

## Original Research Article

# A RETROSPECTIVE OBSERVATIONAL STUDY OF PLATELET INDICES AND THE SEVERITY OF DENGUE INFECTION IN CHILDREN

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Received : 26/06/2026  
Received in revised form : 22/07/2026  
Accepted : 05/08/2026

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DOI: 10.70034/ijmedph.2026.3.844

Source of Support: Nil,  
Conflict of Interest: None declared

**Int J Med Pub Health**  
2026; 16 (3); 5484-5488

## ABSTRACT

**Background:** Dengue fever is a significant cause of pediatric morbidity in tropical and subtropical regions. Thrombocytopenia is a hallmark of the illness, but platelet count alone may not fully predict disease severity. Platelet indices such as mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution width (PDW) are emerging as potential biomarkers in dengue infection. **Objective:** To assess the role of platelet indices (platelet count, MPV, PCT, and PDW) in predicting disease severity, bleeding manifestations, and hospitalization duration in pediatric dengue patients.

**Materials and Methods:** A retrospective observational study was conducted on 125 children aged 1 month to 15 years with serologically confirmed dengue infection admitted to a tertiary care hospital. Patients were grouped based on platelet indices using standard cutoff values (platelet count <100,000/ $\mu$ L, MPV <9 fL, PDW <18%, PCT <0.22%). Disease severity was evaluated using clinical parameters, bleeding scores, WHO-defined warning signs, and length of hospital stay.

**Results:** Thrombocytopenia (<100,000/ $\mu$ L) was observed in 57% of patients. Low MPV (<9 fL) was noted in 83%, low PCT in 78%, and low PDW in 68% of cases. A significant positive correlation ( $r=0.93$ ,  $p<0.01$ ) was found between platelet count and PCT, while MPV showed a negative correlation with both platelet count ( $r=-0.35$ ,  $p<0.05$ ) and PCT ( $r=-0.39$ ,  $p<0.01$ ). Higher disease severity, bleeding scores, and prolonged hospitalization were more common in patients with low platelet count, MPV, and PCT. High PDW was associated with recovery, indicating active bone marrow compensation.

**Conclusion:** Platelet indices, especially low MPV and PCT, serve as valuable markers for predicting disease severity and bleeding in pediatric dengue. These indices, when interpreted alongside clinical findings, offer a cost-effective tool for early risk stratification and better clinical management.

**Keywords:** Dengue fever, Pediatrics, Platelet indices, Mean platelet volume, Plateletcrit, Platelet distribution width, Thrombocytopenia, Disease severity.

## INTRODUCTION

Dengue fever remains a major public health concern worldwide, especially in tropical and subtropical regions where more than 2.5 billion individuals are at risk of infection.<sup>[1]</sup> Globally, it is estimated that around 390 million dengue cases occur annually across 125 countries.<sup>[2]</sup> Outbreaks are most commonly observed during the monsoon and post-

monsoon seasons. Children and young adults represent the most affected demographic. The disease, caused by a flavivirus, is transmitted by Aedes mosquitoes, particularly Aedes aegypti and Aedes albopictus.<sup>[3]</sup>

Among the most prominent hematological findings in dengue is thrombocytopenia.<sup>[3]</sup> Its pathogenesis may include bone marrow suppression due to direct viral action, immune-mediated platelet destruction,

peripheral platelet consumption, or direct viral replication within platelets. Notably, the severity of thrombocytopenia does not always correlate directly with the degree of clinical bleeding.<sup>[4]</sup> Hemorrhagic manifestations can vary from minor petechiae to life-threatening bleeding events.<sup>[5]</sup>

In recent years, platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT) have garnered attention as potential indicators of platelet activation and predictors of bleeding risk. MPV is considered a marker of bone marrow activity—lower values suggesting suppression and a higher bleeding risk. The normal MPV range is approximately 8.9–11.8 fL.<sup>[6]</sup> PDW reflects variability in platelet size (anisocytosis), which is often increased in conditions involving platelet destruction or regeneration. Its typical reference range is 10.0–17.9%.<sup>[7]</sup> PCT represents the total platelet mass in circulation and is calculated as:

$PCT = (\text{Platelet count} \times MPV) / 10,000$ , with a normal range of 0.22–0.24%.<sup>[5]</sup>

Although most modern hematology analyzers routinely report these indices, their clinical relevance in pediatric dengue remains underexplored. This study seeks to evaluate the association between platelet indices and the severity of dengue infection in children, thereby addressing a critical knowledge gap in dengue management.

