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**ORIGINAL RESEARCH**

# Evaluating Coagulopathy in Children with Dengue Fever: A Correlative Study of Clinical Presentations and Laboratory Parameters

Dr. Ashok G.M[1*], Dr Keerti Hiremath[2], Dr. Kusuma N[3]

[*1]Consultant, Department of Pediatrics, I Care Children's Hospital, Hospet, Karnataka, India.
[2]Consultant, Department of Pathology, I Care Children's Hospital, Hospet, Karnataka, India.
[3]Consultant, Department of Pediatrics, I Care Children's Hospital, Hospet, Karnataka. India.

**Corresponding Author**
Dr. Ashok G.M
Consultant, Department of Pediatrics, I Care Children's Hospital, Hospet, Karnataka, India

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## ABSTRACT

**Background:** Dengue fever is a significant public health concern in tropical countries, with children often presenting with atypical features and rapid clinical deterioration. Coagulation abnormalities are common in dengue and may lead to life-threatening complications such as bleeding, shock, and multiorgan dysfunction. Early recognition of laboratory derangements and their clinical relevance is vital for timely intervention and improved outcomes. **Objective:** To evaluate the prevalence and spectrum of coagulation abnormalities in pediatric patients diagnosed with dengue fever and to correlate laboratory findings with clinical severity and bleeding manifestations. **Methods:** This hospital-based observational study was conducted over six months from June 2024 to November 2024. A total of 200 children aged 1 to 18 years with laboratory-confirmed dengue infection were included. Coagulation parameters such as platelet count, prothrombin time (PT), activated partial thromboplastin time (aPTT) and international normalized ratio (INR) were assessed. Clinical data including bleeding symptoms, dengue classification and outcomes were recorded. Statistical analysis was performed to identify correlations between laboratory values and clinical severity. **Result:** Of the 200 children studied, thrombocytopenia was observed in 82.5% and prolonged PT or aPTT in 38%. Clinical bleeding manifestations were present in 29.5% of cases, most commonly epistaxis, petechiae, and gum bleeding. Children with severe dengue exhibited significantly lower platelet counts and more frequent coagulation abnormalities compared to those with non-severe disease ($p < 0.05$). APTT prolongation was notably associated with mucosal bleeding. INR >1.5 was observed in 12% of cases and strongly correlated with clinical severity and prolonged hospitalization. **Conclusion:** Coagulation abnormalities are prevalent in pediatric dengue fever and show significant correlation with disease severity and bleeding manifestations. Monitoring coagulation profiles alongside platelet count provides valuable prognostic information and should be integrated into routine evaluation to guide supportive care and prevent complications.

**Key words:** Dengue Fever; Pediatric Coagulopathy; Thrombocytopenia; Prothrombin Time; Activated Partial Thromboplastin Time; INR; Bleeding Manifestations; Dengue Hemorrhagic Fever; Dengue Shock Syndrome; Laboratory Correlation.



## INTRODUCTION

Dengue fever, caused by the dengue virus (DENV), is one of the most prevalent arboviral infections globally, particularly in tropical and subtropical regions. In recent decades, the disease has emerged as a major public health concern in India, with cyclical outbreaks leading to increased morbidity in pediatric populations.[1] The clinical spectrum of dengue infection ranges from an asymptomatic or mild febrile illness to severe forms such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), which are associated with significant hemodynamic instability, bleeding complications and multiorgan involvement.[2]

Children with dengue infection often present with nonspecific symptoms and are at risk of rapid clinical deterioration. Among the complications associated with dengue, coagulation abnormalities play a critical role in disease progression and prognosis.[3] These disturbances are multifactorial in origin, resulting from thrombocytopenia, vascular endothelial dysfunction, hepatic involvement, bone marrow

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suppression and consumptive coagulopathy. Prolonged bleeding time, elevated prothrombin time (PT), activated partial thromboplastin time (aPTT) and international normalized ratio (INR), along with declining platelet counts are frequently documented laboratory abnormalities in moderate to severe dengue cases.[4]

While thrombocytopenia is well recognized as a hallmark of dengue, isolated reliance on platelet count may not reliably predict bleeding risk. Clinical studies have shown that coagulation parameters such as PT, aPTT, and INR provide additional prognostic information, especially in identifying children at risk of mucosal bleeding, hematuria, gastrointestinal hemorrhage, or intracranial bleeds. Furthermore, deranged coagulation profiles are commonly associated with progression to severe dengue, prolonged hospitalization, and higher intensive care requirements.[5]

