



Original Article

Prognostic Indicators for Early Prediction of Dengue Severity in Children at a Tertiary Care Hospital in Western India: A Retrospective Observational Study

Moxesh Yogeshbhai Shah¹, Bulbul Dayachand Jain²

¹Junior Resident, Department of Internal Medicine, Gujarat Medical Education & Research Society (GMERS) Medical College and Hospital, Navsari, Gujarat, India\

²Senior Resident, Department of Pediatrics, Gujarat Medical Education & Research Society (GMERS) Medical College and Hospital, Navsari, Gujarat, India

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Corresponding Author:

Moxesh Yogeshbhai Shah

Junior Resident, Department of Internal Medicine, Gujarat Medical Education & Research Society (GMERS) Medical College and Hospital, Navsari, Gujarat, India

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ABSTRACT

Background: Dengue is a mosquito-borne viral infection with a wide clinical spectrum. In children, early recognition of severe dengue is important because shock, bleeding, plasma leakage, and organ involvement may develop rapidly.

Aim: To evaluate clinical, biochemical, coagulation, and radiological markers associated with severe dengue in children admitted during a dengue outbreak at a tertiary care hospital.

Materials and Methods: This retrospective hospital-based observational study included children aged 15 years or younger with clinically suspected dengue infection between June and September 2025. Of the 59 screened children, 54 met the eligibility criteria and were included in the analysis. Dengue was confirmed by NS1 antigen with or without IgM positivity. Patients were classified according to the WHO-based clinical severity. Severe dengue included children with warning signs who progressed to severe dengue and children with severe dengue with dengue shock syndrome. Clinical findings, hemogram, liver enzymes, PT/INR, chest X-ray, and ultrasound findings were assessed.

Results: Among 54 children, the most common age group was 5 to 9 years (24 children, 44.44%), and 30 children (55.56%) were female. Fever was present in all cases. Abdominal pain was seen in 32 children (59.26%), vomiting in 26 (48.15%), and mucosal bleeding in 24 (44.44%). Severe dengue was significantly associated with vomiting, mucosal bleeding, lethargy, respiratory distress, hepatomegaly, thrombocytopenia, and pleural fluid on chest X-ray. SGPT, SGOT, PT/INR, and gallbladder wall edema were higher in severe dengue. Significant SGOT elevation, increased PT/INR, and gallbladder wall thickness more than 5 mm were more frequent in children who progressed to severe dengue or had dengue shock syndrome.

Conclusion: Clinical warning signs, supported by liver enzymes, PT/INR, chest X-ray, and ultrasound findings, can help recognize severe dengue in children.

Keywords: Dengue, Severe dengue, Children, Liver enzymes, Gallbladder wall edema.

INTRODUCTION

Dengue is a systemic mosquito-borne viral infection and one of the most important arboviral diseases in tropical and subtropical regions. It is caused by the dengue virus, which belongs to the Flaviviridae family. The virus is transmitted mainly by *Aedes aegypti* mosquitoes, while *Aedes albopictus* also contributes in several regions.^[1]

Dengue virus has four antigenically distinct serotypes, DENV 1, DENV 2, DENV 3, and DENV 4. Infection with one serotype usually gives long-lasting immunity to that serotype. However, later infection with a different serotype may increase the risk of severe dengue through immune enhancement and altered host immune response.^[2,3]

The global burden of dengue has increased markedly. Bhatt et al. estimated that nearly 390 million dengue infections occur per year, of which about 96 million are clinically apparent.^[4] Evidence-based mapping has shown wide geographical distribution of dengue transmission across many countries, with continuing expansion into new settings.^[5] In India, dengue remains a major public health problem, especially during seasonal outbreaks and among children.