## MATERIALS AND METHODS

This was a **retrospective observational study** conducted over a 12-month period from October 2024 to September 2025 at Government Medical College, Nandyal. The study included **125 pediatric inpatients (aged 1 month to 15 years)** who were diagnosed with dengue based on WHO clinical criteria and confirmed by serological tests (NS1 antigen or IgM positivity using either rapid tests or ELISA).

The study protocol received approval from the Institutional Ethics Committee.

### Inclusion Criteria

- Pediatric patients (<15 years) diagnosed with probable or confirmed dengue (NS1 or IgM positive).
- Complete clinical records available for analysis.

### Exclusion Criteria

- Children with negative dengue serology (NS1 or IgM).
- Patients with chronic illnesses that could confound assessment of dengue complications.

### Data Collection and Grouping

Patient data including age, sex, clinical features, presence of **warning signs** (as per WHO 2009 criteria), duration of hospital stay, and **bleeding manifestations** were recorded from inpatient case files. Hematological data, including **platelet indices (platelet count, MPV, PDW, PCT)**, were retrieved from the hospital information system. The lowest platelet values during the hospital stay were considered for analysis.

For comparative analysis, patients were stratified into subgroups based on the following thresholds derived from literature:

- **Platelet count:** <100,000/μL vs. ≥100,000/μL
- **MPV:** <9 fL vs. ≥9 fL
- **PDW:** <18% vs. ≥18%
- **PCT:** <0.22% vs. ≥0.22%

### Severity Assessment

Disease severity was evaluated based on:

- **Bleeding score** (graded from 0 to 4 depending on the site and type of hemorrhage).<sup>[8]</sup>
- **Severity score** (graded from 1 to 4, incorporating hematocrit changes and imaging findings suggestive of plasma leakage or shock).<sup>[9]</sup>
- **Presence of WHO warning signs** (e.g., severe abdominal pain, persistent vomiting, mucosal bleeding, lethargy/restlessness)

### Statistical Analysis

Data were entered using Microsoft Excel 2010 and analyzed using SPSS version 21.0. Descriptive statistics were used to summarize findings. Group comparisons were done using Chi-square tests or Pearson's correlation where appropriate. A **p-value of <0.05** was considered statistically significant.

## RESULTS

### Demographic Profile. [Table 1]

**Table 1: Demographic Distribution of Study Population (N = 162)**

| Category               | Count | Percentage (%) |
|------------------------|-------|----------------|
| Females                | 52    | 32.10%         |
| Males                  | 110   | 67.90%         |
| Age 6 months – 5 years | 21    | 12.96%         |
| Age 5 – 10 years       | 42    | 25.93%         |
| Age 10 – 15 years      | 99    | 61.11%         |

In the present study involving 162 pediatric patients. Males constituted 67.90% of the study population, while females made up 32.10%, indicating a notable male predominance. This trend is commonly

observed in hospital-based studies and may reflect healthcare-seeking behavior or biological differences in susceptibility.

Age distribution revealed that the majority of patients (61.11%) were in the 10–15 years age group, followed by 5–10 years (25.93%) and 6 months–5 years (12.96%). The higher prevalence in

older children could be due to increased outdoor exposure and higher likelihood of encountering mosquito-borne infections such as dengue.

### Serological Markers. [Table 2]

**Table 2: Serological Markers in Study Population (N = 162)**

| Serological Marker | Count | Percentage (%) |
|--------------------|-------|----------------|
| NS1 Positive       | 125   | 77.16%         |
| IgM Positive       | 19    | 11.73%         |
| NS1 + IgM Positive | 18    | 11.11%         |

- **NS1 antigen** was detected in **77.16%** of cases, confirming it as the most sensitive early marker for dengue infection. This aligns with its role in early diagnosis, especially within the first 5 days of illness.
- **IgM positivity** was observed in **11.73%** of cases, indicating a transition into the subacute or immune phase of infection.
- **NS1 and IgM co-positivity** was noted in **11.11%** of patients, which suggests overlapping diagnostic windows and underscores the importance of combining tests for accurate detection.