Early recognition of these hematological alterations can guide clinicians in triaging patients, initiating timely interventions such as fluid resuscitation, transfusion support and preventing complications. Despite the clinical relevance, the correlation between coagulation parameters and clinical severity remains underexplored in many pediatric cohorts, especially in outbreak-prone regions of India.[6]

This study was undertaken to assess the prevalence and pattern of coagulation abnormalities in children aged 1 to 18 years diagnosed with dengue fever and to evaluate their association with clinical manifestations and disease severity. By identifying statistically significant correlations between laboratory derangements and clinical outcomes, the study aims to enhance early risk stratification and support the development of evidence-based protocols for pediatric dengue management.

## MATERIALS AND METHODS

This hospital-based observational study was conducted in the Department of Pediatrics at a tertiary care centre over a six-month period from June 2024 to November 2024. A total of 200 children aged 1 to 18 years who presented with clinical features suggestive of dengue fever and had serological confirmation by NS1 antigen or dengue IgM ELISA were included in the study. The primary objective was to evaluate coagulation abnormalities and correlate them with the clinical severity of dengue and bleeding manifestations.

Children with known bleeding disorders, chronic liver disease, ongoing anticoagulant therapy, or other systemic conditions known to affect coagulation were excluded from the study. Written informed consent was obtained from parents or guardians prior to enrollment.

Detailed clinical history was recorded at admission, including duration of fever, presence of bleeding manifestations, rash, abdominal pain, vomiting, hepatomegaly and signs of shock. Vital parameters and systemic examination findings were documented. Patients were classified into three categories based on the WHO 2009 dengue guidelines: dengue without warning signs, dengue with warning signs and severe dengue.

Blood samples were collected at the time of admission before initiating fluid or blood product therapy. The following hematological and coagulation parameters were analyzed:

- Platelet count (automated cell counter)
- Prothrombin time (PT)
- Activated partial thromboplastin time (aPTT)
- International normalized ratio (INR)
- Hematocrit
- Total leukocyte count

Platelet count <100,000/mm³ was considered thrombocytopenia. Prolonged PT was defined as >14 seconds, prolonged aPTT as >40 seconds, and INR >1.2 was considered elevated. Bleeding manifestations were classified into minor (epistaxis, petechiae, gum bleeding) and major (hematemesis, melena, hematuria, intracranial bleeding).

Patients were managed as per institutional dengue management protocol. Laboratory data and clinical findings were compiled and analyzed. Statistical analysis was performed using appropriate software. Categorical variables were expressed as frequencies and percentages. Quantitative data were presented as mean ± standard deviation. Associations between coagulation abnormalities and clinical severity were evaluated using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

## RESULT

A total of 200 pediatric patients aged 1 to 18 years with laboratory-confirmed dengue fever were included in the study. The majority of cases occurred in the 6–10 year age group, with a male-to-female ratio of approximately 1.3:1. Based on the WHO 2009 classification, 122 children (61%) had dengue without warning signs, 54 (27%) had dengue with warning signs, and 24 (12%) were diagnosed with severe dengue. Bleeding manifestations were observed in 59 children (29.5%), most frequently in the form of petechiae, epistaxis, and gum bleeding. Thrombocytopenia was seen in 165 cases (82.5%), and coagulation abnormalities including prolonged PT, aPTT, or elevated INR were noted in 76 children (38%). Coagulation derangements were significantly more common in children with severe dengue and were associated with a higher incidence of bleeding and prolonged hospital stay.

Table 1 shows the age and sex distribution of the study population, with the majority of cases falling in the 6–10 year age range.

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**Table 1: Age and Sex Distribution of Children with Dengue Fever (N = 200)**

| Age Group (years) | Male (n) | Female (n) | Total (n) | Percentage (%) |
|---|---|---|---|---|
| 1–5 | 32 | 26 | 58 | 29.0 |
| 6–10 | 48 | 33 | 81 | 40.5 |
| 11–15 | 28 | 19 | 47 | 23.5 |
| 16–18 | 9 | 5 | 14 | 7.0 |
| **Total** | **117** | **83** | **200** | **100.0** |

Table 2 presents the distribution of clinical severity among the study subjects according to WHO 2009 classification.