The clinical presentation of dengue ranges from mild fever to severe dengue with plasma leakage, bleeding, shock, and organ involvement. The revised WHO classification divides dengue into dengue without warning signs, dengue with warning signs, and severe dengue. This classification is useful because it focuses on early warning signs and helps clinicians identify patients who require close monitoring.^[6]

Several clinical and laboratory indicators have been linked with severe dengue. Vomiting, abdominal pain, mucosal bleeding, lethargy, fluid accumulation, hepatomegaly, thrombocytopenia, rising hematocrit, and elevated liver enzymes have been reported as important predictors of severity.^[7,8] Prediction models in children have also identified vomiting, platelet count, AST level, and other early clinical markers as useful variables for early prognosis.^[9–11]

Radiological markers are also important because severe dengue is characterized by endothelial dysfunction and plasma leakage. Ultrasound and chest X-ray can detect pleural effusion, ascites, gallbladder wall edema, and other third-space fluid collections. A scoping review on ultrasound in dengue reported that ascites, pleural effusion, and gallbladder wall thickening were among the most common ultrasound findings.^[12]

In many resource-limited settings, clinical diagnosis can be difficult because dengue overlaps with other febrile illnesses. Therefore, simple clinical, biochemical, and radiological markers may help clinicians identify children at risk of severe dengue earlier. The present study evaluated these markers as predictors of severe dengue among pediatric patients admitted during a dengue mini-outbreak at a tertiary care hospital in India.

MATERIALS AND METHODS

Study design and setting

This was a retrospective hospital-based observational study conducted at Gujarat Medical Education and Research Society (GMERS) Medical College and Hospital, Navsari, Gujarat, India, during a dengue mini-outbreak from June to September 2025.

Study population

Children presenting with clinically suspected dengue infection were screened. Of 59 screened children, 54 fulfilled the eligibility criteria and were included in the final analysis. The study included children aged 15 years or younger who met WHO-based dengue criteria, had fever for 2 or more days, and tested positive for dengue NS1 antigen, with or without IgM antibodies.^[6]

Inclusion criteria

Children aged 15 years or below, fever for two or more days, clinical suspicion of dengue, WHO-based dengue criteria, and dengue NS1 antigen positivity with or without IgM antibody positivity were included.

Exclusion criteria

Children aged 15 years or older, children with fever for less than 2 days, and children who tested negative for dengue.

Clinical monitoring and investigations

After admission, vital signs were monitored every four hours. Intake and output charts were maintained and reviewed every eight hours by the consultant. A complete hemogram was performed daily. Platelet count, hematocrit, AST, ALT, and PT/INR were recorded. Chest X-ray and ultrasound of the abdomen were performed when clinically indicated.

Ultrasound examination was performed by a consultant radiologist using a GE Voluson E8 machine. Gallbladder wall thickness was measured in longitudinal and transverse planes. Ascites, perirenal fluid, and pleural fluid were recorded as evidence of plasma leakage. Ultrasound scans were repeated when the clinical condition or laboratory parameters worsened. Children with gallbladder wall thickness more than 3 mm were managed with close monitoring and appropriate fluid therapy.

Severity classification

Patients were classified according to the WHO-based dengue severity classification.^[6] For comparison, the severe dengue group included children with dengue with warning signs who progressed to severe dengue, as well as children with severe

dengue with dengue shock syndrome. The non-severe dengue group included children with dengue and dengue with warning signs who did not progress to severe dengue.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 29.0. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean and standard deviation. The chi-square test or Fisher's exact test was used to compare categorical variables, as appropriate. The independent Student's t test was used to compare continuous variables between two groups. Analysis of variance was used to compare continuous variables across more than two groups. A p-value less than 0.05 was considered statistically significant.

Ethical consideration

The study was approved by the Institutional Ethics Committee. As this was a retrospective record-based study, a waiver of informed consent was obtained from the ethics committee. Patient confidentiality was maintained, and personal identifiers were not disclosed in the analysis or publication.

RESULTS

A total of 54 pediatric patients with dengue infection were included in the study. The most common age group was 5 to 9 years, comprising 24 children (44.44%). Female children were slightly more common than male children. Fever was present in all patients. The common clinical features were abdominal pain, vomiting, mucosal bleeding, lethargy, fluid accumulation, respiratory distress, and shock. Thrombocytopenia was the most common laboratory finding, followed by raised hematocrit, while hepatomegaly was the most common clinical examination finding. Radiological evidence of plasma leakage was seen as pleural fluid on chest X-ray and ascites.

