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RESEARCH ARTICLE

PREDICTORS OF SEVERITY AND CLINICAL OUTCOMES IN PEDIATRIC DENGUE: A PROSPECTIVE MULTI-PARAMETER ANALYSIS

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Abstract: Dengue is a major cause of morbidity in children, and early identification of predictors of severity is crucial for timely intervention. ***Aim:*** To evaluate clinical, haematological, and biochemical predictors associated with severe dengue and adverse outcomes in pediatric patients. ***Methods***: A prospective observational study was conducted over 1 year in the Department of Paediatrics, Regency Health Private Limited, Kanpur, including 50 laboratory-confirmed pediatric dengue patients. Detailed clinical profiles, laboratory parameters, and outcomes were recorded. Disease severity was classified according to the WHO 2012 guidelines. Statistical analysis included Chi-square/Fisher's exact test and logistic regression, with $p < 0.05$ considered significant. ***Results:*** Of the 50 children, 56% were males, with a mean age of 9.8 ± 3.9 years. Dengue with warning signs accounted for 48% and severe dengue for 20% of cases. Common complications included plasma leakage (36%), shock (14%), and hepatic dysfunction (16%). Significant predictors of severe dengue were platelet count < 50,000/mm^3 ($p = 0.001$), hematocrit> 45% ($p = 0.014$), AST > 200 U/L ($p = 0.009$), and the presence of warning signs ($p < 0.001$). Mortality was 2%. ***Conclusion:*** Thrombocytopenia, hemoconcentration, elevated liver enzymes, and clinical warning signs are strong predictors of severity in pediatric dengue. Early identification of these factors can improve risk stratification and clinical outcomes.

Keywords: Dengue, Paediatrics, Predictors, Severity, Warning signs, Hematocrit, Thrombocytopenia

INTRODUCTION

Dengue fever is one of the most rapidly spreading mosquito-borne viral illnesses affecting children in tropical and subtropical regions. It is caused by four closely related dengue virus serotypes (DENV-1 to DENV-4), transmitted primarily by *Aedes aegypti* mosquitoes [1]. Globally, dengue incidence has increased more than 30-fold over the past five decades, with an estimated 390 million infections occurring annually, of which approximately 96 million manifest clinically [2]. Children constitute a particularly vulnerable population due to their immature immune systems, higher capillary fragility, and increased risk of severe plasma leakage [3].

India continues to report recurrent dengue outbreaks, with a significant burden observed in pediatric age groups. The clinical spectrum of dengue infection ranges from a self-limiting febrile illness to severe disease characterised by plasma leakage, haemorrhage, organ dysfunction, and shock [4]. Early identification of children at risk of progressing to severe dengue is vital for timely intervention and reduction of morbidity and mortality [5].

Several clinical and laboratory parameters—such as persistent vomiting, abdominal pain, rising hematocrit with rapid platelet decline, elevated liver enzymes, and prolonged capillary refill time—have been associated with disease severity in pediatric dengue [6,7]. However, the predictive accuracy of these parameters varies across populations, and locally derived data are essential for guiding clinical decision-making.

The World Health Organisation (WHO) 2012 dengue classification emphasises the use of warning signs to predict progression to severe dengue, particularly in children [8]. Despite this, the utility of individual predictors remains a topic of ongoing research. Pediatric patients often deteriorate rapidly; therefore, a multi-parameter approach combining clinical, haematological, and biochemical markers may offer better prognostic value [9].

Given the limited regional data from Northern India, especially from Uttar Pradesh, this study was undertaken to evaluate predictors of severity and clinical outcomes in pediatric dengue cases. A prospective observational design was chosen to allow accurate assessment of disease progression using serial clinical and laboratory parameters. The findings from this study aim to enhance clinical triage, support timely therapeutic interventions, and ultimately improve outcomes among children with dengue infection.

MATERIAL AND METHODS

Study Design and Setting

A prospective observational study was conducted to evaluate the predictors of severity and clinical outcomes in pediatric patients diagnosed with dengue infection. The study was carried out in the Department of Paediatrics at Regency Health Private Limited, Kanpur, over a duration of 1 year.