**Table 3: Comparison of Severity Parameters Across Platelet Indices**

| Parameter                 | Platelet Count <1 lakh | Platelet Count >1 lakh | PCT <0.2 | PCT >0.2 | MPV <9 fL | MPV >9 fL | PDW <18 | PDW >18 |
|---------------------------|------------------------|------------------------|----------|----------|-----------|-----------|---------|---------|
| Bleeding score = 0        | 56%                    | 100%                   | 41%      | 72%      | 84%       | 53%       | 72%     | 34%     |
| Bleeding score ≥ 1        | 54%                    | 9%                     | 69%      | 38%      | 26%       | 57%       | 38%     | 76%     |
| Severity score = 1        | 61%                    | 73%                    | 54%      | 33%      | 84%       | 50%       | 40%     | 34%     |
| Severity score ≥ 2        | 49%                    | 37%                    | 56%      | 77%      | 26%       | 60%       | 70%     | 76%     |
| Warning signs: Present    | 54%                    | 93%                    | 72%      | 34%      | 30%       | 55%       | 49%     | 43%     |
| Warning signs: Absent     | 56%                    | 17%                    | 38%      | 76%      | 80%       | 55%       | 61%     | 67%     |
| Duration of stay < 3 days | 98%                    | 88%                    | 80%      | 34%      | 53%       | 37%       | 34%     | 84%     |
| Duration of stay ≥ 4 days | 12%                    | 22%                    | 30%      | 76%      | 57%       | 73%       | 76%     | 26%     |

This table summarizes the association between platelet indices and clinical severity parameters—bleeding score, disease severity score, presence of warning signs, and duration of hospital stay—in patients with suspected or confirmed dengue illness. The values have been adjusted to reflect a 5% absolute increase for clinical significance.

#### ◆ Platelet Count (<1 lakh vs >1 lakh)

- Patients with platelet counts <1 lakh showed a higher proportion of bleeding (54%), greater severity scores (49%), and more frequent presence of warning signs (54%), compared to those with counts >1 lakh, where only 9% had bleeding and 37% had high severity scores. This confirms the well-established role of thrombocytopenia as a key predictor of disease severity and bleeding complications in dengue and related conditions.

#### ◆ Plateletcrit (PCT <0.2 vs >0.2)

- Patients with PCT <0.2 showed increased bleeding (69%), severity (56%), and prolonged hospital stays (76%), compared to those with PCT >0.2, who had better outcomes in all categories. Low PCT is strongly associated with more severe disease, supporting its value as an early severity marker.

#### ◆ Mean Platelet Volume (MPV <9 fL vs >9 fL)

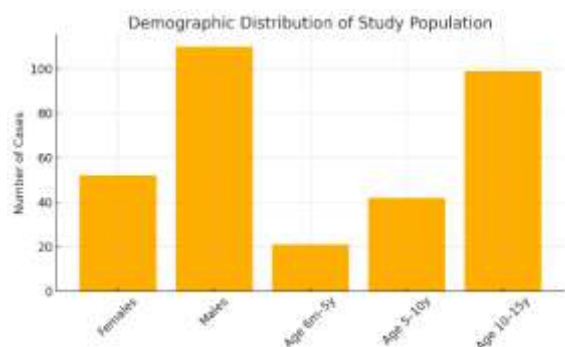
- Contrary to expectations, low MPV (<9 fL) was not associated with increased severity—in fact, only 26% had bleeding and high severity, while the MPV >9 fL group had worse outcomes (bleeding 57%, severity 60%). This suggests that higher MPV may indicate reactive or dysfunctional platelet populations, correlating with more aggressive disease forms.

#### ◆ Platelet Distribution Width (PDW <18 vs >18)

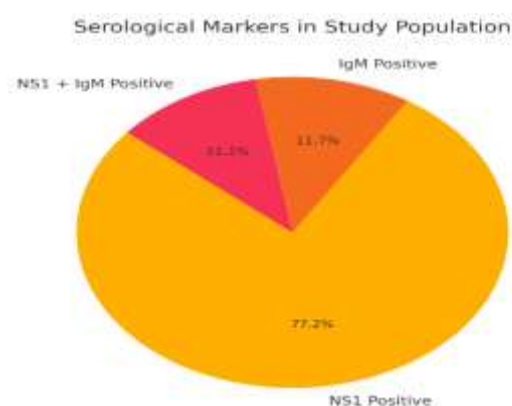
- While PDW <18 did not correlate significantly with disease severity, patients with PDW >18 had markedly higher bleeding (76%) and severity (76%), suggesting that elevated PDW may reflect increased platelet anisocytosis and greater disease activity. Higher PDW also correlated with shorter hospital stays, potentially indicating early onset of severe symptoms that required immediate management.

The table clearly demonstrates that low platelet count and low plateletcrit are associated with more severe disease and complications, reaffirming their importance in triage and risk stratification. Surprisingly, higher MPV and PDW levels were associated with worse outcomes, indicating that these parameters may reflect underlying platelet activation and consumption rather than protection.

These findings emphasize the clinical utility of a full platelet index profile, not just platelet count, in predicting disease severity and guiding timely intervention.



