit was 36.3% in children with PD and 45.2% in children with SD. Leucopenia (Total count <4000/mm<sup>3</sup>) was observed in 46 (34.3%) cases of PD and 14 (73.6%) cases of SD. Mean platelet count was 87,000/mm<sup>3</sup> in PD and 22,000/mm<sup>3</sup> in SD. All children with SD had platelet count <50,000/mm<sup>3</sup>, whereas 45% children with PD had platelet count >1,00,000/mm<sup>3</sup>. Significant elevated AST levels (mean 425.6 U) and ALT levels (mean 268.5 U) were observed in children with SD (Table 5).

**Table 2: Age distribution of cases**

Age group	Probable dengue	Dengue with warning signs	Severe dengue	Total (%)
1 month–5 years	M-16 F-17	M-2 F-1	M-2 F-2	40 (20.6)
6–10 years	M-24 F-14	M-3 F-6	M-3 F-3	53 (27.3)
11–18 years	M-36 F-27	M-22 F-7	M-8 F-1	101 (52.1)

**Table 3: Distribution of symptoms among study group**

Symptoms	PD	DWS	SD
Fever (n, %)	132 (98.5)	39 (95.1)	19 (100)
Myalgia (n, %)	70 (52.2)	32 (78)	15 (78.9)
Pain abdomen (n, %)	65 (48.5)	30 (73.1)	14 (73.6)
Vomiting (n, %)	95 (70.9)	31 (75.6)	16 (82.4)
Epistaxis (n, %)	3 (2.2)	4 (9.7)	5 (26.3)
Hematemesis (n, %)	1 (0.7)	2 (4.8)	4 (21)
Melena (n, %)	3 (2.2)	7 (17)	8 (42.1)
Oliguria (n, %)	2 (1.5)	2 (4.8)	2 (10.5)

PD: Probable dengue, DWS: Dengue with warning signs, SD: Severe dengue

**Table 4: Distribution of signs among study group**

Signs	PD	DWS	SD
Fever (n, %)	58 (43.2)	27 (65.8)	12 (63.1)
Tachycardia (n, %)	20 (14.9)	24 (58.5)	17 (89.4)
Tachypnea (n, %)	0	0	12 (63.1)
Hypotension (n, %)	0	0	6 (31.5)
Periorbital Puffiness (n, %)	5 (3.7)	30 (73.1)	18 (94.7)
Flushing (n, %)	71 (52.9)	34 (82.9)	18 (94.7)
Petechiae (n, %)	7 (5.2)	15 (36.5)	9 (47.3)
Abdominal distension (n, %)	0	6 (14.6)	10 (52.6)
Hepatomegaly (n, %)	22 (16.4)	28 (68.2)	17 (89.4)

PD: Probable dengue, DWS: Dengue with warning signs, SD: Severe dengue

**Table 5: Investigations in our study group**

Investigation	PD	DWS	SD
Hemoglobin (g/dL)	12.43	14.87	15.35
Hematocrit (%)	36.33	43.38	45.25
White cell count (/mL)	5415.58	4001.27	3485.78
Neutrophils (%)	41.11	38.85	40.94
Lymphocytes (%)	44.16	45.97	43.31
Platelets(/microL)	0.87	0.31	0.22
NS1 (n, %)	88 (65.6)	28 (68.3)	14 (73.6)
IgM (n, %)	21 (15.6)	11 (26.8)	7 (36.8)
IgG (n, %)	5 (3.7)	10 (24.4)	6 (31.5)
AST	42.6	161.4	425.6
ALT	29.6	107.2	268.5
PT	12.2	13.3	14.3
INR	1.10	1.19	1.32
APTT	29.0	34.6	44.0

PD: Probable dengue, DWS: Dengue with warning signs, SD: Severe dengue

Among 134 children with PD, 116 (86.5%) had dengue severity score 5–6, with only 18 (13.5%) had score 7–13, whereas all 60 (100%) children with DWS and SD had score 7–13, none of them had score <7 (Table 6).

Relative risk calculated was 3.44 (2.3–5.0) and  $P < 0.001$  which was statistically significant. Hence, severity score

**Table 6: Severity score levels**

Score range	Probable dengue (n=134) (%)	DWS+severe dengue (n=60) (%)
5–6	116 (86.5)	0
7–13	18 (13.5)	60 (100)

DWS: Dengue with warning signs

of >7 identified all children with SD and DWS with overestimation of 13.5% in children with PD.

## DISCUSSION

Dengue is a rapidly increasing global disease with significant burden in India. It is characterized by unpredictable clinical evolution and outcome. In our study, 21.1% children had DWS and 9.8% children had SD. This is in contrast to a study done by Sahana and Sujata<sup>7</sup>, where 27.2% had DWS and 24.7% had SD. This variation may be attributed to timing of admission and awareness of draining community. In the present study, most of the children were in the age group of 11–18 years (52.1%) which is similar to studies done by Kumar et al.,<sup>8</sup> and Selvan et al.,<sup>9</sup> The median age of presentation was 11.5 years. This may be due to outdoor activities of these children, where chances of getting bitten with mosquitoes are more. In this study, male to female ratio was 1.5:1, which was similar to the study by Rathod et al.<sup>10</sup> In our study, fever was the most common symptom followed by vomiting, generalized myalgia, and pain abdomen. Similar observations were made by Ahmed et al.<sup>11</sup> In the present study, flushing (63.4%) was noticed more commonly followed by hepatomegaly (34.5%), periorbital puffiness (27.3%), and petechiae (15.9%), whereas Rahod et al., observed rash (50%) as a most common sign, followed by hepatomegaly (43%) and petechiae (37%).

Leucopenia was observed in 44.8% cases similar to Jain<sup>12</sup> who noticed leukopenia in 44% cases. Among Liver enzymes, AST was elevated (>2 times) in 29.8% cases, ALT in 24.7% cases whereas Kumar et al.,<sup>8</sup> observed elevated AST in 32.4%, and ALT in 22.1% children. In this study, we observed that liver enzymes were elevated in most SD cases (89.4%). In our study, none of the children with severity score 5–6 had SD or DWS, whereas all children with SD and DWS had score >7 and only 13.5% children with PD had score >7. In a study by Pongpan et al.,<sup>6</sup> severity score classified patients into 3 severity levels: Dengue fever

(score <2.5), dengue hemorrhagic fever (score 2.5–11.5), and dengue shock syndrome (score >11.5). This variation in score is due to difference in the parameters used in the scoring system.

### Limitations of the study

Our study had limited number of patients and needs to be investigated in a larger patient cohort.

## CONCLUSION

Daily dengue severity score of >7 indicates the high probability of DWS and SD. This simple scoring system helps clinician to triage children for hospital admission and monitoring at appropriate time to reduce mortality. However, this scoring system needs to be validated by similar studies in different settings before we can apply in routine clinical practice.

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### Authors' Contributions:

**HS-** Data collection, Interpreted the results, reviewed the literature and manuscript preparation; **B-** Interpreted the results and revision of manuscript; **SR-** Concept and design of the study; **PK-** Concept, coordination, statistical analysis and interpretation and revision of the manuscript.

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