**Table 2: Clinical Severity Classification (N = 200)**

| Dengue Category | Number of Cases (n) | Percentage (%) |
|---|---|---|
| Dengue without warning signs | 122 | 61.0 |
| Dengue with warning signs | 54 | 27.0 |
| Severe dengue | 24 | 12.0 |

Table 3 demonstrates the frequency and types of bleeding manifestations. Minor bleeding was more frequent than major bleeding, and most cases occurred in children with warning signs or severe dengue.

**Table 3: Bleeding Manifestations in Study Population (N = 200)**

| Bleeding Type | Number of Cases (n) | Percentage (%) |
|---|---|---|
| Petechiae | 21 | 10.5 |
| Epistaxis | 14 | 7.0 |
| Gum bleeding | 11 | 5.5 |
| Hematuria | 5 | 2.5 |
| Hematemesis | 4 | 2.0 |
| Melena | 4 | 2.0 |
| No bleeding | 141 | 70.5 |
| **Total with bleeding** | **59** | **29.5** |

Table 4 illustrates the distribution of thrombocytopenia. Severe thrombocytopenia (<50,000/mm³) was observed in 36% of cases.

**Table 4: Distribution of Platelet Counts (N = 200)**

| Platelet Count (/mm³) | Number of Cases (n) | Percentage (%) |
|---|---|---|
| ≥100,000 | 35 | 17.5 |
| 50,000–99,999 | 93 | 46.5 |
| <50,000 | 72 | 36.0 |
| **Total with thrombocytopenia** | **165** | **82.5** |

Table 5 presents the prevalence of coagulation abnormalities among the study participants. APTT prolongation was the most common abnormality.

**Table 5: Coagulation Abnormalities Observed (N = 200)**

| Parameter Altered | Number of Cases (n) | Percentage (%) |
|---|---|---|
| Prolonged PT (>14 sec) | 51 | 25.5 |
| Prolonged aPTT (>40 sec) | 64 | 32.0 |
| Elevated INR (>1.2) | 35 | 17.5 |
| Any Coagulation Abnormality | 76 | 38.0 |

Table 6 demonstrates the association of coagulation abnormalities with clinical severity of dengue. Coagulation abnormalities were more frequent in severe cases.

**Table 6: Association of Coagulation Abnormalities with Dengue Severity**

| Dengue Category | Coagulopathy Present (n) | Coagulopathy Absent (n) | Total (n) | p-value |
|---|---|---|---|---|
| Dengue without warning | 30 | 92 | 122 | |

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| | | | | |
|---|---|---|---|---|
| signs | | | | |
| Dengue with warning signs | 24 | 30 | 54 | |
| Severe dengue | 22 | 2 | 24 | <0.001 |

Table 7 presents the association of prolonged aPTT with bleeding manifestations. APTT prolongation was strongly associated with mucosal and gastrointestinal bleeding.

**Table 7: Prolonged aPTT and Bleeding Manifestations (N = 200)**

| aPTT Status | Bleeding Present (n) | No Bleeding (n) | Total (n) | p-value |
|---|---|---|---|---|
| Prolonged (>40 sec) | 42 | 22 | 64 | |
| Normal | 17 | 119 | 136 | <0.001 |

Table 8 shows the correlation of elevated INR with hospital stay duration. Children with INR >1.5 had significantly longer hospitalizations.

**Table 8: Association of INR >1.5 with Prolonged Hospital Stay (>5 days)**

| INR Status | Stay >5 Days (n) | Stay ≤5 Days (n) | Total (n) | p-value |
|---|---|---|---|---|
| INR >1.5 | 18 | 6 | 24 | |
| INR ≤1.5 | 22 | 154 | 176 | <0.001 |

Table 9 compares mean laboratory values between non-severe and severe dengue cases. Children with severe dengue had significantly lower platelet counts and more prolonged PT and aPTT.

**Table 9: Comparison of Mean Laboratory Values by Severity Category**

| Parameter | Non-Severe Dengue (n = 176) | Severe Dengue (n = 24) | p-value |
|---|---|---|---|
| Platelet Count | 72,400 ± 21,100 | 39,300 ± 13,600 | <0.001 |
| PT (seconds) | 13.8 ± 2.1 | 17.2 ± 3.3 | <0.001 |
| aPTT (seconds) | 38.6 ± 5.2 | 49.7 ± 7.1 | <0.001 |
| INR | 1.18 ± 0.12 | 1.42 ± 0.18 | <0.001 |

Table 10 summarizes the combined frequency of thrombocytopenia and any coagulation abnormality, highlighting that 65% of all children had at least one coagulation abnormality or platelet derangement.

