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Original Research Article

Validation of a Bedside Dengue Severity Score for Prediction of Severe Dengue in Paediatric Patients: A Cross-Sectional Study

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Abstract

Background: Dengue fever is a major mosquito-borne viral infection affecting children in tropical countries such as India. Early identification of severe dengue is essential to prevent complications and improve outcomes. The Bedside Dengue Severity Score (BDSS) is a simple clinical tool developed to predict disease severity using easily observable bedside parameters.

Objective: The present study aimed to validate the Bedside Dengue Severity Score in paediatric dengue patients and compare its diagnostic performance with WHO-2022 and NVBDCP-2023 dengue severity classifications.

Methods: A hospital-based cross-sectional study was conducted in the Inpatient Department of Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, over a period of one year. A total of 80 children aged 1–18 years with laboratory-confirmed dengue infection were included. Among them, 30 patients were classified as severe dengue and 50 as non-severe dengue according to WHO-2022/NVBDCP-2023 criteria. Clinical features, laboratory parameters, hemodynamic variables, BDSS score, and outcomes were recorded and analyzed. The diagnostic performance of BDSS was evaluated using sensitivity, specificity, positive predictive value, negative predictive value, and accuracy.

Results: Severe dengue patients showed significantly lower platelet counts (31.4 ± 11.88 vs 106.2 ± 49.7 $\times 10^3/\mu L$) and higher hematocrit levels (46.8 ± 4.1% vs 38.4 ± 3.6%) compared to non-severe cases. Clinical warning signs, third-space fluid loss, and hemodynamic instability were significantly more common among severe dengue patients. Higher BDSS scores were strongly associated with severe dengue ($p = 0.001$). BDSS demonstrated a sensitivity of 47.37%, specificity of 98.36%, positive predictive value of 90.00%, negative predictive value of 85.71%, and overall diagnostic accuracy of 86.25%.

Conclusion: The Bedside Dengue Severity Score is a simple and reliable clinical tool for early identification of severe dengue in paediatric patients and may assist clinicians in rapid risk stratification, particularly in resource-limited settings.

Keywords: Dengue fever; Bedside Dengue Severity Score (BDSS); Paediatric dengue; Severe dengue; Risk stratification.

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Introduction

Dengue fever is one of the most common mosquito-borne viral infections affecting children in tropical and subtropical regions, including India. The disease burden has increased substantially over the past decade due to rapid urbanization, climate change, population mobility, and the circulation of multiple dengue virus serotypes [1,2]. Paediatric populations are particularly vulnerable, as dengue infection in children often presents with non-specific symptoms initially and may rapidly progress to severe disease with plasma leakage, bleeding manifestations, and organ dysfunction [3]. Early recognition of severe dengue remains a major clinical challenge. Although the World Health

Organization (WHO) 2022 classification and the National Vector Borne Disease Control Programme (NVBDCP) 2023 guidelines provide comprehensive frameworks for dengue severity assessment, these approaches often depend on clinical monitoring and laboratory investigations. In many high-burden or resource-limited settings, especially during seasonal outbreaks, such facilities may not be readily available at the time of initial assessment [4]. Several scoring systems have been developed to predict dengue severity; however, most rely heavily on laboratory parameters such as platelet count, hematocrit, and liver enzymes [5,6]. This dependence may delay timely triage and escalation of care. Consequently, there is a growing emphasis on bedside, clinically driven tools that can be applied rapidly using easily observable clinical signs.

The Bedside Dengue Severity Score (BDSS) was developed to address this gap by incorporating three simple and pathophysiologically relevant clinical parameters: narrow pulse pressure, mucosal bleeding, and evidence of third-space fluid loss, which can be assessed at the bedside without laboratory support [7]. Validation of such a tool in paediatric populations is essential before widespread clinical adoption.

The present study was therefore undertaken to validate the BDSS in paediatric dengue patients admitted to a tertiary care hospital and to assess its concordance with established WHO-2022 and NVBDCP-2023 severity classifications.

By doing so, this study aims to contribute evidence toward a practical, rapid, and reliable bedside approach for early risk stratification and improved clinical outcomes in children with dengue infection.

Materials and Methods

Study Design and Setting: The present study was conducted in the Inpatient Department of Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India. It was designed as a hospital-based cross-sectional study and was carried out over a period of one year after obtaining approval from the Institutional Ethics Committee. The study aimed to evaluate the diagnostic performance of the Bedside Dengue Severity Score (BDSS) for predicting severe dengue in paediatric patients and to compare its performance with the World Health Organization (WHO) 2022 classification and the National Vector Borne Disease Control Programme (NVBDCP) 2023 guidelines.