Table 1. Baseline and clinical characteristics of study participants, n = 54

Parameter	n	%
Age 4 years or below	12	22.22
Age 5 to 9 years	24	44.44
Age 10 to 13 years	18	33.33
Male	24	44.44
Female	30	55.56
Fever	54	100.00
Abdominal pain	32	59.26
Vomiting	26	48.15
Mucosal bleeding	24	44.44
Lethargy	20	37.04
Fluid accumulation	24	44.44
Respiratory distress	20	37.04
Shock	8	14.81
Hepatomegaly	28	51.85
Thrombocytopenia	46	85.19
Raised hematocrit	36	66.67
Pleural fluid on chest X-ray	22	40.74
Ascites	14	25.93

According to dengue severity, 10 children (18.5%) had dengue without warning signs, 14 children (25.9%) had dengue with warning signs but did not progress to severe dengue, 20 children (37.0%) had dengue with warning signs and progressed to severe dengue, and 10 children (18.5%) had severe dengue with dengue shock syndrome.

Table 2. Distribution of dengue severity, n = 54

Severity category	n	%
Dengue	10	18.5
Dengue with warning signs, not progressed to severe dengue	14	25.9
Dengue with warning signs progressed to severe dengue	20	37.0
Severe dengue with dengue shock syndrome	10	18.5
Total	54	100.0

Table 3: Distribution of SGOT, PT/INR, and gallbladder wall thickening according to dengue severity

Variable	Category	Dengue fever	Dengue fever with warning signs, not	Dengue fever with warning	Severe dengue or dengue	Total
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			progressed to severe dengue	signs, progressed to severe dengue	shock syndrome (DSS)	
Total patients	Overall distribution	10 (18.5%)	14 (26.0%)	20 (37.0%)	10 (18.5%)	54 (100.0%)
SGOT	Normal, <40 IU/L	6 (60.0%)	4 (40.0%)	0	0	10 (18.5%)
	Mild elevation, 41-200 IU/L	4 (20.0%)	10 (50.0%)	6 (30.0%)	0	20 (37.0%)
	Significant elevation, >200 IU/L	0	0	14 (58.3%)	10 (41.7%)	24 (44.4%)
PT/INR	Normal	10 (31.3%)	8 (25.0%)	10 (31.3%)	4 (12.5%)	32 (59.3%)
	Increased, >1.2	0	6 (27.3%)	10 (45.5%)	6 (27.3%)	22 (40.7%)
Gallbladder wall thickening	Normal, <3 mm	8 (80.0%)	2 (20.0%)	0	0	10 (18.5%)
	3-5 mm	2 (11.1%)	8 (44.4%)	8 (44.4%)	0	18 (33.3%)
	>5 mm, significant	0	4 (15.4%)	12 (46.2%)	10 (38.5%)	26 (48.1%)

Note: Percentages in dengue severity columns are row percentages. Percentages in the total column are calculated from the study population of n = 54.

Raised SGOT, prolonged PT/INR, and increased gallbladder wall thickening were more frequent in children who progressed to severe dengue and in children with severe dengue or DSS.

For comparative analysis, 30 children were included in the severe dengue group and 24 in the non-severe dengue group. Age and sex distributions were not significantly different between the two groups. Vomiting, mucosal bleeding, lethargy, and respiratory distress were significantly more common in severe dengue. Hepatomegaly, thrombocytopenia, and pleural fluid on chest X-ray were also significantly associated with severe dengue.