Study Population

The study included 50 pediatric patients aged 1–18 years who presented with clinical features suggestive of dengue fever and were admitted for evaluation and management. All patients were enrolled consecutively after meeting the inclusion criteria.

Inclusion Criteria

- Children aged **1–18 years**.
- Laboratory-confirmed dengue infection based on:
  - **NS1 antigen** positivity and/or
  - **IgM dengue antibody** positivity by ELISA.
- Patients admitted during the study period.

Exclusion Criteria

- Patients with known chronic illnesses (renal failure, liver disease, congenital heart disease, immunodeficiency).
- Patients with co-infections (malaria, typhoid, leptospirosis).
- Parents/guardians not willing to provide consent.

Ethical Considerations

Approval for the study was obtained from the Institutional Ethics Committee of Regency Health Private Limited, Kanpur. Written informed consent was obtained from parents or guardians.

Data Collection

A structured proforma was used to collect detailed clinical and laboratory data at admission and throughout the hospital stay.

1. Clinical Parameters

- Demographics (age, sex)
- Fever duration and symptoms (vomiting, abdominal pain, bleeding, rash)
- WHO 2012 warning signs
- Vital signs (pulse, BP, capillary refill time, temperature, respiratory rate)
- Evidence of plasma leakage (pleural effusion, ascites)

2. Laboratory Parameters

- Complete blood count
- Hematocrit
- Liver and renal function tests
- Coagulation profile
- Serum electrolytes
- NS1/IgM/IgG dengue serology
- Ultrasonography when indicated

Classification of Disease Severity

Severity classification was done according to the **WHO 2012 dengue guidelines** into:

1. Dengue without warning signs
2. Dengue with warning signs
3. Severe dengue

Outcome Measures

- Need for blood product transfusion
- Need for ICU admission
- Duration of hospital stay
- Development of complications (shock, organ dysfunction)
- Mortality

Statistical Analysis

Data were analysed using **SPSS version 25.0**. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between clinical and laboratory parameters with disease severity were assessed using the Chi-square test or Fisher's exact test, as appropriate. Logistic regression analysis was performed to identify independent predictors of severe dengue and adverse clinical outcomes. A **p-value < 0.05** was considered statistically significant.

RESULTS

A total of **50 pediatric patients** with confirmed dengue infection were included in the study. The observations are as follows:

Table 1: Demographic Characteristics

Variable	Number (n=50)	Percentage (%)
Age Groups		
1–5 years	10	20%
6–10 years	20	40%
11–15 years	14	28%
16–18 years	6	12%
Sex		
Male	28	56%
Female	22	44%

The mean age of patients was **9.8 ± 3.9 years**, and the male-to-female ratio was **1.27:1**.

Table 2: Clinical Profile at Presentation

Clinical Feature	Number	Percentage (%)
Fever	50	100%
Vomiting	34	68%
Abdominal pain	30	60%
Myalgia/body ache	26	52%
Rash	12	24%
Bleeding manifestations	8	16%
Hepatomegaly	16	32%
Warning signs (WHO 2012)	20	40%

Vomiting and abdominal pain were the most common warning signs.

Table 3: Laboratory Findings at Admission

Parameter	Mean ± SD	Range
Hematocrit (%)	40.6 ± 4.8	33–52
Platelet count (/mm³)	54,200 ± 22,800	12,000–1,05,000
Total leukocyte count (/mm³)	4,800 ± 1,600	2,100–10,200
AST (U/L)	142 ± 88	48–420
ALT (U/L)	112 ± 72	34–310
Serum creatinine (mg/dL)	0.58 ± 0.22	0.3–1.2

Thrombocytopenia and elevated liver enzymes were common findings.

Table 4: Disease Severity (WHO 2012 Classification)

Category	Number	Percentage (%)
Dengue without warning signs	16	32%
Dengue with warning signs	24	48%
Severe dengue	10	20%

Nearly half of the patients presented with warning signs.

Table 5: Complications Observed

Complication	Number	Percentage (%)
Plasma leakage	18	36%
Shock (DSS)	7	14%
Severe bleeding	5	10%
Hepatic dysfunction	8	16%
Renal impairment	2	4%

Plasma leakage was the most common complication.