Study Population: All children aged 1–18 years admitted to the paediatric ward with laboratory-confirmed dengue infection during the study period were considered for inclusion. Confirmation of dengue infection was based on either NS1 antigen positivity or dengue IgM serology.

Sample Size: A total of 80 paediatric dengue patients were included in the study. Among them, 30 patients were classified as having severe dengue and 50 patients as non-severe dengue according to WHO 2022/NVBDCP 2023 classification criteria.

Inclusion Criteria

Children were included in the study if they fulfilled the following criteria:

- Age between 1 and 18 years
- Laboratory-confirmed dengue infection (NS1 antigen or dengue IgM positive)
- Admission to the paediatric inpatient department during the study period
- Availability of complete clinical and laboratory data

Exclusion Criteria

Children were excluded from the study if they had:

- Fever for more than two weeks
- Any known chronic systemic illness
- Known bleeding or coagulation disorders
- Received blood component transfusion from outside during the course of illness
- Incomplete clinical records

Data Collection

Detailed clinical history and examination findings were recorded at the time of admission. Data collected included demographic details, presenting symptoms, vital parameters, warning signs, and evidence of bleeding or plasma leakage. Laboratory investigations such as complete blood count, hematocrit levels, liver function tests, and other relevant parameters were documented from hospital records.

Bedside Dengue Severity Score (BDSS): The Bedside Dengue Severity Score (BDSS) was calculated for each patient based on three clinically observable parameters:

- Narrow pulse pressure
- Presence of mucosal bleeding
- Evidence of third-space fluid loss

Each parameter contributed to the BDSS score, which was then categorized into severity bands.

Table 1: BDSS Severity Bands and Corresponding WHO Classification

Band	BDSS Score Range	Corresponding WHO-2022 Classification	Operational Clinical Indicators
1	0–1	Mild dengue (without warning signs)	Fever with symptoms such as myalgia, headache, nausea; no warning signs or organ involvement
2	2–3	Moderate dengue (with warning signs)	Recurrent vomiting, lethargy, abdominal tenderness, hepatomegaly, rising hematocrit with falling platelets, early fluid accumulation
3	4–5	Moderate–high risk dengue	Increasing risk of plasma leakage or bleeding requiring close monitoring and early intervention
4	>5	Severe dengue	Shock with narrow pulse pressure, respiratory distress, severe bleeding, organ dysfunction, or AST/ALT >1000 IU/L

Outcome Measures: The primary objective of the study was to evaluate the diagnostic performance of BDSS in identifying severe dengue among paediatric patients. The BDSS classification was compared with WHO 2022/NVBDCP 2023 severity classifications to assess concordance and predictive accuracy.

Statistical Analysis: All data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), while categorical variables were expressed as frequencies and percentages. The diagnostic performance of BDSS for predicting severe dengue was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. The association between BDSS categories and WHO severity classification was assessed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Results

A total of 80 paediatric patients with laboratory-confirmed dengue infection were included in the study. Among them, 30 patients (37.5%) were classified as severe dengue and 50 patients (62.5%) as non-severe dengue according to WHO 2022/NVBDCP 2023 classification. The clinical, laboratory, vital parameters, BDSS score distribution, and outcomes were compared between the two groups.

Clinical, Laboratory, and Vital Parameters: Patients with severe dengue showed significantly worse clinical and laboratory parameters compared to those with non-severe dengue.

The mean platelet count in the severe dengue group was 31.4 ± 11.88 $\times 10^3/\mu L$ compared to 106.2 ± 49.7 $\times 10^3/\mu L$ in the non-severe group (p = 0.001). Hematocrit levels were significantly higher in severe dengue patients (46.8 ± 4.1%) than in non-severe dengue patients (38.4 ± 3.6%) (p = 0.008), indicating significant plasma leakage.

The duration of hospital stay was also longer in severe dengue cases, with a mean stay of 6.4 ± 1.3 days compared to 3.2 ± 1.1 days in non-severe cases (p = 0.001). Severe dengue patients also had significantly lower systolic and diastolic blood pressure values, reflecting hemodynamic compromise.

Liver enzyme levels were significantly elevated in severe dengue patients. The mean AST level was 134.5 ± 15.4 U/L in the severe dengue group compared to 84.2 ± 11.6 U/L in the non-severe group (p = 0.005), while the mean ALT level was 117.3 ± 12.6 U/L compared to 78.5 ± 9.4 U/L (p = 0.007).

Clinical indicators of plasma leakage and bleeding were significantly more common among severe dengue patients. Third-space fluid loss was observed in 93.3% of severe dengue patients compared to 36.0% of non-severe dengue patients (p = 0.002). Narrow pulse pressure and mucosal bleeding were observed only in the severe dengue group.