Table 4. Comparison of clinical, biochemical, and radiological characteristics between severe and non-severe dengue groups

Parameter	Severe dengue (n = 30)	Non-severe dengue (n = 24)	p value
Age 4 years or below	8 (26.67%)	4 (16.67%)	0.3492
Age 5 to 9 years	14 (46.67%)	10 (41.67%)	
Age 10 to 13 years	8 (26.67%)	10 (41.67%)	
Male	10 (33.33%)	14 (58.33%)	0.2024
Female	20 (66.67%)	10 (41.67%)	
Fever	30 (100.00%)	24 (100.00%)	-
Abdominal pain	20 (66.67%)	12 (50.00%)	0.3901
Vomiting	20 (66.67%)	6 (25.00%)	0.0346
Mucosal bleeding	20 (66.67%)	4 (16.67%)	0.0108
Lethargy	18 (60.00%)	2 (8.33%)	0.0067
Fluid accumulation	18 (60.00%)	6 (25.00%)	0.0743
Respiratory distress	20 (66.67%)	0 (0.00%)	0.0005
Hepatomegaly	24 (80.00%)	4 (16.67%)	0.0013
Thrombocytopenia	30 (100.00%)	16 (66.67%)	0.0174
Raised hematocrit	24 (80.00%)	12 (50.00%)	0.1069
Pleural fluid on chest X-ray	18 (60.00%)	4 (16.67%)	0.0254
Ascites	12 (40.00%)	2 (8.33%)	0.0671

Children with severe dengue had significantly higher liver enzymes, PT/INR, and gallbladder wall edema compared with children with non-severe dengue. These findings indicate more hepatic involvement, coagulation abnormality, and plasma leakage in severe dengue.

Table 5. Comparison of biochemical and radiological findings between severe and non-severe dengue groups

Finding	Severe dengue, n = 30	Non-severe dengue, n = 24	p value
SGPT or ALT (IU/L)	357.53 ± 249.00	33.92 ± 8.61	0.0001
SGOT or AST (IU/L)	391.67 ± 258.81	43.33 ± 19.63	0.0001
PT/INR	1.37 ± 0.26	1.03 ± 0.06	0.0002
Gallbladder wall edema (mm)	7.47 ± 2.00	2.75 ± 0.87	<0.0001

DISCUSSION

The present study evaluated clinical, biochemical, and radiological markers of severe dengue in children admitted during a dengue mini-outbreak. Severe dengue was common in this cohort. This reflects the hospital-based nature of the study, where children with warning signs and complications are more likely to be admitted.

Fever was present in all children. Abdominal pain, vomiting, mucosal bleeding, lethargy, and respiratory distress were common symptoms. Vomiting, mucosal bleeding, lethargy, and respiratory distress were significantly more frequent in severe dengue. These findings support the WHO warning-sign approach and are consistent with evidence from systematic reviews indicating that vomiting, abdominal pain or tenderness, mucosal bleeding, fluid accumulation, and lethargy are associated with severe dengue.^[6-8]

In the present study, children aged 5 to 9 years formed the largest group. Similar pediatric studies from India have reported that school-age children are commonly affected by dengue. Sahana and Sujatha reported that children between 5 and 15 years were most affected, and abdominal pain and vomiting were common presenting symptoms.^[13] Mishra et al. also reported a high burden of dengue in children and described abdominal symptoms, bleeding manifestations, and radiological fluid accumulation in severe cases.^[14]

The clinical pattern observed in this study is also comparable to those reported in other pediatric and hospital-based studies. Chacko and Subramanian reported that clinical, laboratory, and radiological parameters could help predict dengue shock syndrome in children.^[15] Khan et al. reported that younger age, reduced platelet count, and increased hematocrit were significant predictors of severe dengue among children during a dengue outbreak.^[16] Mallhi et al. reported that dengue fever and dengue hemorrhagic fever showed different clinical and laboratory profiles.^[17]

Thrombocytopenia was strongly associated with severe dengue in this study. All children in the severe dengue group had thrombocytopenia compared with 66.67% in the non-severe group. Raised hematocrit was also more common in severe dengue. These findings are biologically important because thrombocytopenia reflects platelet destruction and consumption, while raised hematocrit reflects hemoconcentration due to plasma leakage. Similar variables have been included in early prediction studies and dengue severity models.^[9-11]