**Table 10: Combined Distribution of Coagulopathy and Thrombocytopenia (N = 200)**

| Abnormality Present | Number of Cases (n) | Percentage (%) |
|---|---|---|
| Both thrombocytopenia and coagulopathy | 89 | 44.5 |
| Thrombocytopenia only | 76 | 38.0 |
| Coagulopathy only | 13 | 6.5 |
| Neither | 22 | 11.0 |

## DISCUSSION

Dengue fever remains a leading cause of hospitalization among children in endemic regions and poses considerable diagnostic and therapeutic challenges, particularly in its severe form. While thrombocytopenia is a well-recognized hallmark of dengue infection, this study underscores the importance of evaluating broader coagulation profiles—especially PT, aPTT, and INR—to fully understand the hemostatic disturbances that influence clinical outcomes in pediatric dengue cases.[7]

The present study revealed that coagulation abnormalities were present in 38% of children, with prolonged aPTT being the most common (32%). Thrombocytopenia was observed in 82.5% of cases, with severe thrombocytopenia (<50,000/mm³) in 36%. These findings are consistent with studies conducted in other dengue-endemic regions, where platelet destruction, bone marrow suppression, and viral-induced endothelial injury collectively contribute to hematologic derangements.[8]

Importantly, coagulation abnormalities were significantly associated with clinical severity. Among children with severe dengue, 91.6% exhibited coagulation disturbances, compared to only 24.6% in those with non-severe forms. The prolongation of both PT and aPTT in severe dengue may reflect hepatic dysfunction, consumption coagulopathy, and cytokine-mediated alterations in the coagulation cascade. These results reinforce the notion that coagulation testing is essential not only for diagnosing bleeding complications but also for predicting disease progression.[9]

The study also showed that bleeding manifestations occurred in 29.5% of cases, most commonly as petechiae, epistaxis, and gum bleeding. Mucosal and gastrointestinal bleeding were more prevalent in children with prolonged aPTT, highlighting the

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clinical relevance of intrinsic pathway defects. While thrombocytopenia has traditionally been viewed as the primary driver of bleeding in dengue, the findings here suggest that coagulopathy plays an independent and additive role. This aligns with literature emphasizing the role of capillary leakage and clotting factor imbalances in dengue hemorrhagic states[10, 11].

Another notable observation was the correlation between elevated INR (>1.5) and prolonged hospital stay, reflecting more severe systemic involvement and the need for intensive monitoring or supportive care. Elevated INR, a marker of impaired hepatic synthetic function or systemic inflammation, may serve as a useful prognostic indicator in hospitalized children.[12]

The distribution of dengue clinical categories in this study—61% with dengue without warning signs, 27% with warning signs, and 12% with severe dengue—corresponds with previously reported trends in pediatric populations during outbreak periods. Notably, the younger age group (6–10 years) was most affected, likely due to lower baseline immunity and greater exposure during school-age years.[13] The study also emphasizes the utility of combining platelet count and coagulation profile screening as a more integrated approach to evaluating bleeding risk and guiding clinical decisions. In this cohort, 65% of children had at least one coagulation abnormality or thrombocytopenia, with 44.5% showing both. These findings support the integration of coagulation monitoring into standard dengue evaluation protocols, particularly in settings where severe dengue is anticipated.[14]

Although the study was limited by its single-center design and relatively short duration, the inclusion of 200 pediatric cases and the robust laboratory-clinical correlation provide meaningful insights into the role of coagulopathy in dengue pathophysiology. The results reinforce global and national guidelines emphasizing close hematologic monitoring in pediatric dengue management and provide locally relevant data to refine triage and treatment algorithms.

## CONCLUSION

Coagulation abnormalities are frequent in pediatric dengue fever and demonstrate a strong correlation with clinical severity and bleeding manifestations. Prolonged aPTT and elevated INR, in addition to thrombocytopenia, are significant predictors of mucosal and systemic bleeding and are more commonly observed in children with severe dengue. Routine monitoring of coagulation parameters alongside platelet counts can aid in early risk stratification, guide supportive therapy, and potentially reduce complications. Incorporating coagulation profiling into the standard evaluation protocol for pediatric dengue is both clinically valuable and practically feasible in hospital settings

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