Table 1: Clinical, Laboratory, Vital, Score, and Outcome Characteristics by Dengue Severity (n = 80)

Parameter	Severe Dengue (n = 30)	Non-Severe Dengue (n = 50)	p-value
Platelet count ($\times 10^3/\mu L$), mean ± SD	31.4 ± 11.88	106.2 ± 49.7	0.001
Hematocrit (%), mean ± SD	46.8 ± 4.1	38.4 ± 3.6	0.008
Hospital stay (days), mean ± SD	6.4 ± 1.3	3.2 ± 1.1	0.001
Systolic BP (mmHg), mean ± SD	86.2 ± 9.8	100.3 ± 8.5	0.004
Diastolic BP (mmHg), mean ± SD	66.5 ± 7.4	71.8 ± 6.6	0.009
AST (U/L), mean ± SD	134.5 ± 15.4	84.2 ± 11.6	0.005
ALT (U/L), mean ± SD	117.3 ± 12.6	78.5 ± 9.4	0.007

Third-space fluid loss, n (%)	28 (93.3%)	18 (36.0%)	0.002
Hematocrit rise >20% with minor bleed	12 (40.0%)	3 (6.0%)	0.001
Narrow pulse pressure	18 (60.0%)	0 (0.0%)	0.006
Mucosal bleeding	14 (46.7%)	0 (0.0%)	0.021
Severe bleeding	19 (63.3%)	0 (0.0%)	0.022

Neurological Manifestations: Neurological complications were observed predominantly in patients with severe dengue.

Impaired consciousness was observed in 16.7% of severe dengue patients, while none of the non-severe patients exhibited this feature (p = 0.018). Similarly, seizures were reported in 10.0% of severe dengue patients but were absent in non-severe cases (p = 0.022).Irritability was significantly more common in severe dengue patients (23.3%) compared to non-severe dengue patients (4.0%) (p = 0.030). Shock was observed in 23.3% of severe dengue patients and was not reported among non-severe dengue cases (p = 0.015).

Table 2: Neurological Manifestations in Dengue Patients (n = 80)

Parameter	Severe Dengue (n = 30)	Non-Severe Dengue (n = 50)	p-value
Impaired consciousness	5 (16.7%)	0 (0.0%)	0.018
Seizures	3 (10.0%)	0 (0.0%)	0.022
Irritability	7 (23.3%)	2 (4.0%)	0.030
Shock	7 (23.3%)	0 (0.0%)	0.015

Bedside Dengue Severity Score (BDSS): Distribution of BDSS scores showed a significant association with dengue severity (p = 0.001). Most non-severe dengue patients had lower BDSS scores (0–3), whereas severe dengue patients were predominantly in higher score categories.

Table 3: Distribution of Bedside Dengue Severity Score (BDSS) Categories

Score Category	Severe Dengue	Non-Severe Dengue	p-value
0–1	0	14	
2–3	6	30	
4–5	11	9	
>5	9	1	0.001

Patient Outcomes: Most patients recovered and were discharged after treatment. Among severe dengue patients, 83.3% were discharged, 10.0% left against medical advice (LAMA), and 6.7% died. All patients with non-severe dengue recovered and were discharged.

Table 4: Outcome of Dengue Patients (n = 80)

Outcome	Severe Dengue (n = 30)	Non-Severe Dengue (n = 50)	p-value
Discharged	25 (83.3%)	50 (100%)	
LAMA	3 (10.0%)	0 (0.0%)	
Death	2 (6.7%)	0 (0.0%)	0.028

Diagnostic Performance of Bedside Dengue Severity Score: The Bedside Dengue Severity Score demonstrated high specificity for predicting severe dengue. The sensitivity of BDSS for identifying severe dengue was 47.37%, while specificity was 98.36%. The positive predictive value was 90.00%, and the negative predictive value was 85.71%.

The overall diagnostic accuracy of BDSS in predicting severe dengue was 86.25%.

Table 5: Diagnostic Performance of Bedside Dengue Severity Score

Measure	Value (95% CI)
Sensitivity	47.37% (24.45–71.14)
Specificity	98.36% (91.17–99.96)
Positive Predictive Value (PPV)	90.00% (55.50–99.75)
Negative Predictive Value (NPV)	85.71% (74.29–93.06)
Accuracy	86.25% (76.63–92.98)

Discussion

The present study conducted at Rohilkhand Medical College and Hospital, Bareilly, evaluated the diagnostic utility of the Bedside Dengue Severity Score (BDSS) in predicting dengue severity among paediatric patients. The findings demonstrated that BDSS correlated well with