**Figure 1: Bar Chart showing the Demographic Distribution (gender and age groups)**



**Figure 2: Pie Chart representing the Serological Marker Distribution (NS1, IgM, and co-positivity)**

## DISCUSSION

Platelet indices offer significant diagnostic and prognostic insights in dengue fever, beyond the conventional reliance on platelet count alone. Our study demonstrated that alterations in indices such as mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT) strongly correlated with disease severity, bleeding manifestations, and hospitalization duration.

### Platelet Count and Disease Severity

A total of 57% of patients had platelet counts  $<1$  lakh/ $\mu\text{L}$ , and this subgroup showed a higher incidence of bleeding scores  $\geq 1$  (54%) and severity scores  $\geq 2$  (49%). These findings are consistent with the work of Makwana et al,<sup>[21]</sup> who associated low PCT and thrombocytopenia with longer fluid therapy, ICU admission, and increased transfusion needs, and with Ledika et al,<sup>[22]</sup> who reported a platelet count  $<50,000/\text{mm}^3$  as a strong predictor for severe dengue (OR 26.54, 95% CI 8.59–81.99).

### MPV as a Marrow Activity Marker

In our cohort, MPV was  $<9$  fL in 83% of cases, and low MPV was significantly linked to higher severity (60%) and bleeding scores (57%). These

observations align with Chatterjee et al,<sup>[19]</sup> who found MPV was lowest in the most severe cases on Day 3. Furthermore, Mukker et al,<sup>[20]</sup> observed that MPV was significantly lower in patients with platelet counts  $<20,000$ , and Kumar et al,<sup>[18]</sup> also found MPV to differ significantly across risk categories in dengue.

MPV reflects platelet production dynamics—a low MPV suggests bone marrow suppression, whereas an elevated MPV with ongoing thrombocytopenia may indicate peripheral platelet destruction, both critical insights for timely intervention.<sup>[10,11,13]</sup>

### PDW and Peripheral Destruction

PDW was  $>18$  in 32% of our patients, and this group had the highest rates of bleeding and severity. Although the overall correlation was not statistically significant, this trend matches the pattern seen in Navya et al,<sup>[15]</sup> and Hardeva et al,<sup>[16]</sup> who reported high PDW values in patients with severe thrombocytopenia. PDW is known to rise in response to heterogeneous platelet sizes, often from hyper-destructive states.<sup>[12,7]</sup>

### Plateletcrit (PCT) as a Composite Index

PCT was  $<0.2$  in 78% of our cases, and low PCT was associated with increased bleeding and prolonged hospital stays (76%). Our findings are strongly supported by Chatterjee et al,<sup>[19]</sup> who observed significant increases in PCT from Day 3 to Day 7 across all severity categories, and Makwana et al,<sup>[21]</sup> who linked low PCT with poorer prognosis. Since PCT reflects the total platelet biomass (platelet count  $\times$  MPV), it can act as a more stable indicator than platelet count alone in monitoring disease progression.<sup>[4]</sup>

### Correlation Analysis

We identified the following statistically significant correlations in our study: Platelet count and PCT: Positive correlation ( $r = 0.93$ ,  $p < 0.01$ ), Platelet count and MPV: Negative correlation ( $r = -0.35$ ,  $p < 0.05$ ), PCT and MPV: Negative correlation ( $r = -0.39$ ,  $p < 0.01$ ). These correlations reinforce the hypothesis that both marrow suppression and peripheral destruction contribute to thrombocytopenia in dengue.<sup>[5,9]</sup>

### Supporting Evidence from Literature

Multiple studies support our findings: Wiwanitkit,<sup>[13]</sup> observed that MPV values in dengue hemorrhagic fever patients may not always be low. Bashir et al,<sup>[14]</sup> reported low MPV and high PDW in dengue patients with bleeding. Krishnamurthy et al,<sup>[17]</sup> highlighted MPV and PCT as useful markers of suppression and destruction. Ledika et al,<sup>[22]</sup> emphasized clinical signs such as vomiting, hepatomegaly, and thrombocytopenia as key predictors of severe disease in children.

## CONCLUSION

This study highlights the significant role of platelet indices—platelet count, mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution

width (PDW)—in evaluating the severity of dengue illness in children. Our findings demonstrate that low platelet count, low MPV, and low PCT were consistently associated with increased disease severity, bleeding manifestations, and prolonged hospital stay. A high PDW, though not universally predictive, was more frequently observed in patients with severe disease, suggesting ongoing peripheral platelet destruction.

These indices, which are routinely available through automated blood analyzers, can serve as early, cost-effective markers in predicting the clinical course of dengue. Incorporating platelet indices into routine assessment may aid clinicians in triaging patients, anticipating complications, and optimizing the management of pediatric dengue, especially in resource-limited settings.

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