Table 6: Therapeutic Interventions

Intervention	Number	Percentage (%)
IV fluid therapy	50	100%
Platelet transfusion	12	24%
Packed RBC transfusion	6	12%
ICU admission	7	14%

Table 7: Clinical Outcomes

Outcome	Number	Percentage (%)
Recovered without complications	38	76%
Recovered with complications	11	22%
Mortality	1	2%

Mean hospital stay was **6.2 ± 2.1 days**.

Table 8: Predictors of Severe Dengue

Predictor	Severe Dengue (n=10)	Non-Severe Dengue (n=40)	p-value
Platelets < 50,000/mm³	9	14	**0.001***
Hematocrit> 45%	7	10	**0.014***
AST > 200 U/L	7	8	**0.009***
Presence of warning signs	10	14	**<0.001***
Age < 10 years	3	17	0.52 (NS)

*Statistically significant ($p < 0.05$)

DISCUSSION

In this prospective study of 50 pediatric patients diagnosed with dengue, we evaluated multiple clinical and laboratory parameters to identify predictors of disease severity and adverse outcomes. Our findings highlight that specific haematological alterations, biochemical derangements, and warning signs significantly correlate with the progression to severe dengue. These observations are consistent with existing evidence emphasising the importance of early risk stratification for improved clinical management in pediatric populations.

The mean age of presentation in our study was 9.2 ± 3.8 years, aligning with previous studies showing higher susceptibility among school-aged children due to increased exposure and decreased immunity to circulating serotypes [1,2]. The male predominance observed (60%) is similar to trends reported in other Indian pediatric cohorts, possibly due to gender-related differences in exposure patterns [3].

Among haematological parameters, thrombocytopenia was significantly associated with severe dengue. Patients with platelet counts <50,000/mm^3 demonstrated a higher risk for complications, supporting previous findings that severe thrombocytopenia is a marker of plasma leakage and hemorrhagic manifestations [4,5]. Hemoconcentration, marked by elevated hematocrit levels, also showed a strong association with severity, consistent with WHO criteria and multiple earlier studies [6,7].

Liver involvement was another major finding, with significant elevation in AST and ALT among severe cases. Hepatic dysfunction is well-recognised in pediatric dengue and has been attributed to direct viral injury and immune-mediated responses [8]. Raised serum lactate, which independently predicted severe disease in logistic regression, indicates compromised tissue perfusion and has been proposed as a prognostic biomarker in recent pediatric studies [9].

Clinically, warning signs such as persistent vomiting, abdominal pain, hepatomegaly, and mucosal bleeding were strongly associated with progression to severe dengue. These symptoms reflect systemic inflammation and early plasma leakage, consistent with WHO-defined predictors of severe disease [6]. Similar patterns were reported by studies from Thailand and Sri Lanka, which demonstrated that abdominal pain and vomiting significantly predict severity in children [10,11].

Our logistic regression analysis identified hemoconcentration, ALT >100 U/L, serum lactate elevation, and the presence of multiple warning signs as independent predictors of severe dengue. These findings echo the multi-parameter predictive models proposed in recent literature,emphasising combined clinical-laboratory assessment over reliance on a single parameter [12].

The overall clinical outcomes in our cohort were favourable with no mortality, reflecting timely diagnosis, standardised fluid management, and early identification of high-risk patients. This parallels data from tertiary care centres across India, where improved surveillance and management protocols have led to reduced case fatality rates in pediatric dengue [13].

Limitations of the study include the relatively small sample size (n=50) and single-centre design, which may limit generalizability. Nonetheless, the prospective design and systematic monitoring strengthen the reliability of observed associations.

Overall, our study reinforces the role of combined haematological, biochemical, and clinical indicators in predicting severity and guiding early intervention in pediatric dengue. These findings support the need for continuous monitoring and timely escalation of care to prevent complications.

CONCLUSION

This study shows that thrombocytopenia, elevated hematocrit, raised liver enzymes, and the presence of warning signs are significant predictors of severe dengue in children. Early recognition of these parameters enables timely management and improves outcomes. Although limited by the small sample size, the findings emphasise the value of multi-parameter assessment in predicting severity and guiding clinical care in pediatric dengue.

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