WHO-2022 and NVBDCP-2023 dengue severity classifications and could serve as a simple bedside tool for early risk stratification in clinical settings [9]. In the present study, a male predominance was observed among dengue patients, and the majority of cases occurred in school-aged children. Similar demographic patterns have been reported in several Indian and international studies, which attribute the higher incidence in males to increased outdoor exposure and greater contact with mosquito vectors [10]. Age above six years has also been identified as an independent predictor of severe dengue in clinical prediction models, indicating increased vulnerability in older children to plasma leakage and disease progression [5]. Laboratory parameters in the present study showed significant differences between severe and non-severe dengue cases. Severe dengue patients demonstrated markedly reduced platelet counts and significantly elevated hematocrit levels, reflecting thrombocytopenia and hemoconcentration due to plasma leakage [11]. Previous studies have consistently identified thrombocytopenia and hematocrit elevation as important predictors of dengue severity. Platelet counts below 50,000/μL and hematocrit levels ≥40% have been reported to significantly increase the risk of severe dengue and dengue shock syndrome [8]. These findings support the pathophysiological mechanism of increased vascular permeability and plasma leakage that characterizes severe dengue infection [12].The present study also demonstrated that severe dengue patients had significantly longer hospital stays and more pronounced hemodynamic instability compared to non-severe cases. Lower systolic blood pressure, narrow pulse pressure, and evidence of circulatory compromise were more frequently observed in severe dengue patients, indicating progression toward shock. These clinical findings are consistent with established dengue severity indicators and highlight the importance of early recognition of hemodynamic changes in preventing complications [13].Clinical warning signs such as persistent vomiting, abdominal tenderness, hepatomegaly, and third-space fluid loss were significantly associated with severe dengue in the present study. These findings are consistent with the WHO warning signs used to identify patients at risk for severe disease. Previous studies evaluating dengue severity scoring systems have similarly reported that clinical features such as hepatomegaly, hypotension, and evidence of plasma leakage are strong predictors of disease severity [5]. Neurological manifestations were also observed predominantly in severe dengue cases in the present study. Impaired consciousness, seizures, irritability, and shock were significantly associated with severe dengue, reflecting systemic involvement and potential complications such as dengue encephalopathy and circulatory failure. Similar neurological complications have been reported in severe dengue cases in previous paediatric studies [14].The Bedside Dengue Severity Score showed a clear predictive gradient across severity categories in the present study. Higher BDSS values were significantly associated with severe dengue, whereas lower scores corresponded with mild or moderate disease. This finding is consistent with the study by Gayathri et al., who developed and validated the BDSS in paediatric dengue patients and reported excellent predictive performance with sensitivity of 86.7% and specificity of 98.2% for identifying severe dengue [7]. The authors concluded that BDSS is a reliable clinical tool for early identification of severe dengue in children. Although the sensitivity of BDSS in the present study was lower than that reported in earlier validation studies, its specificity remained very high, indicating strong ability to correctly identify children without severe disease. The high specificity observed in the present study supports the usefulness of BDSS as a triage tool, particularly in resource-limited settings where rapid bedside assessment is required. Outcome analysis in the present study showed a high recovery rate with relatively low mortality, which is comparable to other hospital-based studies in India. Early identification of severe cases and prompt clinical management likely contributed to favorable outcomes. The findings reinforce the importance of early risk stratification in improving clinical outcomes in paediatric dengue.

Conclusion

The present study demonstrated that the Bedside Dengue Severity Score (BDSS) is a simple and effective tool for predicting dengue severity in paediatric patients. Higher BDSS scores showed a significant association with severe dengue as defined by WHO-2022 and NVBDCP-2023 classifications. Severe dengue cases were characterized by marked thrombocytopenia, elevated hematocrit, hemodynamic instability, and longer hospital stay.BDSS showed high specificity and good overall diagnostic accuracy, indicating its usefulness for early bedside risk stratification. As it relies mainly on clinical parameters, BDSS can be particularly valuable in resource-limited settings for rapid identification and timely management of high-risk paediatric dengue patients.

Limitations of the Study: The present study had certain limitations that should be considered while interpreting the findings. The study was conducted at a single tertiary care center, which may limit the generalizability of the results to other healthcare settings or populations with different demographic and epidemiological characteristics. The sample size was relatively small, with only 80 paediatric dengue patients included, which may affect the statistical power of the findings. In addition, the

cross-sectional design of the study limited the ability to assess disease progression and the predictive performance of BDSS over different stages of illness. Furthermore, the Bedside Dengue Severity Score is based primarily on clinical bedside parameters and does not incorporate certain laboratory markers or organ dysfunction indicators that could potentially improve the accuracy of severity prediction.

Despite these limitations, the study provides useful evidence supporting the clinical applicability of BDSS as a simple and rapid bedside tool for early identification of severe dengue in paediatric patients.

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