Hepatomegaly was significantly more common in severe dengue. Liver enzymes were markedly elevated in severe dengue, with significantly higher SGPT and SGOT levels. Dengue-associated liver involvement may occur due to direct viral injury, immune-mediated injury, hypoperfusion during shock, and systemic inflammation. Recent pediatric evidence indicates that hepatic involvement can help predict dengue severity, and systematic reviews confirm that liver involvement is common in dengue infection.^[18,19]

PT/INR was significantly higher in severe dengue. This suggests a coagulation disturbance, which can result from hepatic dysfunction, capillary leakage, consumption of clotting factors, and severe systemic inflammation. When prolonged PT/INR occurs along with mucosal bleeding, thrombocytopenia, and raised liver enzymes, the child should be monitored closely for severe dengue and bleeding risk.^[20,21]

Radiological findings were useful in identifying severe dengue. Pleural fluid on chest X-ray was significantly more common in severe dengue, while ascites also showed a higher frequency. Gallbladder wall edema was markedly higher in severe dengue. These findings are consistent with the pathophysiology of dengue, in which endothelial dysfunction leads to plasma leakage into serosal cavities and gallbladder wall edema. A scoping review reported ascites, pleural effusion, and gallbladder wall thickening as common ultrasound findings in dengue.^[12] Pothapregada et al. also reported that ultrasound can serve as an early predictor and prognostic sign of severe dengue during outbreaks.^[22]

The present severity-wise distribution further supports the role of SGOT, PT/INR, and gallbladder wall thickening as practical markers of severity in pediatric dengue. Children with dengue without warning signs mainly had normal SGOT, normal PT/INR, and normal gallbladder wall thickness. In contrast, significant SGOT elevation of more than 200 IU was seen only in children who progressed to severe dengue or had severe dengue with DSS. Similarly, increased PT/INR was more frequent in the progressed severe dengue and severe dengue/DSS groups. Gallbladder wall thickness greater than 5 mm was also strongly associated with advanced dengue severity. These findings are comparable to those of Chacko and Subramanian, who reported that clinical, laboratory, and radiological parameters were useful for predicting dengue shock

syndrome in children.^[15] Alam et al. showed that hepatic involvement can help predict dengue severity in children, while Campana et al. confirmed that liver involvement is common in dengue infection.^[18,19] Adane and Getawa reported coagulation abnormalities in dengue, and Orsi et al. observed reduced thrombin formation and excessive fibrinolysis in dengue patients with bleeding manifestations.^[20,21] Dewan et al. reported that ascites, pleural effusion, and gallbladder wall thickening are common ultrasound findings in dengue, while Pothapregada et al. found that ultrasound can help predict severe dengue during outbreaks.^[12,22] Thus, the combined assessment of SGOT, PT/INR, and gallbladder wall thickness may help in the early identification of children who require close monitoring, careful fluid management, and timely escalation of care.

The major strength of this study is that it evaluates simple and widely available markers that can be used in routine pediatric practice.

Limitations of the study

This study has limitations. The sample size was small, and the study was conducted at a single tertiary care hospital. Therefore, the findings may not represent all children with dengue in the community. The retrospective design depended on available hospital records, so incomplete documentation may have affected some variables. Selection bias is possible because admitted children usually have more severe illness than children treated on an outpatient basis. Long-term follow-up was not available. Treatment variations could not be fully controlled.

CONCLUSION

This study shows that severe dengue in children is associated with a combination of clinical warning signs, biochemical abnormalities, coagulation disturbance, and radiological evidence of plasma leakage. Vomiting, mucosal bleeding, lethargy, respiratory distress, hepatomegaly, thrombocytopenia, raised hematocrit, raised SGPT and SGOT, prolonged PT/INR, pleural fluid, and gallbladder wall edema were useful markers of severity. Severity-wise distribution also showed that significant SGOT elevation, increased PT/INR, and gallbladder wall thickness more than 5 mm were more common in children who progressed to severe dengue and in children with severe dengue or DSS. These findings support the value of combining clinical assessment with simple laboratory and ultrasound markers for early recognition of severe dengue in children.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this study.

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